Australian Government
Australian Transport Safety Bureau

Mid-air collision involving Eurocopter EC130B4, VH-XH9, and Eurocopter EC130B4, VH-XKQ

Main Beach, Gold Coast, Queensland, on 2 January 2023

ATSB Transport Safety Report
Aviation Occurrence Investigation
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Addendum

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Interim report

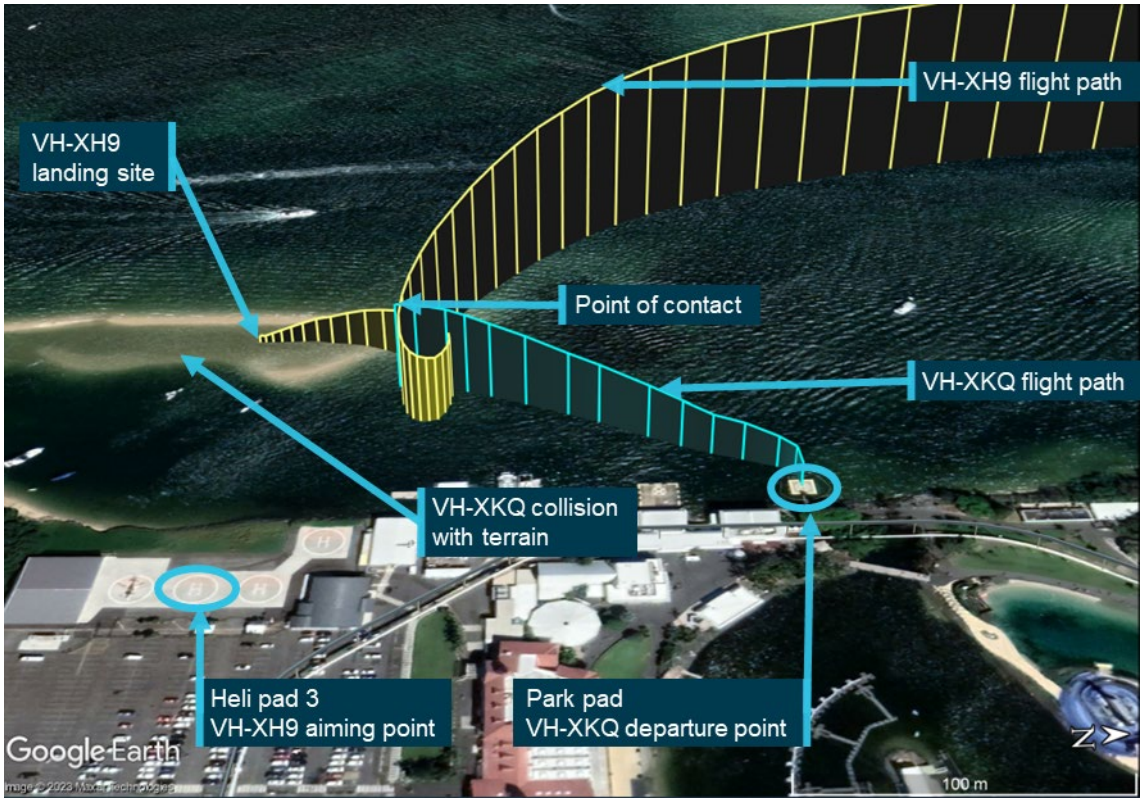
This interim report details factual information established in the investigation's evidence collection phase, and has been prepared to provide timely information to the industry and public. Interim reports contain no analysis or findings, which will be detailed in the investigation's final report. The information contained in this interim report is released in accordance with section 25 of the *Transport Safety Investigation Act 2003*.

Contents

The occurrence

On 2 January 2023, Sea World Helicopters was conducting a series of scenic flights in 2 Eurocopter[1] EC130B4 helicopters registered VH-XH9 (XH9) and VH-XKQ (XKQ). The flights were performed under the visual flight rules from its base at Sea World on the Gold Coast, Queensland. The helicopters were operating from separate helipads about 220 m apart. These were pad 3 at the operator's heliport and the park pad inside the theme park (Figure 1).

Figure 1: Helipad configuration at Sea World on 2 January 2023



Source: Google Earth, annotated by the ATSB

The pilots of both helicopters flew in the morning, then after a lunch break commenced more flights. The first flight after lunch for the pilot of XH9 was a 10-minute scenic flight, which landed at about 1345 local time. Around the same time, the pilot of XKQ also conducted a 10-minute scenic flight, landing at about 1350.

The passengers boarding XH9 and XKQ had watched a pre-flight safety video, either at the operator's main terminal or in a small building near the park pad. Following this presentation, the passengers were each fitted with a constant wear lifejacket by a ground crew member, before being escorted out to the helicopter.

At 1351:40, XH9 departed pad 3 at the operator's heliport for a 5-minute scenic flight, with the pilot and 5 passengers on board. The pilot reported making a taxi call prior to lift-off. XH9 departed the helipad to the southwest, made an immediate left turn to the east over the Sea World Grass, and at around 1352:05 the pilot made a departure call. They then entered the coastal lane at

[1] Eurocopter became Airbus Helicopters in 2014. The Eurocopter EC130 series is now sold as the Airbus Helicopters H130.

90 degrees for a clear view north and south, before turning left to track north at 500 ft over water following the guidance in En Route Supplement Australia[2] for that area.

At 1353:20 ground crew began loading passengers into XKQ. At 1353:44, around the time the pilot of XKQ was discussing loading with ground crew and accepting front seat passengers, the pilot of XH9 was recorded making an inbound radio call from Porpoise Point.

Loading of XKQ ended at 1355:07. The ground crew reported that they completed a final visual check of the helicopter, which included checking all the doors were closed and ensuring the surrounding area was free from watercraft or aircraft. At that time, XH9 was about 1,200 m to the north of their location. The ground crew signalled that it was a ‘Tour 1’ and communicated to the pilot with a thumbs up that XKQ was ready for departure. The pilot acknowledged with a thumbs up. The ground crew member left the helipad and began checking details of the next flight. The helicopter remained on the pad for around 23 seconds before departing.

In XH9, the track southbound along the Broadwater provided a clear view of the helipads at Sea World. The pilot of XH9 stated that, while transiting the Broadwater, they saw passengers being loaded into XKQ and the doors of XKQ closing. The pilot of XH9 recalled that their assessment at the time was that they would be clear of XKQ and that it would pass behind them. Therefore, they did not make any further radio calls.

Prior to the departure of XKQ, a passenger recalled that the pilot advised the passengers to 'talk amongst yourselves', and the passenger did not recall hearing the pilot make any other calls. Helicopter XKQ departed at 1355:42.

There were two vessels on the Broadwater between the park pad and the heliport which XKQ passed to the outside of while climbing towards the sandbar south-west of the helipad. One of those vessels was crossing XH9’s intended flight path, and the pilot of XH9 planned to pass behind it on their approach to the helipad (Figure 2).

Figure 2: Vessels on Broadwater

Source: Witness videos, annotated by the ATSB

At 1356:06, as XKQ climbed tracking approximately south-west and XH9 descended tracking approximately south-east, the helicopters collided. The tail and main rotor separated from XKQ and it fell, uncontrolled onto a sandbar. Although XH9 was heavily damaged and the pilot was injured, the pilot landed XH9 on the sandbar at 1356:35.

Four people aboard XKQ were fatally injured and 3 were seriously injured (Figure 22). Three people aboard XH9 were seriously injured and 3 had minor injuries (Figure 21).

[2] En Route Supplement Australia (ERSA) is published by Airservices Australia and contains vital operational information for pilots operating in Australian airspace.

Context

Time reference

A number of devices with differing clocks provided evidence used in the investigation. These were:

- tracking units aboard the aircraft
- iPhones and Android phones of passengers and witnesses
- action cameras
- CTAF recording at Southport aerodrome
- CCTV in various locations
- primary and secondary surveillance radar.

The tracking systems aboard the helicopter were chosen to anchor the time frame because:

- the same type of unit was installed on both aircraft
- the unit times concurred at time of collision
- the time signal comes from a high precision GNSS time reference
- there is little opportunity for human intervention in system time setting.

All times stated in this report are with reference to that source. Other sources, if necessary, had adjustment applied to their time stamp for purposes of analysis. Synchronisation between the tracking system and CTAF recording has a margin of error of +/- 2 seconds.

Pilot Information

Pilot of VH-XH9

The pilot was inducted into helicopter operations at Sea World Helicopters on 18 May 2022. The pilot obtained a Commercial Pilot Licence (Helicopter) in Australia in March 2012. They held additional ratings and endorsements for:

- instrument flight
- night flight
- Grade 2 instruction
- low level
- formation flight.

The pilot held a Class 1 Aviation Medical Certificate which was valid to 3 May 2023, and required use of corrective lenses.

The pilot's logbook and operator's records showed a total flying experience of about 3,150 hours. The pilot's flying experience was gained entirely in helicopters. In the previous 30 days they had flown 78.0 hours.

The pilot had completed EC130B4 difference training and undertook a biennial flight review in an EC130 on 5 November 2022 in a 1.8 hour flight with the operator's head of flight operations. Since that time the pilot accrued 60.4 hours experience on the EC130B4. The pilot was familiarised with operations to and from the operator's park pad facility with the EC130 in a flight of 0.4 hours on 23 December by the head of flight operations.

The pilot of XH9 held 3 roles with the operator:

- line pilot

- safety manager
- drug and alcohol management plan (DAMP) supervisor.

The pilot of XH9 completed DAMP awareness for Safety Sensitive Aviation Activity (SSAA) employees, and DAMP Supervisor training on 18 May 2022. The DAMP supervision role was minimal as DAMP testing was conducted by Village Roadshow Theme Parks (VRTP) (see *Drug and Alcohol Management Plan and VRTP AOD Policy*).

The pilot also had previous experience as an engineer and hazard and safety inspector from a different industry, and as such the pilot was nominated to the Civil Aviation Safety Authority (CASA) as the operator's safety manager on 27 November 2022.

Prior to joining and while working for the operator the pilot completed the check and training activities listed in Table 1.

Table 1:Training and checking activities

Date	Activity	Type	Examiner	Notes
10 May 2021	Flight crew dangerous goods awareness	NA	External	Ground based
7 May 2022	Line check	AS350	Chief Pilot	Radio comms great, Approach and departure paths, good understanding with different winds.
8 May 2022	Helicopter Flight Review	AS350	Chief pilot	Flew well, another base check within three months once familiar with the machine.
12 May 2022	AS350 D2 proficiency test	AS350	Chief Pilot	Ground based
18 May 2022	DAMP Awareness for SSAA employees	NA	CASA	Ground based
18 May 2022	DAMP Supervisor	NA	CASA	Ground based
19 May 2022	Crew Emergency Proficiency test	AS350	Chief pilot	Ground based
19 May 2022	Electronic Flight Bag training	NA	Chief Pilot	Ground based
19 May 2022	Ground crew procedures training	AS350, EC130	Chief pilot	Ground based
20 May 2022	Fatigue Risk Management System Training	NA	Chief Pilot	Ground based
27 Jun 2022	Base Check	AS350	CEO	Worked on forced landing procedures for scenic flights. Autos and hydraulic failures all up to standard.
2 Sep 2022	Base Check	AS350	CEO	Forced landing procedures, engine failures and hydraulic failures all up to standard.
10 Oct 2022	EC130 Proficiency exam	EC130	Chief pilot	Ground based
5 Nov 2022	EC130B4 difference training and helicopter flight review	EC130	Chief pilot	No notes in file
5 and 6 Nov 2022	Jump pilot training	AS350	Chief pilot	Training for parachute operations
15 Nov 2022	Pilot permitted maintenance	EC130	Licenced engineer	
23 Dec 2022	Park pad familiarisation	EC130	Chief pilot	No notes in file

Pilot of VH-XH9 72 hour history

In the days leading up to 2 January 2023, the pilot of XH9 worked and flew:

- 30 December – XH9 - 2.5 hours

- 31 December – XKQ - 1.2 hours – SWL 0.9 hours
- 1 January – XKQ - 5.0 hours
- 2 January – XH9 - 3.4 hours.

Additionally, they spent time with new ground crew, training them in passenger handling. The pilot reported being experienced in flying busy summer tourism seasons and stated that their sleep over that period was consistent, retiring at 2130, rising at 0700 and starting work at 0830.

Pilot of VH-XKQ

The pilot was inducted into helicopter operations at Sea World Helicopters on 2 August 2019. The pilot obtained a Commercial Pilot Licence (Helicopter) in July 2007 and obtained an Air Transport Pilot Licence (Helicopter) in November 2013. They held ratings and endorsements for:

- float alighting gear
- Grade 1 instruction
- sling
- low level
- firefighting.

The pilot held a Class 1 Aviation Medical Certificate which was valid to 14 June 2023.

The pilot's logbook and operator's records showed a total flying experience of 6,208.5 hours in operation of single engine helicopters. They first flew the EC130 on 12 July 2016 and had accumulated 200.0 hours on the type. The pilot was qualified and authorised to check the competency of other pilots in the helicopter and had checked the pilot of XH9.

The pilot of XKQ had several roles with the operator. These roles comprised:

- head of flight operations (Chief Pilot)
- head of operations (HOO) (Part 138)
- head of aircraft airworthiness and maintenance control (HAAMC)
- drug and alcohol management plan (DAMP) supervisor
- line pilot
- managerial responsibilities within the business.

The pilot of XKQ was acting in the capacity of a line pilot at the time of the accident. The pilot had flown 448.2 hours over the previous year, 90.4 hours in the previous 90 days and 47.7 hours in the previous 30 days.

While working for the operator, the pilot of XKQ completed the training tasks detailed in Table 2 below.

Table 2: Training and checking activities

Date	Activity	Type	Examiner	Notes
26 May 2019	AS350 Proficiency exam	AS350	HOFO	Ground based
6 Sep 2019	Helicopter Flight review	AS350	External	No notes in file
1 Aug 2019	Fatigue training exam	NA	Unknown	Ground based
27 July 2020	Fatigue training exam	NA	Self	Ground based
29 Aug 2020	DAMP Awareness for SSAA employees	NA	CASA	Ground based
29 Aug 2020	DAMP Supervisor	NA	CASA	Ground based
1 May 2021	Helicopter Flight Review / Flight instructor proficiency check / Low level	AS350	CEO	No notes in file
4 Sep 2021	Dangerous Goods Awareness	NA	External	Ground based
11 Mar 2022	Base check with park pad procedures	AS350	CEO	Conducted several landings onto new helipad. Confirmed procedure for approach departure. All flying to a very high standard.
14 Apr 2022	AS350 SD2 proficiency exam	AS350	Self	Ground based
2 Jul 2022	FRMS exam	NA	Unknown	Ground based
18 Jul 2022	Pilot permitted maintenance	AS350	Licenced engineer	
12 Aug 2020	Airbus Helicopters Safety Roadshow	NA	NA	Ground based
31 Aug 2022	Crew Emergency Proficiency test	AS350 EC130	CEO	Ground based
3 Sep 2022	base check	AS350	CEO	All well flown with excellent judgement
10 Nov 2022	EC130B4 proficiency exam	EC130	Self	Ground based
30 Dec 2022	Pilot permitted maintenance	AS350 EC130	Licenced engineer	

Pilot of VH-XKQ 72 hour history

On 30 December 2022 the pilot was rostered for work between 0900 and 1700. Records show they signed in at 08:32 and signed out at 20:22. They did not fly and conducted administrative tasks. Their sleep that night was said to be normal.

The next day 31 December was a rostered day off. The pilot worked around the house and spent time with their family. That evening, New Year's Eve, they had a family gathering at their house and the pilot was reported to have retired at 0200.

On 1 January 2023, New Year's Day was also a rostered day off. They woke at around 1030 and spent the day relaxing at home with their family.

On the morning of 2 January 2023, after 10 hours sleep they reported feeling good and left for work at around 0830. Colleagues reported that the pilot looked well and was in good spirits.

Ground crew information

There were 5 ground crew members working on the day of the accident, 2 were assigned to the park pad and 3 were working from the main heliport. Their experience with the operator varied between 2 days to 9 months, and all but 1 had previous aviation experience, either as ground crew or as a pilot.

Ground crew members' training included the requirement to read and understand the operator's documented standard operating procedures and completion of the operator's emergency procedures training, which covered the use of emergency equipment, and all aspects of passenger management, including passenger briefings. The training involved a practical component and included familiarisation on the different helicopter types, as well as a written assessment.

After completion of the required training, ground crew were buddied with a more experienced person until they were competent to undertake their duties without direct supervision. One ground crew member present that day was not yet approved to work independently and they worked under the supervision of a trained team-mate at the heliport.

Aircraft information

EC130B4

The Airbus Helicopters EC130B4 is a French light utility helicopter developed from the earlier Eurocopter AS350 Écureuil. It combined elements of the EC120 and the EC135 into the AS350 product line. The cabin was widened and lengthened, and an 11 bladed fenestron tail rotor replaced the conventional tail rotor of the AS350. The position of the pilot in command was moved from the front right in the AS350 (standard in most helicopters) to the front left in the EC130B4.

The maximum all-up weight of the EC130B4 was 2,427 kg, and the power plant was a single Safran (formerly Turbomeca) Arriel 2B1, with a take-off power output of 632 kW.

The EC130 had two rows of seating accessed by four doors. On both sides, the front row of seats was accessed by conventionally hinged doors. The right side front door was larger to allow access to the rear seats also, although access could be increased by opening a supplemental rear hinged door immediately behind the front door. On the left side of the aircraft, the rear row of seats was accessed by a large rearward sliding door. Both front doors had quick release functions and acted as emergency exits.

In the configuration used by the operator there were individual seats for the pilot and 6 passengers. Each seat consisted of a carbon composite bucket seat attached to a floor mounted aluminium frame featuring a passive energy absorption system designed to attenuate vertical impact loads. The seats were each fitted with a 4-point safety harness featuring manually adjusted lap belts, automatically adjusting inertia reel shoulder harnesses and a central rotary buckle. Each seating position had an aviation headset connected to the aircraft's avionics. This enabled everyone on board to communicate with each other and provided hearing protection.

Both helicopters were to be maintained in accordance with the Airbus Helicopters EC130 master servicing manual and the Safran Arriel 2B1 maintenance manual, which required a periodic inspection every 150 hours or 12 months, whichever came first. The flight instruments, electrical and radio systems were to be maintained as per CASA Schedule 5. Both helicopters were to be operated in the air transport category and visual flight rules (VFR) Day meteorological conditions.

Existing fleet

The operator had 1 EC130B4 helicopter (VH-XKK) on loan from another company in the same group. That helicopter was used for private flights, commercial charter and as a spare or surge capacity helicopter for scenic flights.

The operator also had 2 AS350SD2 (AS350) helicopters. These were the primary helicopters prior to the addition of EC130B4 helicopters XKQ and XH9 in December 2022. The AS350SD2 had an MAUW of 2,250 kg, and carried a pilot and five passengers.

Both of the AS350 helicopters were fitted with UHF radio for communication with ground crew, and an airborne collision avoidance system (ACAS) with an audio alert and visual display. While both helicopters were variously fitted with emergency floats, at the time of the accident, one was fitted with emergency floats which was a company requirement for departures over water from the park pad.

Tour Camera Systems

The AS350 helicopters in the operator's fleet were fitted with Rugged Video camera systems. These systems comprised cameras, cabling, monitor, command module, switching, and recording devices. The cameras could be manually selected by the pilot, set to cycle through the cameras, or set to switch according to time and GPS location.

The EC130B4 helicopters XH9 and XKQ were supplied without these systems. The operator purchased and installed these systems for these helicopters. While the systems had been installed they were not yet approved for use as the engineering order certifying the installation had not been completed. The systems were on but not recording at the time of the accident.

Due to the large volume of data the systems produce and their primary aim of creating videos for sale to customers, the operator retained only around one week of footage on a rolling basis. Twenty-one flights in camera equipped aircraft from prior flights were provided to the ATSB.

Airborne collision avoidance systems

A traffic alert and collision avoidance system (TCAS) fulfills the International Civil Aviation Organizations (ICAO) ACAS standard, and the terms are often used interchangeably.

There are two types of ACAS, TCAS I and II which differ by their alerting capability. Both helicopters were fitted with TCAS I. TCAS I provides traffic advisories (TA) to assist the pilot in the visual acquisition of intruder aircraft. The level of protection provided by ACAS equipment depends on the type of transponder the target aircraft is carrying.

A limitation of the system, described by ICAO is that:

> When a Mode C interrogation is transmitted, all the Mode C transponders that detect it reply. Since the reply duration is 21 microseconds, aircraft whose ranges from ACAS are within about 3.2 km (1.7 NM) of each other generate replies that persistently and synchronously overlap each other when received at the interrogating aircraft.

To overcome that, two techniques are used, being directional detection and interrogation at different intensities (whisper-shout). Directional detection narrows interrogation to intruders ahead of the aircraft. Whisper-shout takes advantage of variability in sensitivity of equipment in surrounding aircraft by using sequences of varying power, so not all aircraft respond at once.

Helicopters may rotate through 180 degrees during departure and encounter each other at low altitudes. Local pilots stated that for their operation, ACAS systems often produced alerts considered to be late or operationally inconsequential and rarely provided actionable information about previously unknown aircraft, making ACAS only useful to them only in cruise flight along coastal lanes.

VH-XH9

Overview

EC130B4, serial number 3845, was manufactured in 2004 and operated in the US between 2004 and 2012. The helicopter was then operated in Panama 2012-2018 and New Zealand (NZ) 2018-2022. The helicopter was registered as VH-XH9 on 2 November 2022, and following certification of airworthiness requirements, entered service in Australia on 9 December 2022.

A review of XH9's maintenance records showed no record of accidents or major repair having been conducted prior to entry into Australia. A periodic inspection was completed during the entry in Australia and the current maintenance release was issued 1 December 2022, at 6,750.0 hours total time in service (TTIS). Two throttle microswitches were replaced on 7 December 2022 and a 25/30 hour inspection was conducted on 30 December 2022. At the time of the occurrence, XH9 had accumulated 6,786.6 hours TTIS, being operated for 1.6 hours that day.

VH-XH9 conspicuity devices

While operating in NZ, the helicopter was fitted with an L3 Lynx NGT 9000D+ transponder with Automatic Dependent Surveillance–Broadcast (ADS-B)-out capability on 27 September 2022. At that point the unit appeared to function with recorded data[3] matching records of flights undertaken in NZ up to 19 October 2022.

Details of the new registration were to be updated in the unit, and some problems doing so were encountered. For flights from 2 December 2022 to 26 December 2022, externally recorded ADSB data was either showing no data (4 days) or the old NZ registration (11 days). From 27 December 2022 the new Australian registration was recorded but all tracking within Australia was intermittent.

Additionally, on 20 December 2022 air traffic control at Gold Coast Airport could not identify XH9 on secondary surveillance radar.[4] Following this, pilots were aware that they would not be accepted into controlled airspace in XH9 without a functioning transponder. Troubleshooting of the transponder was not complete at the time of the accident. During inspection of XH9 post-accident, the ATSB lowered the belly panel and found that the transponder antenna was disconnected.

The helicopter was fitted with 3 position lights, one anti-collision light, a taxi light and a landing light. Figure 3 shows the lighting configuration of XH9 for the accident flight. At the time of publishing, the status of the landing light had not been confirmed.

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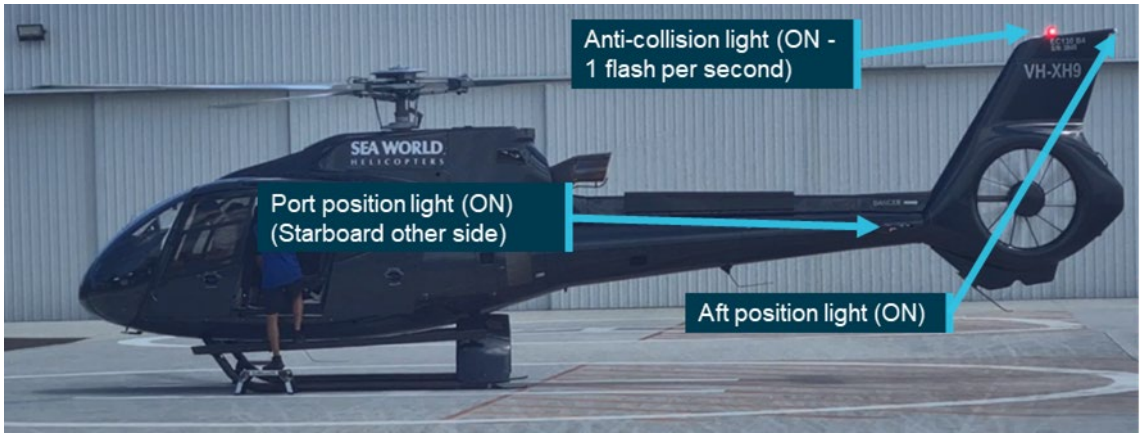
[3] ADS-B is recorded by a distributed network of ground based receivers, and collated into a centralised system.

[4] Secondary surveillance radar (SSR): A radar system that interrogates transponders and displays aircraft identity and tracking information to air traffic controllers.

Figure 3: VH-XH9 lighting configuration



Source: Witness video annotated by ATSB

The top side of XH9's main rotor blades were painted with a high visibility paint scheme (alternating white sections over the normal grey blade) in accordance with the maintenance manual. The result being, when viewed from above, the rotor disc would appear to be a series of concentric white circles (see Figure 4). The undersides of main rotor blades are not painted to reduce risk of flicker vertigo,[5] so the main rotor disc was not as visible when viewed from below.

Figure 4: Exemplar main rotor blade paint schemes

Effect of paint schemes on blade visibility. The centre panel has no high visibility paint and the rotor system is harder to detect.
Source: Airbus Helicopters

VH-XH9 detection equipment

The L3 Lynx NGT 9000D+ also provided traffic advisory (TA) alerts. The unit could visually display traffic although this was not configured. In addition, the system was also not linked to another display, therefore it gave audible alerts only. Pilots would hear warnings such as 'traffic, traffic, 3 o'clock high, 2 miles'.

There were two sensitivity levels, A and B. Sensitivity level A reduced the number of nuisance TAs during take-off and landing. Sensitivity level B maximised the detection of TAs during the cruise phase of flight. If the aircraft was at or below 1,700 ft above ground level (AGL), the traffic advisory system (TAS) would not display or calculate alerts for other aircraft which were determined to be on ground (not airborne). Intruders determined to be below 380 ft AGL were considered to be on ground.

A configuration option called 'Ground Filtering Altitude' allowed the user to set the on ground (alternate) determination for 5 ft instead of 380 ft AGL.

At the time of publishing, the exact settings of this unit had not been determined and analysis is ongoing.

[5] Flicker Vertigo: Disorientation or nausea caused by low frequency flickering.

VH-XH9 communication equipment

The avionics communications suite consisted of 2-band aviation navigation and communication (Nav/Com) radios, and a commercial VHF/UHF radio. The radio designated Com1 was a Garmin GNS430 with radio communication, radio navigation, and global navigation satellite system (GNSS) functions. The radio designated Com2 was a Bendix King KX165A (Figure 5) with radio communication and radio navigation functions. A third radio was a Tait TM9300 commercial VHF/UHF digital/analogue mobile radio. Pilots reported using Com2 as the primary radio as the GNS430 switches were faulty and its database had not been updated.

A Precision Engineering 7000H audio switch panel permitted all occupants to communicate through aviation headsets. The pilot could configure the cabin communications to include all passengers or isolate the passengers from the pilot and radio calls.

VH-XH9 radio system settings

- Com1 – Damaged beyond repair due to main rotor blade strike. The ATSB could not determine the settings on this unit.
- Com2 – The selected frequency was 119.00 MHz, with a standby frequency 118.10 MHz. The volume knob on the unit was found to be set at approximately 50% (see Figure 5).
- Com3 – This unit was carried and not configured for use in XH9.
- Audio Panel – Both transmit and receive functions had only Com2 selected. The audio panel volume control was positioned at approximately 40%. The intercom mode was set to ‘All’.

Figure 5: Bendix King KX-165A from VH-XH9 - Indication on power up

Source: ATSB

VH-XKQ

Overview

EC130B4 serial number 4639 was manufactured in 2008 and operated in NZ between 2008 and 2019. The helicopter was then operated in Indonesia from 2019 to 2022. The helicopter was registered as VH-XKQ on 2 November 2022, and following certification of airworthiness requirements, entered service in Australia on 9 December 2022.

A review of XKQ’s maintenance records showed no record of accident or major repair having been conducted prior to entry into Australia. A periodic inspection was completed during the entry to Australia and the current maintenance was issued 9 December 2022, at 2,258.3 hours TTIS. Endorsements on the maintenance release indicated the dual pilot controls were installed on 16 December 2022 and a main rotor track and balance was conducted on 16 December 2022. At the time of the occurrence, XKQ had accumulated 2,268.5 hours TTIS, having been operated for 1 hour that day.

VH-XKQ equipment fit

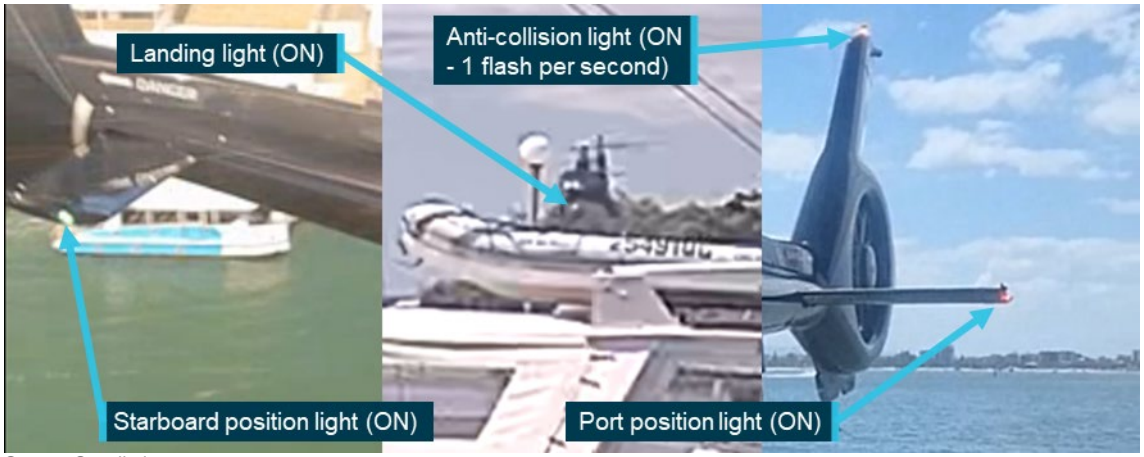
XKQ was fitted with a pilot-activated emergency float system, consisting of 2 cylinders mounted in the aircraft belly, 2 float bags mounted on the landing skids, an arm switch and a firing pushbutton located on the pilot's collective.

The aircraft was not fitted with a fire extinguisher although the centre console did have a placard pointing to the location where one would normally be fitted in the cabin of an EC130. A review of import records indicated the aircraft previously had a dry powder extinguisher. The maintainer indicated it was removed when the aircraft was imported into Australia as it was a type not acceptable for use in an Australian registered aircraft.

VH-XKQ conspicuity equipment

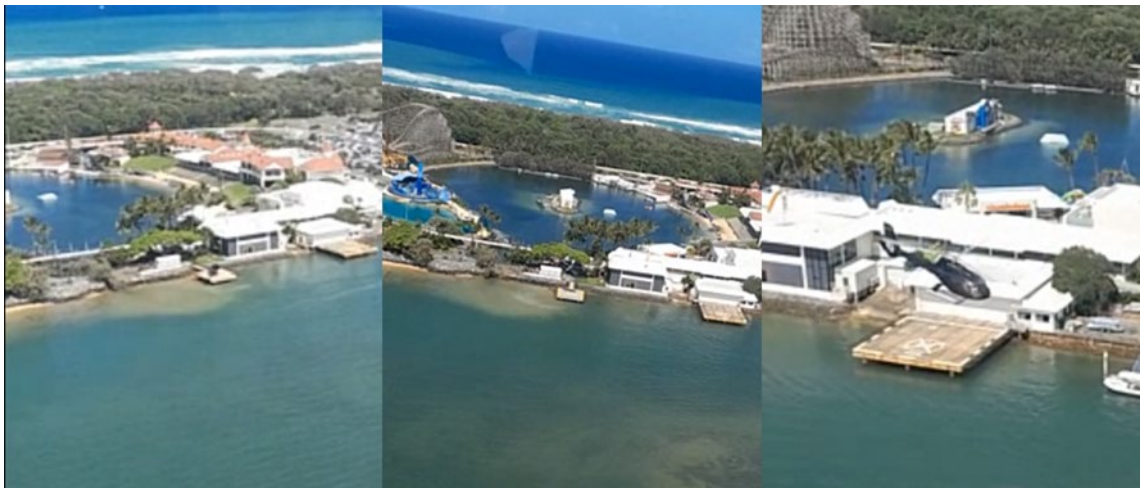
XKQ was fitted with 3 position lights, one anti-collision light, a taxi light and a landing light. Figure 6 shows the known lighting configuration of XKQ for the accident flight. While the aft position light could not be detected in video of the aircraft, likely due to bright daylight conditions, that light was switched on with the port and starboard position lights. XKQ did not have high visibility markings on its rotor system (Figure 7).

Figure 6: VH-XKQ lighting configuration



Source: Supplied

Figure 7: VH-XKQ as captured from the rear seats of VH-XH9



Source: Supplied

XKQ was equipped with a Garmin GTX327 Transponder which was detectable by secondary surveillance radar and was detected on the day of the accident.

VH-XKQ detection equipment

The helicopter was fitted with an Avidyne TAS600 TAS. The system had a ground mode and a flight mode. It would automatically switch between the 2 as the aircraft climbed or descended through 400 ft. In flight mode, when a detected intruder met the criteria for TA, the system used an annunciator light (marked 'Traffic' or 'Traffic Alert') and an audible voice annunciation. The announced phrase was preceded by a tone and began as 'Traffic', the clock position of the alert was given, and then the relative altitude of the intruder and range was announced. It was reported that no annunciator light was present in XKQ.

When the host aircraft descended below 400 ft AGL, the system transitioned to 'ground mode' and TA announcements were muted. While XKQ was on the ground, the TAS600 would be in ground mode. Aural annunciations would be muted and the aircraft did not have an interface from the TAS system to a display. After departure on the accident flight, XKQ did not reach an altitude that would have triggered the TAS600 to switch to flight mode.

The side windows of XKQ were fitted with bronze tinted windows from Tech Tools Plastics. These were an aftermarket window to replace those provided by the original equipment manufacturer. The windows were approved by the FAA as meeting Federal Aviation Regulation (FAR) 27 airworthiness requirements and were issued a supplemental type certificate.

VH-XKQ communication equipment

The avionics communications suite consisted of 2 aviation band Nav/Com. The equipment setup was similar to XH9, with a GNS430 as Com1, a KX165A as Com2, and a Precision Engineering 7000H audio switch panel.

The aircraft was also fitted with a mode C transponder, a multi-function display and a CD player. The Garmin GMX200 multi-function display had a TAS function, however from video recorded inside the cabin of the helicopter, the display was turned off for the accident flight.

VH-XKQ radio system settings

- Com1 – The selected frequency was 119.00 MHz, with a standby frequency 134.50 MHz. The volume knob on the unit was found to be set at approximately 75% (see Figure 8).
- Com2 – The selected frequency was 118.70 MHz, with a standby frequency 128.75 MHz. The volume knob on the unit was found to be set at approximately 10%.
- Audio Panel – Both transmit and receive functions had only Com1 selected. The audio panel volume control was positioned at approximately 75%. The intercom mode was set to 'Isolate'.

Figure 8: Garmin GNS430 from VH-XKQ - Indication on power up after self-test

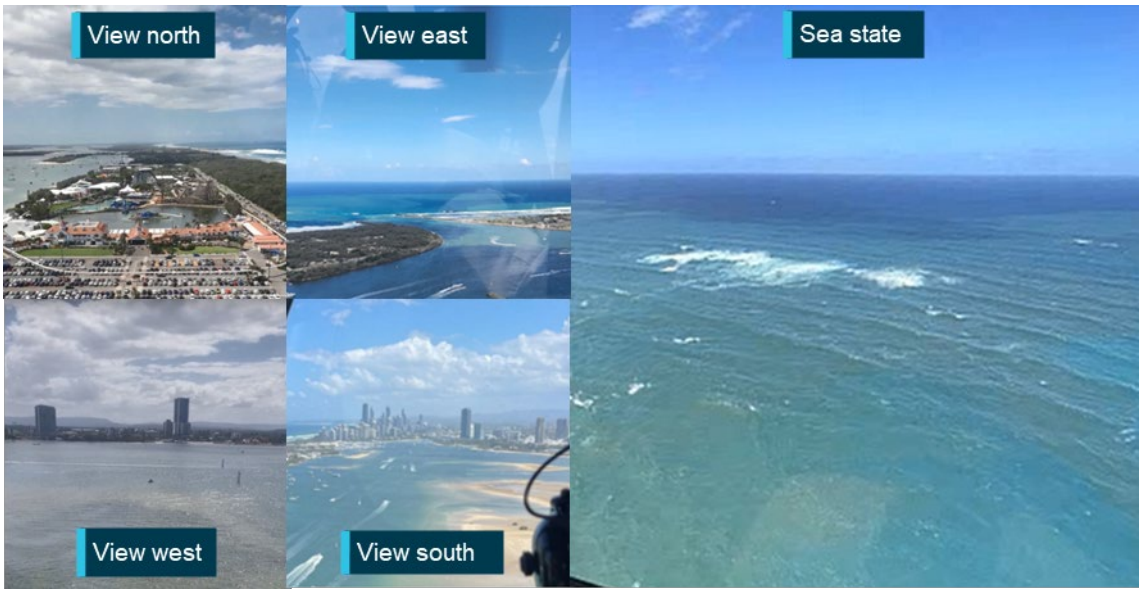
Source: ATSB

Meteorological information

Weather reports for the day show that the weather was consistent with forecast conditions and suitable for flying. There was a ridge of high pressure extending up the southeast coast of Queensland, and scattered cloud over land at around 3,500 ft. There were moderate south-easterly winds at around 15 kt with gusts up to 25 kt, and the temperature was around 25 °C. While the forecast carried areas of reduced visibility due to showers and smoke the area of operation was not affected. Images taken from both helicopters show that visibility was good.

The sea state from passenger photographs near Porpoise Point showed small waves and a few whitecaps starting to form on the surface of the sea suggesting wind speeds of 11 to 16 kt (Figure 9).

Figure 9: Passenger photographs showing inflight conditions



Source: Supplied

The sea breeze in the afternoon meant that wind almost always had an easterly component and was predominantly south easterly (as it was during the day). Approaches were ordinarily made into wind and departures made with a downwind or crosswind component.

Wreckage recovery and examination

Overview

Four ATSB investigators arrived on-site at about 1750 on 2 January 2023, about 4 hours after the accident. The sandbar where the helicopters were located had been inundated by a 1.05 m high tide at 1706. The sandy surface and tides meant that there was very little information remaining in ground marks. A higher tide of 1.49 m was due at 0605 on 3 January and further deterioration of evidence in the corrosive environment was a risk. This meant that the helicopters had to be recovered from site far more quickly than usual.

Figure 10: XH9 and tail rotor of XKQ

Source: Queensland Police Service

In the time available at the accident site, the ATSB had uninhibited access to XH9, and took photographs and recovered evidence from that helicopter. Access to XKQ in its position and location was limited and controlled examination and recovery of components was not possible.

Members of the Queensland Police Service (QPS) forensic crash unit had mapped and photographed the accident site, and provided that data to the ATSB. Additionally, QPS divers combed the area underneath the point of collision and around the sand bank for components.

The ATSB did not take immediate possession of the accident site and instead the Queensland coroner with the resource and support of the QPS recovered the helicopters. A QPS barge had arrived on site at 1640 on 2 January and secured the scene overnight before transporting the helicopters to the water police headquarters early on 3 January. The helicopters were loaded onto flatbed trucks and transported to a secure facility (Figure 11). They were stored under a protection order from the ATSB, and 3 ATSB engineers examined both aircraft in detail at the secure facility.

Figure 11: QPS barge Stewart Kerlin II and transport of helicopters

Source: QPS and ATSB

Fuel testing

Aviation turbine fuel (AVTUR) was stored at the site in a 30,000 litre bulk container. The Sea World bulk fuel and daily fuel samples for both XH9 and XKQ were examined and found to be free of debris and contaminants. A fuel sample taken from the undamaged fuel tank in XH9 was also free of debris. In addition, testing detected nil water present in any of the fuel samples.

Aircraft Wreckage

Wreckage examination was conducted by the ATSB at a secure location in Brisbane. Examination of both helicopters identified no pre-existing defects that would affect normal operation, and included inspection of the:

- flight and engine controls
- engine, transmission and hydraulic systems (including chip detectors and filters)
- main rotor and tail rotor assemblies, including Starflex main rotor hub, blades and mounts
- the drivetrain, between engine and main and tail rotor systems
- fuselage and landing gear
- instruments and avionic components.

Lifejackets

Eleven Eastern Aero Marine (EAM) KSE-35HC2L8 adult lifejackets were retrieved from both helicopters at the accident site along with two EAM IN-V20L8 infant lifejackets. These life jackets are approved by the Federal Aviation Administration (FAA) to Technical Standards Order (TSO) C13e. These FAA approvals are acceptable to CASA for use on Australian aircraft as detailed in Civil Aviation Safety Regulation (CASR) 21.502.

The KSE-35HC2L8 is a pouch style lifejacket worn in a pack that is strapped around the wearer's waist. If required, the lifejacket is donned by opening the pouch and pulling it over the head of the wearer. The lifejacket is then ready for use and is manually inflated as required.

One adult lifejacket had been removed from its pouch. All lifejackets were within their published service lives and inspection intervals. It could not be identified which lifejacket came from which aircraft. From passenger mobile phone video and photographic evidence, all passengers were wearing a lifejacket for the flight.

Two Crewsaver constant wear lifejackets were also retrieved from the accident site. These lifejackets were for use by the Sea World pilots. One Crewsaver lifejacket was retrieved in an

inflated condition and was still holding pressure two days after the accident. Inspection of the lifejacket revealed it was 5 months overdue for inspection.

The Crewsaver is an ISO 12402-3 approved lifejacket. It was not CASA approved or one permitted by the CASR (1998) Part 21 regulations. From passenger video evidence, neither pilot was wearing a lifejacket.

Radio system settings

The ATSB recovered avionics equipment from both helicopters for analysis. Each unit was assessed for damage and repaired where possible. All viable units had electrical power applied and their settings at the time of the accident were recorded. See Aircraft above.

VH-XH9

Overview

Four main rotor blade strikes from XKQ were identified in the windscreen, forward cabin structure, and centre console of XH9. Debris and damage signatures along with injuries sustained by the occupants of XH9 correlate to the right-to-left main rotor blade path (clockwise rotating main rotor system) through the cabin of XH9. Each blade pass was successively higher, deeper and further to the right in the cabin, consistent with the relative movement of XKQ climbing left-to-right and XH9 descending.

In addition to breaking windscreens and frame structures in XH9, one blade strike destroyed instruments and severed the primary wiring loom in the centre console of XH9, thereby removing power from all remaining gauges and instrumentation.

Based on physical evidence and flight path data, XKQ continued to climb relative to XH9 and both aircraft's main rotor discs[6] passed through each other. A main rotor blade of XH9 had a scuff mark on the lower surface, about mid span. In addition, the skin delaminated on the upper and lower surfaces at the trailing edge, aft of the blade's spar structure. Following consultation with Airbus Helicopters, it was concluded the scuff mark and delamination was consistent with contact from one of XKQ's main rotor blades. XH9's other blades were undamaged.

Apart from the front cabin structure, the airframe including the tail boom, fin, horizontal stabilisers, and skids were undamaged.

VH-XH9 Avionics

The analogue flight instruments, a digital 'Vehicle and Engine Multifunction Display' (VEMD), and video recording unit and display, were all destroyed and were not recoverable for further examination. The following components were removed from the helicopter and transported to an ATSB technical facility for further examination:

- pilot's Bose ANX ANR headset
- Garmin GNS430 GPS navigation and communication system (destroyed)
- Bendix King KX165A VHF radio
- Precision Engineering PMA7000H (damaged)
- L3 Harris NGT-9000D+ Lynx ADS-B in/out transponder

Examination of this equipment is ongoing.

[6] Rotor disc is the area or plane being swept by the main rotor blade system at any point in time.

VH-XKQ

Overview

XKQ came to rest inverted and was initially examined in the recovered inverted orientation, concentrating on flight controls, float system components and landing gear mounts. The airframe was then oriented upright for the remainder of the examination, providing access to the cabin and upper structure.

The floor was fractured around the front right (passenger) seat but remained substantially attached with the floor bent upward 20° laterally and 7° fore/aft. This was the first section of the fuselage to strike terrain. The floor remained structurally intact and remained attached to the rear fuselage.

All windscreens, windows, and window and door pillars were fractured. All doors had separated from the cabin. The rear cabin bulkhead buckled allowing the roof to compress towards the floor, reducing the available space within the cabin, particularly for the front row occupants. Complete reduction in space was prevented by the seat backs.

All seats were pushed substantially diagonally to the right, in some cases bearing on adjacent seats. All seats remained attached to the seat tracks and the tracks remained attached to the floor. The seat's passive energy absorbers partially activated due to the high lateral deceleration and due to the cabin collapsing onto the seats. Some composite seat bases fractured due to impinging on other structures.

All safety harnesses remained intact, with only one lap belt being partially cut due to pinching between adjacent structures. One safety harness rotating buckle, which should remain attached to a section of lap belt, was found loose in the wreckage. Laboratory examination found all safety harnesses to be in working order.

The right pilot flight control collective lever was installed, but the right cyclic control was not fitted. Damage to both collective levers was consistent with the impact sequence. The aircraft was fitted with analogue flight instruments, VEMD, and avionics navigation and communication equipment. Some flight instruments sustained impact related damage. The VEMD and some communications and navigation equipment were removed for further examination.

The polymer (caprolactone) fuel tank had shattered with only the forward, left and bottom of the tank remaining continuous. Surveillance recording of the impact showed some fuel being forcibly ejected during the impact. All the remaining fuel drained from the tank, some of which poured over the rear left seat passenger.

The tail boom structure remained attached to the fuselage. However, the tail boom was severed, most likely by its main rotor system. The Fenestron had separated from the helicopter at the tail boom junction plate. The rear driveshaft had sheared at the entrance to the Fenestron. The fan blades were undamaged and three static aerofoils (stators) showed impact damage.

The engine, main gearbox, main rotor mast and main rotor system were found approximately 15m away from the fuselage.

VH-XKQ Avionics

The analogue flight instruments, a VEMD, and video recording unit and display, were all damaged to varying degrees in the ground impact.

The following components were removed from the helicopter and transported to an ATSB technical facility for further examination:

- cyclic stick (and switches)
- pilot's Bose A20 ANR headset

- Garmin GNS430 GPS navigation and communication system
- Bendix King KX165A VHF Radio
- Precision Engineering PMA7000H Audio Selector Panel
- Garmin GTX327 Transponder.

Examination of this equipment is ongoing.

Communications

Southport CTAF area

The scenic flight operation was largely conducted in Class G airspace. Class G airspace is uncontrolled, meaning that aircraft operating under instrument flight rules (IFR) or VFR are permitted, and do not require clearance from air traffic control. Aircraft movements in Class G airspace are supported by communications on the common traffic advisory frequency (CTAF) appropriate to that area. In this case the Southport CTAF.

There was only one broadcast a pilot must make in a CTAF, and that was at the discretion of the pilot. The civil aviation safety regulation Part 91 manual of standards, section 21.04, stated:

> The pilot in command of an aircraft must ensure that broadcasts on the CTAF are made for a non-controlled aerodrome …. When the pilot in command considers it reasonably necessary to broadcast to avoid the risk of a collision with another aircraft.

There were also a number of broadcasts which were recommended by the regulations for the purpose of building traffic awareness among the pilots using the airspace. These included the taxi, departure and inbound calls, which were required by procedures at Sea World Helicopters.

The Southport CTAF was 119.00 MHz. Communication on that frequency was to be performed by appropriately licenced pilots to the standards set out in the Aeronautical Information Package[7] (AIP), Gen 3.4. Southport was a private airfield around 3.6 NM north-west of the Sea World heliport. From 2 June 2011 the visual terminal chart listed the same frequency (ERSA listed from 15 November 2012) for operations at Heck Field, an aerodrome used for light aircraft and flight training around 12.5 NM north-north-west of the Sea World Heliport.

The area was not a mandatory broadcast area and the CTAF did not have a defined boundary. The limits of the airspace were defined only by controlled airspace to the south, restricted areas to the west and the recommended positional broadcast at 10 NM from an aerodrome when conducting flight in the vicinity of it. The apparent boundary of the area using 119.00 MHz is shown in Figure 12.

[7] Aeronautical Information Package: A document produced by Airservices Australia, which consolidates the rules and requirements of piloting aircraft in Australian airspace.

Figure 12: Apparent CTAF boundary for 119.0 MHz

Source: Airservices Australia, annotated by the ATSB

CTAF congestion

The ATSB interviewed 6 local helicopter pilots. Each raised issues with congestion on the CTAF on account of it covering a large area of high volume traffic. The CTAF covers the area shown in Figure 12 from Heck Field, past Southport and to the controlled airspace boundary 2 NM north of Burleigh Heads.

Airservices Australia recorded that there were 65 aircraft movements[8] below 5,000 ft within 5 NM of the Sea World heliport in the 24 hours prior to the accident. Annual movements below 5,000 ft within 30 NM of the heliport totalled around 250,000 with around 13,000 of those confirmed to be helicopters.

[8] Aircraft movement: an aircraft taking off or landing.

After the accident, on 1 June 2023 the Office of Airspace Regulation (OAR) within the Civil Aviation Safety Authority (CASA) opened a review into the Class G airspace around Southport and invited comment from users of the airspace. This review is ongoing at the time of publishing.

At the time of the accident the airspace was not busy. Sport aviation activity at Heck Field had wound down around lunch time, Southport aerodrome was quiet, and four scenic flight helicopters (including XH9 and XKQ) were in the Southport airspace. The Southport CTAF was not congested at the time of the accident.

Internal company UHF communications

The operator's AS350 helicopters were fitted with UHF radios for company communication. The ground crew and office were also equipped with radios and operated on the same UHF frequency available to the pilots. It was reported that most of the communication over UHF was between pilots and ground crew or ground crew and ground crew for arranging passenger loads and refuelling requirements.

The EC130 helicopters were not utilising UHF. XKQ was not fitted with a UHF radio, and XH9 was fitted with a TAIT 9300 radio which was not configured for company communications. Communication between pilots of the EC130 helicopters and ground crew was through hand signals.

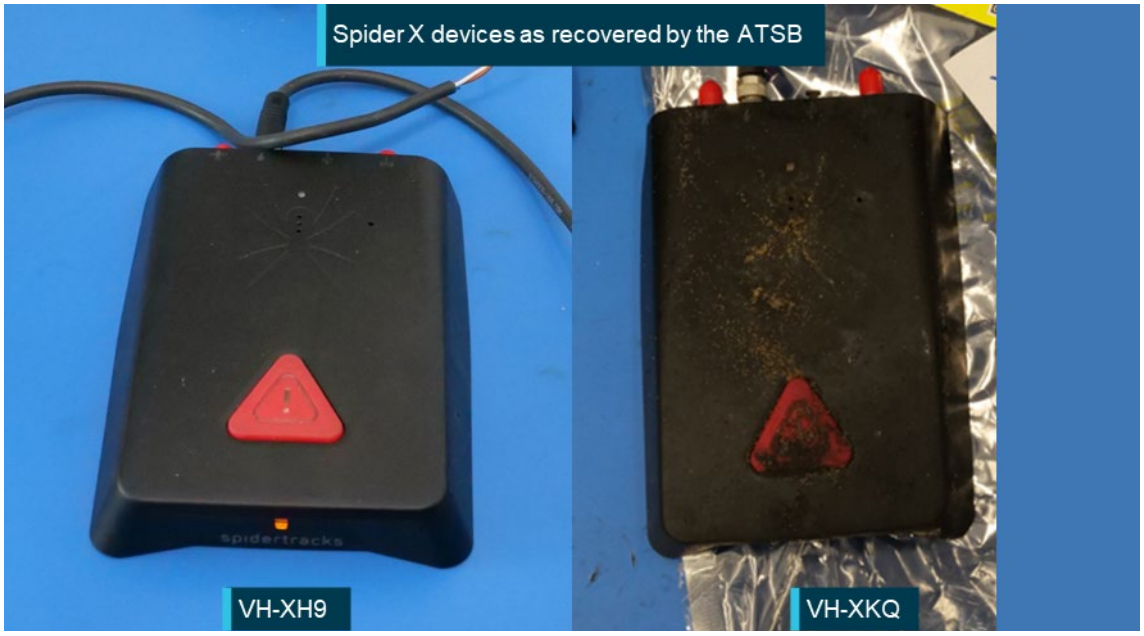
Recorded information

Aircraft tracking devices

Both XKQ and XH9 were fitted with SpiderTracks Spider X aircraft position identification and monitoring units. Spider X included a standard data fidelity of 5 seconds, an increased alert data fidelity of one second, and an attitude heading reference system (AHRS). The AHRS system uses a series of sensors within the unit at varying data rates, to estimate the aircraft's pitch, roll, yaw, and vertical speed. This is combined with aircraft position, latitude, longitude and altitude into a single file.

Both units were taken to the ATSB technical facilities for assessment and download.

Figure 13: Aircraft tracking devices



Source: ATSB

XH9's unit was largely undamaged and was able to be powered on and the unit uploaded data to the SpiderTracks server from where it was recovered. The ATSB received all the data recorded by the unit, including AHRS data, from its arrival into Australia until the landing on the sandbank following the collision on the day of the accident.

Initially, the ATSB was only able to access flight data from XKQ that had already been uploaded to the SpiderTracks server. This included data up until the flight prior to the accident. Due to the damage to the unit, the data from the accident flight had not been uploaded and was not able to be recovered through its usual upload method. The ATSB examined the unit and removed the chip containing the relevant data (Figure 14). Data, including position and AHRS data, for the accident flight from XKQ's Spider X unit was subsequently recovered directly from the memory.

Figure 14: VH-XKQ Spider X

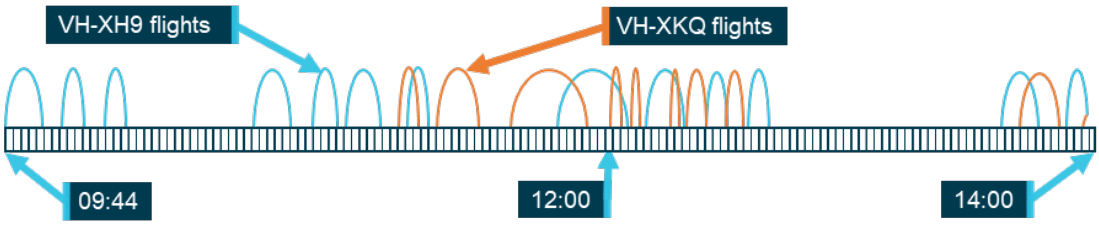
Source: ATSB

The recovery of the AHRS data from both aircraft allowed investigators to develop detailed flight paths for the accident flight and previous flights, and assess the aircraft's attitude in the lead up to the collision.

As part of the ATSB's analysis, the recorded GPS altitude values were corrected for the location of the accident. The SpiderTracks AHRS system records altitude values based on the WGS84 ellipsoidal model of the earth. As the earth is not actually an ellipse, these values tend to differ to the actual height above the ground depending on the location the measurement is taken. Geoscience Australia identifies that in the Gold Coast region that WGS84 ellipsoidal altitudes overestimate height by about 40 m. The ATSB corrected the altitude and then positively checked the data by identifying times that the helicopters were on the landing pads, which were 2 m above mean sea level.

The tracking systems aboard each aircraft were used to show the tempo of operations on the day. Almost all of the flights shown on the diagram at Figure 15 should have had calls detectable on the recording of the CTAF.

Figure 15: Timeline of flights on 2 Jan for VH-XH9 and VH-XKQ



Source: ATSB, Operator data

Common traffic advisory frequency (CTAF) recording

The CTAF was recorded at Southport Airfield about 3.6 NM north-west from the Sea World Heliport (Figure 16). Southport Flying Club received CTAF radio calls through a regular vertical antenna. The estimated detection envelope for the antenna was 30 NM for aircraft above 500 ft. Buildings along the foreshore of the Broadwater between Southport Airfield and Sea World Heliport were up to 250 ft tall. Therefore at lower altitudes, the built environment reduced the detection envelope, resulting in calls from aircraft around 200 ft and below not being detected at Southport Airfield.

Figure 16: Southport Airfield and building shielding to Sea World

Source: Queensland Government Department of resources, annotated by the ATSB

While both XKQ and XH9 were airborne, about 16 aircraft (some calls were undistinguishable on the recording) were using the airspace covered by the Southport CTAF frequency. Recorded calls from XH9 (highlighted in blue) and XKQ (highlighted in yellow) are listed in Table 3 below.

Departure calls, position reports, and inbound calls from XH9 can be heard clearly throughout the day. The final two recorded calls from XH9 at 13:52:05 and 13:53:44 are from the accident flight.

However, XKQ featured only in broken transmissions from the area of Porpoise Point. The ATSB gathered evidence from pilots operating in the vicinity of Sea World with XKQ on 2 January 2023 and none reported issues with XKQ's transmissions.

Table 3: CTAF calls recorded at Southport for periods VH-XKQ was airbourne.

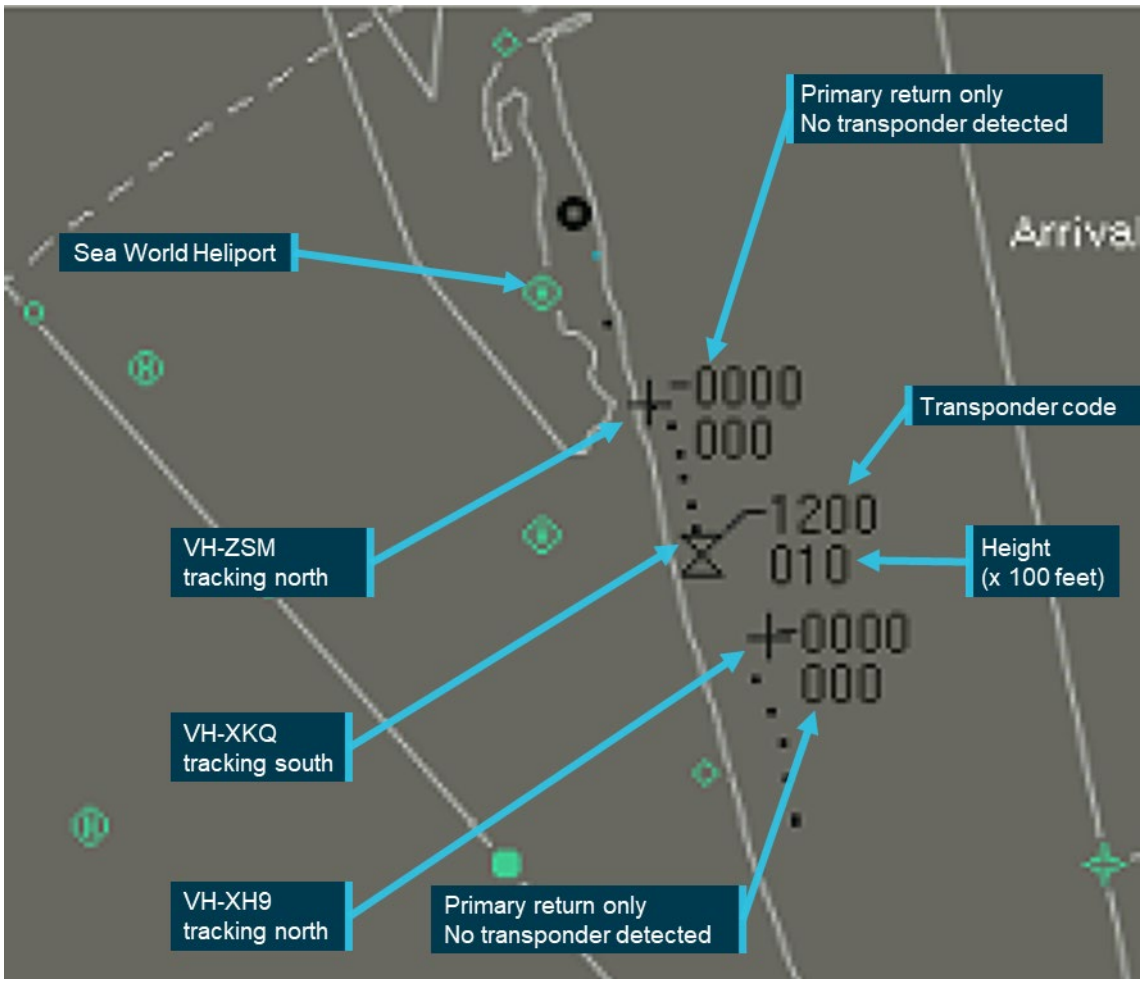
Time	Aircraft	Time	Aircraft
11:16:04	Sport aircraft 1	12:21:25	single click
11:18:27	VH-XH9 Departure call north	12:22:05	Cessna 172 1
11:19:42	Sport aircraft 2	12:22:28	Cessna 172 2
11:19:48	VH-XH9 Porpoise Point Inbound call	12:22:44	Unreadable Heck Field traffic
11:20:00	Sport aircraft 1	12:23:01	Cessna 172 1
11:21:53	Sport aircraft 2	12:24:35	VH-XKQ Broken inbound call
11:24:48	Sport aircraft 1	12:25:14	Cessna 172 1
11:26:02	Cirrus SR22	12:25:28	Cessna 172 2
11:26:56	Cirrus SR22	12:26:20	Sport aircraft 3
11:38:43	Bell 429	12:27:47	VH-XH9 departure call north
11:40:05	Media Helicopter	12:29:29	VH-XH9 Porpoise Point Inbound call
11:46:29	Bell 429	12:29:44	Media Helicopter
11:49:05	Media Helicopter	12:34:28	Unreadable
11:53:21	Media Helicopter	12:35:44	Sport aircraft 2
11:54:59	VH-XH9 Departure call south	12:37:29	VH-XH9 Departure call north
11:56:29	Media Helicopter to VH-XKQ in response to call from XKQ	12:38:59	Unreadable aircraft for aerobatics
11:57:50	VH-XH9 turning to track north	12:39:08	VH-XH9 Porpoise Point Inbound call
11:58:24	Media helicopter and VH-XKQ exchange greetings.	12:41:54	Unreadable Heck Field traffic
11:59:02	Media Helicopter	**Lunch break**	
12:00:05	VH-XH9 north of Q1 tracking north	13:33:43	GCHT 2
12:00:17	Media helicopter acknowledged	13:37:01	VH-XH9 Departure call south
12:01:54	VH-XH9 Porpoise Point tracking north	13:37:47	Cirrus SR20
12:02:21	Unreadable aircraft for aerobatics	13:38:08	GCHT 1
12:03:19	VH-XH9 tracking south from Sovereign Island	13:39:55	VH-XH9 Q1 turning north
12:04:27	Cessna 172 1	13:41:46	GCHT 2
12:05:15	VH-XH9 2 NM north of Wave Break Island inbound for Sea World.	13:42:07	GCHT 1
12:07:32	VH-XKQ Broken transmission	13:42:18	Cirrus SR20
12:08:58	Cessna 172 1	13:43:18	VH-XH9 Porpoise Point Inbound call
12:11:52	Cessna 172 1	13:43:45	Unreadable tracking north bound coastal
12:12:30	Media Helicopter	13:44:04	Cirrus SR20
12:13:27	VH-XH9 Departure call south	13:46:09	Cirrus SR20
12:13:44	Media Helicopter	13:46:54	Cirrus SR20
12:15:38	Cessna 180	13:47:45	VH-XKQ partial inbound call
12:16:16	VH-XH9 Q1 turning north	13:49:40	GCHT 1
12:16:57	Cessna 180	13:52:05	VH-XH9 departure call north
12:19:20	Cessna 180	13:53:44	VH-XH9 Porpoise Point Inbound call
12:19:36	VH-XH9 Porpoise Point inbound call	13:53:59	GCHT 1

Radar

Airservices Australia provided the ATSB with radar recordings of 2 January 2023. These recordings were used in conjunction with CTAF recordings to determine the locations of various aircraft in the area at the time of the accident.

Figure 17 shows an example of the output showing both helicopters on their penultimate flight. Other aircraft in the area were picked up on primary radar, and XKQ was picked up on secondary radar. The transponder code 1200 denotes an aircraft operating outside of controlled airspace. As the helicopters were close to the ground when they collided, radar did not record the accident.

Figure 17: Radar screen shot from 1342:50 2 January 2023



Source: Airservices Australia, annotated by ATSB

Passenger and witness cameras

The operator required passengers to give mobile phones to ground crew between briefing and boarding the helicopter. This was to ensure passengers focussed on the boarding process and the associated hazards of moving on the helipad next to an operating helicopter. Phones were ordinarily returned to passengers once secure in the aircraft. Some confusion about this rule led three passengers of XH9 to leave their phones back at the heliport.

As it was, passengers of both helicopters captured photos and video of almost all elements of each flight. Four passenger's phones were recovered from XKQ, 3 of those phones were downloaded by QPS. One telephone was unable to be accessed and efforts to do so continue. Photos and videos from 2 passengers aboard XH9 were provided to the ATSB.

Additionally, the ATSB made a call for witnesses and/or video or photographs that were taken showing the accident sequence or the aftermath. As a result, 87 people contacted the ATSB. From that contact the ATSB obtained additional videos and photographs, eyewitness accounts, information about previous flights with the operator, and local flying activities.

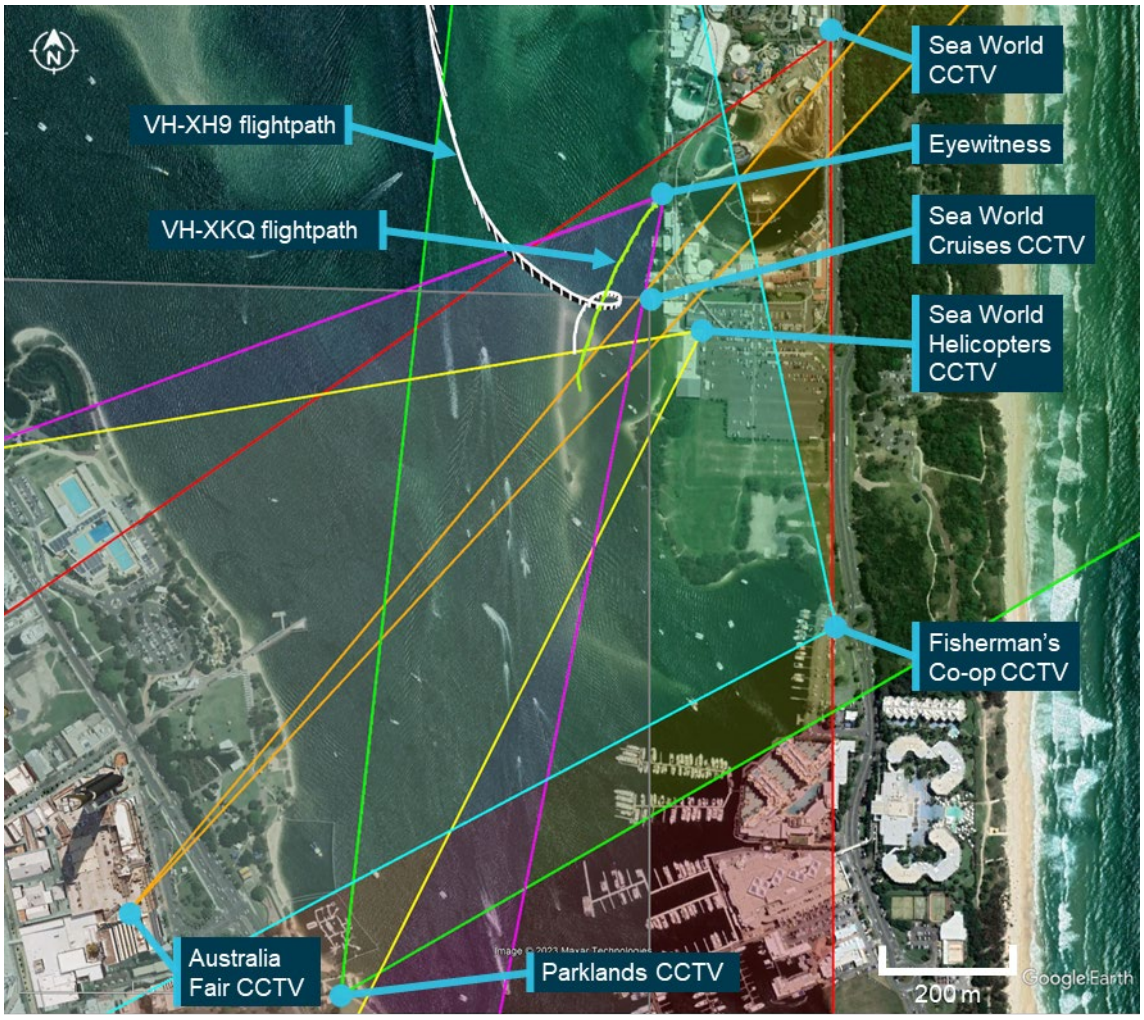
This evidence has been vital in informing the investigation and has been used in simulation and analysis of the event to create a high level of understanding of the mid-air collision.

Closed circuit television recordings

The accident and rescue efforts by eyewitnesses and bystanders was recorded in detail by numerous CCTV in addition to eyewitnesses with mobile phones. Most recordings started in response to the collision and captured the landing of XH9, and the subsequent rescue efforts. Of those recordings made available to the ATSB, seven recordings external to the helicopters were stable and detailed enough to be used for analysis purposes. Of these, 4 recordings caught the mid-air collision, 5 showed the XKQ impact with the ground, and 4 showed the landing of XH9 on the sandbar.

These recordings, along with those made by witnesses and passengers on board, enabled detailed analysis of the pre-collision conditions, the collision dynamics and breakup sequences, determination of ground impact speed and attitudes, and occupant survivability envelopes.

Figure 18: Video recordings capturing the accident



Source: Google Earth, annotated by the ATSB

Medical information

A Queensland state pathologist conducted a coronial autopsy and toxicology examination of the pilot of XKQ. The autopsy report showed no evidence of significant natural disease. The toxicology report showed a positive result for cocaine metabolites and a common cutting agent levamisole. The examining forensic pathologist reported that there were no signs of chronic stimulant use. The results recorded were:

- Benzoylecgonine Detected <0.1 mg/L
- Methylecgonine Detected <0.01 mg/L
- Levamisole Detected.

The ATSB engaged a forensic pharmacologist to examine and interpret the results. They stated that:

> The presence of the benzoylecgonine and methylecgonine indicate the pilot used cocaine within the previous few days (possibly up to about 4 days prior) but, the very low concentrations of these metabolites suggest use was not likely to have been within 24 hours prior to his death and it is unlikely there would have been impairment of his psychomotor skills. Illicit cocaine frequently contains levamisole which is used as a cutting agent. Based on the blood or urine concentration, it would be impossible to state if withdrawal effects were likely or not.

Cocaine is an illicit drug and can have harmful effects on pilot performance. Effects include risk-taking, inattentiveness and poor impulse control. The indication of exposure to cocaine is highlighted as the effects of cocaine and post-cocaine exposure increase risk in aviation activities.

However, although it is unlikely the pilot of XKQ would have had any psychomotor skill impairment on the day of the accident, it is not known whether post-cocaine exposure effects of the drug which can include fatigue, depression and inattention had any effect on the performance of the pilot.

The pilot of XH9 attended hospital for their injuries. They were admitted on 2 January 2023 and discharged on 4 January 2023. Although the pilot reported consenting to testing for alcohol and other drugs (AOD) and bloods were taken, no AOD testing was conducted. The pilot of XH9 had a medical procedure planned for early 2023, and it was reported that this did not affect their ability to hold a class 1 aviation medical certificate at the time of the accident.

Passenger and survivability aspects

Passenger safety briefing

Regulatory requirements

The operator was in the process of transitioning to the new regulations at the time of the accident and was therefore working with Civil Aviation Order (CAO) Section 20.11 which required (among other things) that passengers receive a pre-flight briefing that covered when and how to fit seatbelts, the method of fitment of lifejackets and the location of the exits.

In addition to the requirements of CAO 20.11 the new Civil Aviation Safety Regulations part 133 Manual of Standards, Chapter 7 *Safety briefings, instructions and demonstrations* required that passengers receive information about the location of the safety briefing card (if required) and the brace position. Further guidance was provided in a multi-part advisory circular (AC) for Part 133, AC 133-10 *Passenger safety information*. The AC noted:

> 2.1.2 Accident investigations have shown that survival rates are improved when passengers are provided with accurate and effective information about the correct use of equipment such as seatbelts, and the actions they should take in a life-threatening situation such as how to adopt the brace position.

Operator procedure for pre-flight safety briefings

Sea World Helicopter's (SWH) procedure required that passengers be provided a briefing prior to departure which included but was not limited to the following:

- The use of seat belts and the appropriate method of fastening and adjustment; also recommend that passengers keep their seat belt fastened at all times in case of unexpected turbulence;
- Location and method of operation of emergency exits including doors and other openings which may be used for that purpose;
- Prior to embarkation, the SWH staff members shall ensure that all passengers are referred to the Helicopter Safety card and are familiar with it;

The operator would normally use a pre-recorded video to provide passengers with pre-flight safety information, but if time was restricted, the ground crew would brief the passengers verbally. While Sea World Helicopter's safety briefing video covered most of the required aspects (and was available in multiple languages), it did not contain information about the location/operation of the EC130 doors. It also did not contain information about a brace position or where passengers could find the safety briefing card on the aircraft, nor was it required to at the time.

Fitment of seatbelts

The EC130B4 helicopters were equipped with 4-point safety harnesses featuring manually adjusted lap belts, automatically adjusting inertia reel shoulder harnesses and a central rotary buckle point at all seating positions. In addition, passengers wore EAM KSE-35HC2L8 pouched constant wear lifejackets around their waist.

Sea World Helicopters procedures required the following in relation to seatbelts:

> Use of Seats and Seatbelts
>
> The pilot in command [PIC] shall occupy a control seat and wear a seat belt properly fastened at all times.
>
> The PIC shall ensure that all occupants have their seat belts / harnesses fitted and correctly adjusted during all stages of flight.

There was no guidance about how to fasten seatbelts in the operator's documented procedures.

Correct fitment of seatbelts reduces the likelihood of serious injury or fatality in an accident. Both helicopters were fitted with 4-point restraints. To ensure that a seatbelt is fitted correctly and that it will be effective, as advised by various aviation regulators and the aircraft manufacturer:[9]

- Seatbelts must not be twisted, they must be fitted without slack, and adjusted to fit as tightly as comfort allows.
- The lap portion of the seatbelt must be placed low and tight across the hips.
- Seatbelts must not be fitted across the abdomen as this can cause internal injuries or result in the person sliding out the bottom of the harness (submarining), nor should they be fitted across the thighs, or the seatbelt will not effectively prevent forward movement.
- For 4-point restraints, the lap belt portion of the restraint should be fitted and adjusted first before the shoulder harness.

---

[9] Airbus Helicopters Safety Information Notice (SIN) 3444-S-25 *Correct use of restraints to minimise the risk of injury*
Civil Aviation Safety Authority Multi-Part Advisory Circular (AC) AC 133-10 – *Passenger Safety information*
Federal Aviation Administration Advisory Circular 91-65 *Use of shoulder harnesses in passenger seats*
Federal Aviation Administration *Seatbelts and shoulder harnesses – smart protection in small aircraft* (2020)
Transport Canada AC 605-004 (3) *Use of safety belts and shoulder harnesses on board aircraft*
Transport Canada AC 700 036 (1) *Brace for impact positions for all aircraft occupants*

While Sea World Helicopters provided information about how to fit the different types of seatbelts on each of their helicopter types in their pre-flight safety briefing video, some aspects of the above guidance were not followed in the pre-flight safety briefing video (Figure 19). This was due, in part, to the positioning of the constant wear lifejacket worn by passengers.

Figure 19: Still images from safety briefing video

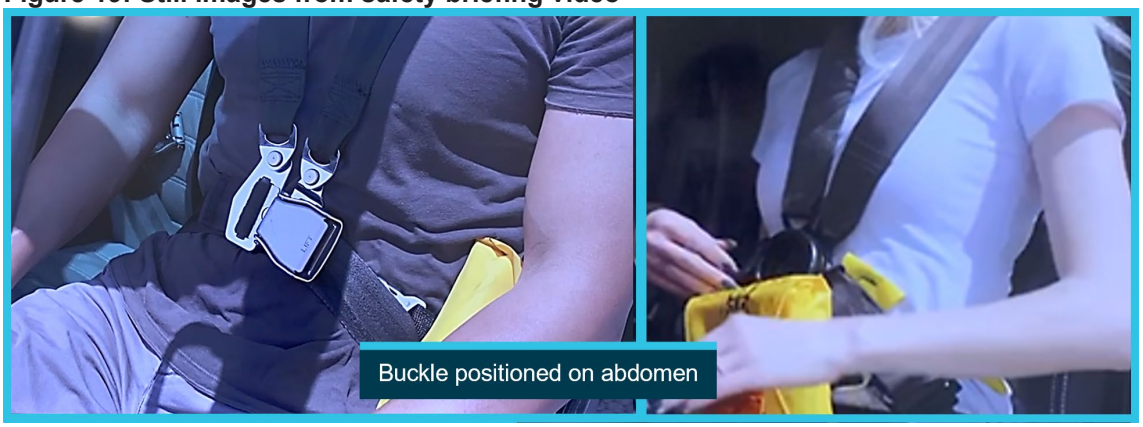


Image shows both Airbus EC130 and AS350 seatbelts
Source: Sea World Helicopters, annotated by the ATSB

Photographs, videos and interviews indicated that some passengers did not have their seatbelts fitted correctly (Figure 20). Incorrect fitment included:

- the buckle of the seatbelt positioned across the abdomen
- the belt passing over the lifejacket creating slack
- twisted seatbelt webbing.

While some occupants of XKQ survived, the ATSB would categorise the impact with terrain for that helicopter as likely not survivable (the occupants were not expected to survive the impact).

Figure 20: Examples of passenger incorrect seatbelt fitment

Source: Passenger photographs/video, annotated by the ATSB

Further investigation determined that seatbelts were not being fitted correctly by the operator on a regular basis. In interview, it was reported by 1 ground crew member that in preparation for passenger loading, 2 portions of the 4-point restraints would already be clipped in, so that when passengers boarded, there was only 1 shoulder harness and 1 waist component that would be required to be inserted. Unless the seatbelt is readjusted correctly whereby the lower portion of the harness is fitted low and tight across the hips, this can lead to incorrect fitment of the seatbelt.

The ATSB investigated the prevalence of the incorrect fitment of seatbelts with constant wear lifejackets more broadly through a review of social media images. The review found that there were numerous examples in the helicopter tourism industry, both in Australia and internationally and it was not limited to Sea World Helicopters' operation.

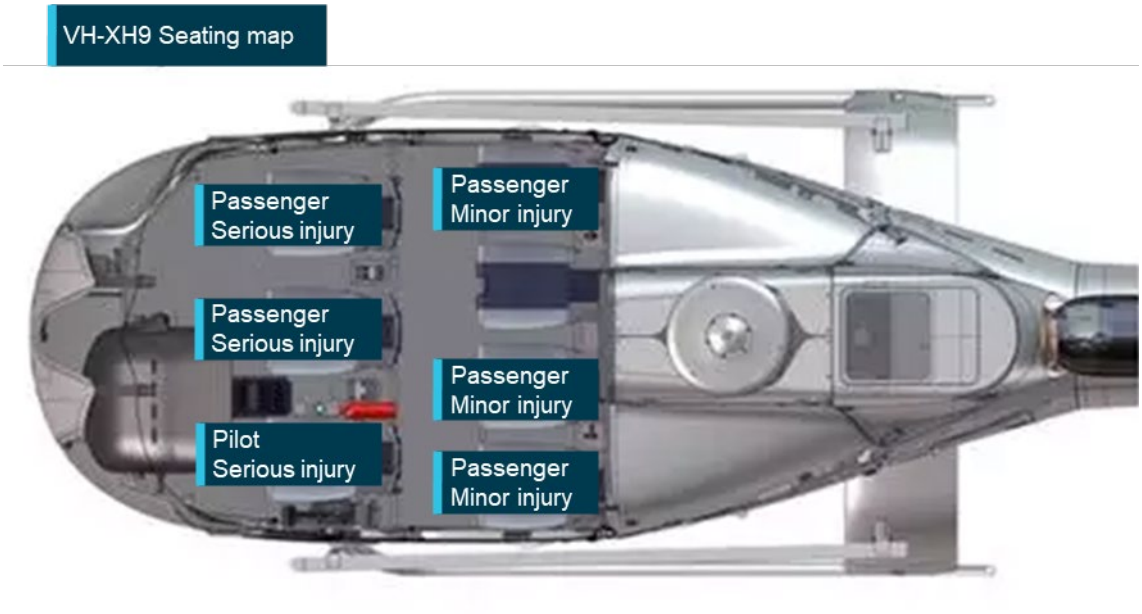
Passenger loading and pre-departure procedures

Seating positions

Passengers were seated by the ground crew, and the ground crew had carriage of all aspects of passenger loading including helicopter weight and balance. The operator's booking system created a manifest which provided ground crew with a schedule of flights that included the passenger's names, measured weights, tour type and anticipated time of flight. The ground crew used that information to seat passengers in accordance with the operator's documented helicopter loading chart. The chart provided options for the pilot's weight and fuel load and gave a range of corresponding weight limits for the front and rear seats of the helicopter.

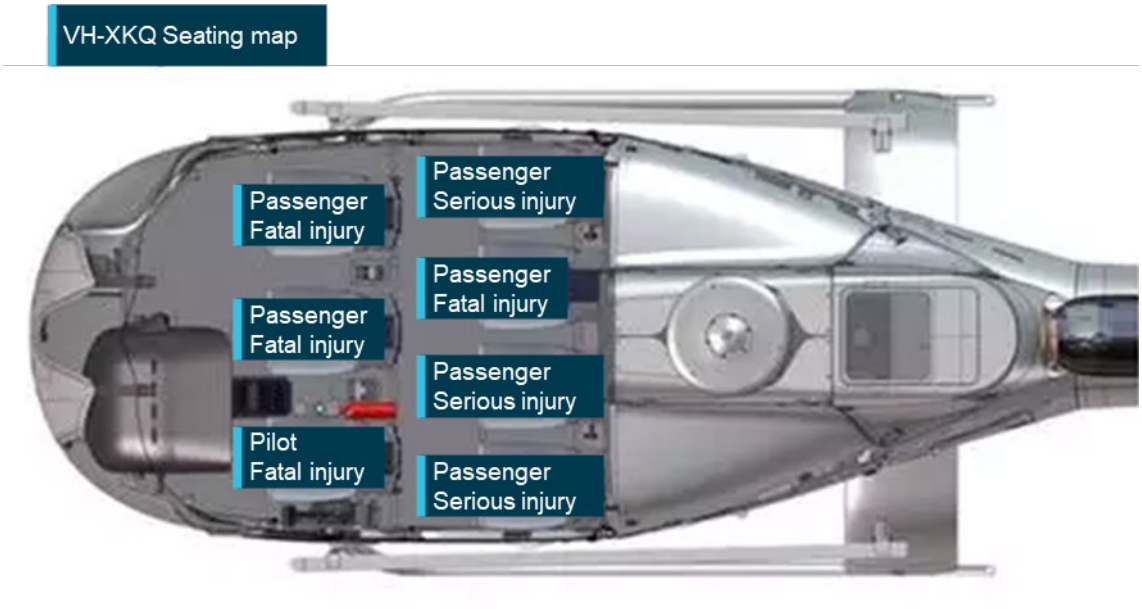
Remaining within the limits of the chart would keep the helicopter within its centre of gravity limitations. Any loading configurations outside of the limits of the chart required consultation with the pilot who would conduct a calculation to check that the proposed configuration was acceptable.

Figure 21: XH9 seating map



Source: Airbus, annotated by the ATSB

Figure 22: VH-XKQ seating map

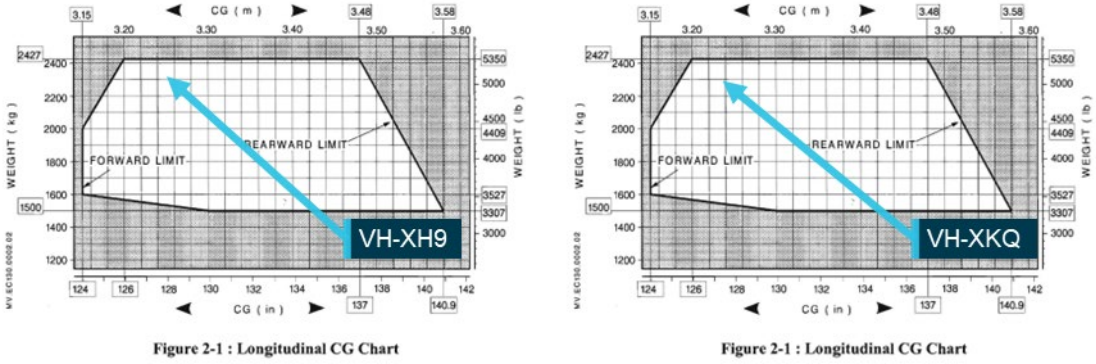


Source: Airbus, annotated by the ATSB

Weight and balance

For the loading of XKQ, the combined weight of the front seat passengers exceeded the usual limit as indicated by the operator's loading chart. The ground crew member responsible for checking this, spoke with the pilot who then manually calculated and confirmed that the passengers could be seated in the front (Figure 23).

Figure 23: XH9 and XKQ calculated longitudinal centre of gravity for accident flight



Source: Airbus Helicopters, annotated by the ATSB

Preparation for departure

Sea World Helicopter's procedure for ground crew, to ensure that the flight was ready to depart stated:

> Once all passengers are loaded and their seat belts secured, loaders should ensure that nothing is hanging outside the doors and that the doors are secured correctly before walking away from the helicopter.
>
> The last loader should then visually check the doors are secured, check the area is clear behind the helicopter and on the adjoining helipads, and then give the pilot the thumbs up and signal for the flight, Tour 1, 2, 3 etc.
>
> The loader should then exit the helipad.

Only loader should give the thumbs up to the pilot. This signal means, the doors are closed, no seat belts are hanging out and you are clear to depart. It is a very important signal and must not be given unless you are sure these things are correct.

Organisational and management information

Sea World Helicopters

Helicopter scenic flights have been available from the Sea World theme park for about 35 years. The site of the current heliport first became a pad for helicopter and hovercraft transfers for the world expo in 1988. Known as the 'car park pad' it saw use for group bookings or itinerant helicopters. Scenic flights were primarily operated from the joy flight pad (now the park pad) and hangar pad (now decommissioned) (Figure 24).

Figure 24: Helipads at the Sea World theme park in 2008

Source: Google Earth, annotated by the ATSB

The current owners of Sea World Helicopters bought the helicopter operation in December 2018 and entered into a concession agreement with VRTP. The owners also owned another Australian helicopter company, and elements of that company were used to support operations at Sea World. This included internal quality audits and management support. Annual second party audits of the operator were also commissioned by VRTP.

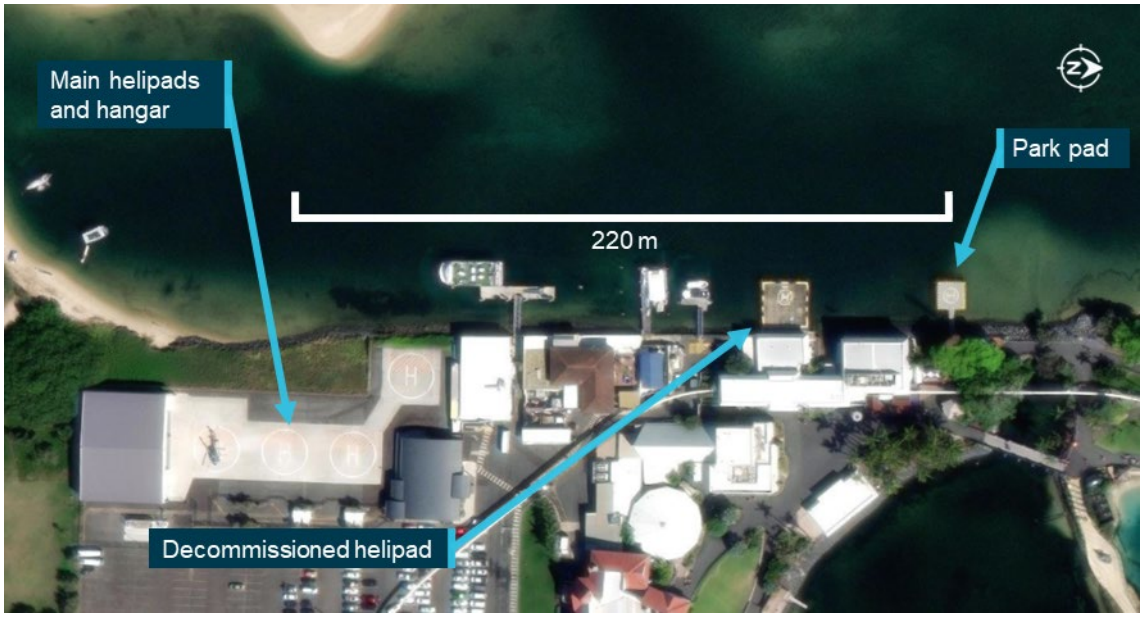
During the COVID-19 pandemic international and interstate travel to Queensland was halted, and from March 2020 inbound tourism stopped. State borders reopened with restrictions in December 2021, and a tourism industry recovery began. The operator reported that during this period they focussed on developing their product which included replacing the AS350SD2 helicopters with EC130 helicopters.

At the time of the accident the operator employed 18 people including office staff, ground handling staff, and flight crew. They had access to 5 helicopters, 2 AS350SD2 'Squirrel' helicopters, 2 recently acquired EC130B4 helicopters, and one EC130B4 helicopter on loan from another company in the group.

Helicopter landing sites

The current owner developed a heliport and dedicated passenger handling facility on the site of the old car park pad which opened in 2019. The helipad and passenger facilities in the theme park were renovated in works that began in December 2021 and completed in March 2022 (Figure 25). See also Operational information.

Figure 25: Helipads at the Sea World theme park in 2023



Source: State of Queensland, annotated by the ATSB

Air operator's certificate

On 22 October 2019 CASA conducted on on-site audit of Sea World Helicopters. That surveillance event made 4 administrative findings which were all subsequently acquitted.

A CASA Air Operator's Certificate (AOC) was renewed on 21 July 2022 and covered Part 119 (air transport) and Part 138 (aerial work), it was valid until 31 July 2027. The organisation was authorised to perform helicopter air transport flights and was in the process of transitioning to Part 133 (air transport in rotorcraft).

The pilot of XKQ was approved by CASA as the operator's chief pilot on 24 September 2019. The operator had three permanent pilots (including the chief pilot) and four casual pilots. CASA's *Head of Flying Operations guide* (2022) stated that the chief pilot's responsibilities included:

- monitoring, maintaining and reporting to the CEO on the operator's compliance with the provisions of the civil aviation legislation and the exposition that apply to the flying operations
- ensuring that the operator's flight crew are provided with the information and documentation necessary to properly carry out their responsibilities
- ensuring the proper allocation and deployment of the operator's aircraft and personnel
- maintaining an operational library for flight crew.

The pilot of XKQ was also appointed by CASA as Head of Aircraft Airworthiness and Maintenance Control (HAAMC) on 17 September 2019. The operator had five helicopters and the CASA defined role of the HAAMC was to:

- Ensure operational compliance of aircraft used under the Air Operator's Certificate (AOC)
- Manage all scheduled and unscheduled maintenance to ensure airworthiness

- Investigation and reporting of defects
- Be a single point of liaison for internal and external parties with respect to airworthiness
- Ensure all aircraft flown satisfy the provisions of Section 20AA (4) of the Civil Aviation Act (1988).

The pilot of XKQ also had a role as drug and alcohol management plan (DAMP) supervisor which began with completing training called DAMP awareness for Safety Sensitive Aviation Activity (SSAA) employees, and DAMP Supervisor on 29 August 2020. CASA's *DAMP Contact Officers and Supervisors guide* (2021) stated that a DAMP supervisor was:

- trained to form an opinion whether an SSAA employee is affected by drugs or alcohol
- authorised by the organisation to form this opinion, which will determine if an employee should be stood down from duty and/or referred for a DAMP test under reasonable grounds.

They also state that a DAMP Supervisor may:

- provide information about treatment services and refer employees, if required support the needs of staff and monitor performance on return to work
- assess the working environment and identify conditions that could be changed or improved to prevent or reduce alcohol and other drug related harm.

The pilot of XKQ was additionally made head of operations (HOO) for the organisation's Part 138 (aerial work) operations on 10 May 2022. This role overlapped to a large extent with the pilot's existing role as head of flight operations HOFO for the AOC.

The report of a second party audit conducted on behalf of VRTP on 24 January 2022 stated:

> The HOFO (head of flight operations) is a competent and proficient office-holder who has successfully combined the tasks of flying whilst managing the complexities of the operation during extraordinary times. However on occasion this workload comprises an excess of tasks, and his office could benefit with assistance from a post holder who is schooled in the SM's (safety manager) role.

The pilot of XH9 was employed on 18 May 2022 and officially advised to CASA as safety manager on 27 November 2022.

Safety Management

Overview

The operator's *Safety Management System (SMS) Manual* contents section described the following elements:

- Safety Management System Manual
- Drug and Alcohol Management Plan & VRTP AOD Policy
- Annex 1: Emergency Response Plan
- Annex 2: Fatigue Risk Management
- Annex 3: Management of Change
- Annex 4: Hazard and Risk Management.

The company operations manual stated that the duties of the safety manager were:

> a) The maintenance, review and revision of the Safety Management System [SMS];
>
> b) Conducting internal audits of procedures or organising an audit conducted by an external organisation;

Furthermore, the safety management system manual stated that the safety manager was responsible for:

> … managing corrective, remedial and preventable actions of the companies SMS.

Safety was discussed as a topic in weekly management meetings and included the safety manager and HOFO. The ATSB reviewed the minutes of these meetings from 30 September 2022 to the date of the accident. Most of the safety items discussed concerned work health and safety, management of passengers and ground handling of aircraft.

Staff safety meetings did not appear to be held according to a set schedule, and documents provided showed 6 meetings were conducted in a 9 month period. Topics included aviation safety risk, passenger briefing and helipad management.

Drug and alcohol management plan and VRTP AOD policy

The safety manager (pilot of XH9) and the HOFO (pilot of XKQ) had completed DAMP supervisor training. The HOFO was listed in the operator's management system manual as the contact officer for the drug and alcohol management plan.

SWH maintained a DAMP manual detailing how it would meet the requirements of CASR Part 99 *Drug and alcohol management plans and testing*. The DAMP manual referred directly to VRTP policy for the conduct of daily testing:

> SWH has entered into an arrangement with [VRTP] to have SWH Pilots breath-tested prior to their shifts. This testing will be performed by suitably experienced staff... This testing will be performed in line with that companies DAMP. SWH management will be alerted should any Pilot fail this test.

VRTP policy listed a helicopter pilot as a high risk position and Sea World Helicopters' staff were integrated into the VRTP alcohol and other drugs (AOD) process. Through VRTP, alcohol was tested with a breathalyser, and drugs were tested with a mouth swab kit for an oral fluid drug screen.

Sea World Helicopters' staff were breathalysed for alcohol alongside VRTP staff and contractors at the beginning of each workday. On the day of the accident, both pilots were breathalysed to test for alcohol on and returned results of 0.000 alcohol in breath. On the day of the accident neither pilot was screened for drugs, and by the evidence available, drug testing was not a regular practice.[10]

On employment with Sea World Helicopters, pilots completed an oral fluid drug screen for VRTP. The VRTP AOD policy also carried a provision for random drug screening. The pilot of XH9's most recent screen was prior to employment on 5 May 2022 and they passed with a negative result. The pilot of XKQ's most recent screen was on 1 August 2022, and they also passed with a negative result.

Emergency response plan

The emergency response plan explained roles and responsibilities and provided guides for various emergency occurrences. Practice emergencies were conducted regularly with the VRTP emergency response team with the last scenario being conducted on 16 November 2022.

Fatigue risk management

The operator had implemented a fatigue risk management plan. Flight crew were trained in issues of fatigue and fatigue management and completed an exam which was kept on their pilot file. All staff were required to review their fatigue through a series of questions when starting work each day. An adverse answer to any of the questions would trigger review by a senior staff member and if necessary reassignment to tasks which did not carry risk associated with fatigue.

Records of these assessments were kept. On the day of the accident there was no record of assessment for the pilot of XKQ.

---

[10] At the levels detected in the post-mortem toxicology, an oral fluid drug screen of the type used by VRTP would have had around a 50% chance of detecting the drug.

Following the accident, CASA undertook a surveillance event into the operator focusing on fatigue with no safety findings identified. ATSB examination of fatigue is ongoing.

Hazard and risk management

Recording of hazards and incidents by an organisation is an essential part of a functioning safety management system. By recognising hazards, reporting and recording them, and managing them through a system, organisations can learn and protect themselves. Further, reporting incidents to the ATSB actively contributes to the improvement of aviation safety for all operators.

The *Hazard and risk management section* of the operator's *SMS Manual* provided instruction and advice on how to conduct risk assessment.

Hazards and incidents relating to aviation safety risk were collected and managed in an electronic safety, operations and compliance system. This system had been operated by different accountable managers and owners. Between 2 September 2014 and 25 April 2019, 14 collision risk reports were made, 10 of those were with drones operating in the vicinity of the park, 3 involved other aircraft, and 1 involved watercraft. No hazards involving aircraft traffic were recorded after April 2019.

From 2022, hazards recorded were concerned mainly with ground handling events and passengers moving on the helipads. Of matters reported to the ATSB[11] involving aviation safety incidents there was a bird strike and an AS350 tail rotor strike on the park pad. Both were classified as high risk for management through the operator's system.

Change management

In Annex 3 of the *SMS Manual*, the management of change section addressed the process for actioning changes to operations, policies and procedures, and in particular, identifying which were required to be notified to CASA as significant. The focus of the annex was continual improvement, and it included a controlled document for a change request. The document captured recording of the need to act, and called for risk analysis in planning the change. The annex did not address implementation of change through change management processes and while it mentioned post implementation evaluation of a change, it provided no procedure for monitoring a change.

The operator's *SMS Manual* stated:

> **7.2 Management of Change**
>
> 7.2.1 While there should be constant vigilance to identify hazards, increased vigilance should be exercised during situations involving organisational or operational change or at other times such as those listed below:
>
> a) When major structural changes are made to the company
>
> b) Times of rapid growth
>
> c) When many employees are inexperienced
>
> d) When new equipment, procedures or processes are introduced
>
> e) If financial problems start affecting operational decisions
>
> f) Pre-assessment of any subcontracted services or equipment

Within procedural documents, 'should' does not have the power of a mandatory requirement, though there is an expectation of implementation where considered relevant to do so. Not all events in the list would therefore undergo a managed change. For example, a document titled '*change management planner'* was used for the recommencement of park pad operations after a 2 year closure, and not for the onboarding of 2 newly imported helicopters into the operation. The

[11] Safety occurrences reportable to the ATSB are outlined in the Transport Safety Investigation Regulations.

operator stated that as they had one EC130 already, no change management planning was required for the importation or implementation of the 2 new helicopters.

The change management planner for the recommencement of park pad operations in 2022 included a line item for pilot training in flight paths and indicated the need for a job hazard analysis (JHA). The JHA which was accepted by the HOFO and CEO included risk of mid-air collision in cruise flight, not on departure. The mitigators for mid-air collision in cruise flight were:

- Pre-arranged flight paths
- Traffic collision advisory devices
- Monitoring and use of the CTAF channel.

The risks (and controls in sub-points) for aircraft on departure considered were:

- Tail rotor contact with building or fence
    - Pilots were not to pedal turn past 90 degrees to fence
- Engine failure on take off
    - Steep profiles
    - Emergency Floats
    - Remaining outside of height velocity curve
- Aircraft accident on or near pad
    - Sand bars and beaches to be used as alternate landing sites.

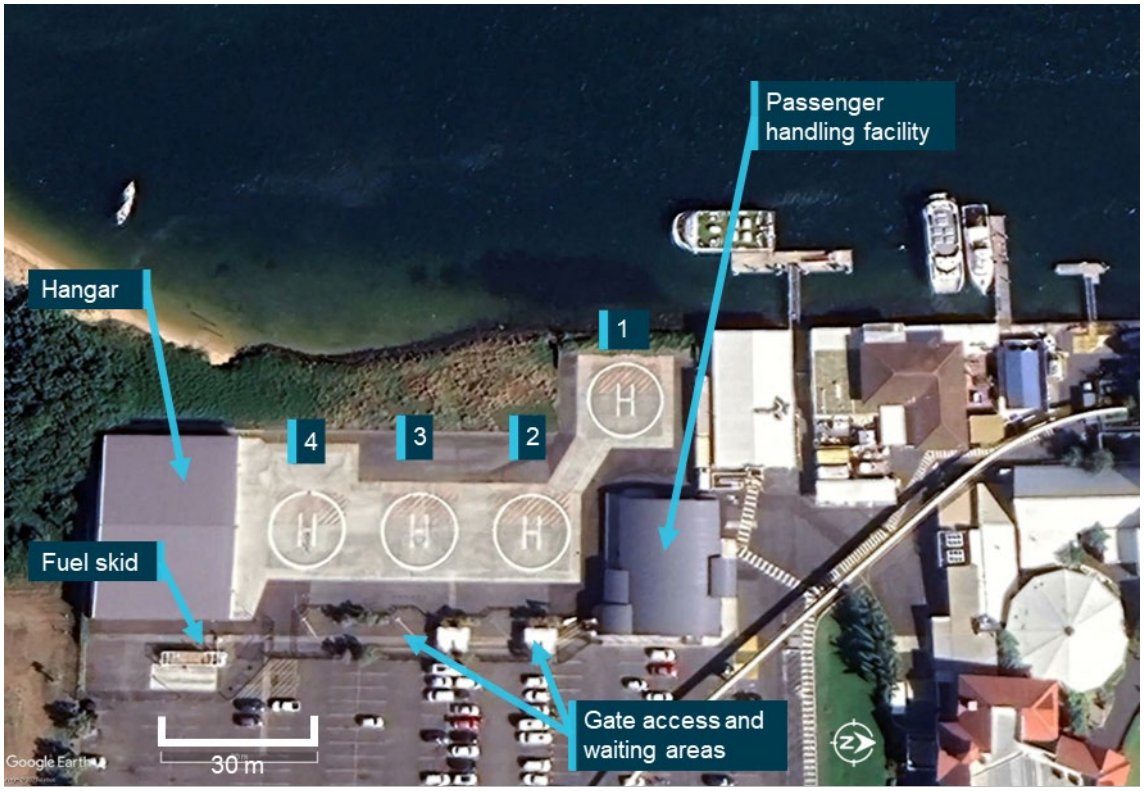
Operational information

There were two helipad facilities in use at Sea World on the day of the accident. The heliport adjacent the Sea World theme park, and the 'park pad' a helipad located within the Sea World theme park. High density public spaces flanked each facility on the eastern side, meaning departures and approaches almost exclusively had a westerly component. Winds are predominantly from the southeast at that location.

Sea World Heliport

The heliport at Sea World was redeveloped and opened as a main base of operations in November 2019. The design provided for 4 independent helicopter stands with individual gate access and passenger waiting areas (Figure 26). Passenger handling facilities were designed around passenger handling flow. Calibrated scales were set into the floor at four counters where passengers were processed before being directed to a waiting area or briefing room. The briefing room had video briefing in several languages, and led directly to the walkway to the helipads, where passengers would be accompanied by ground crew for loading into the helicopters.

Figure 26: Sea World Heliport

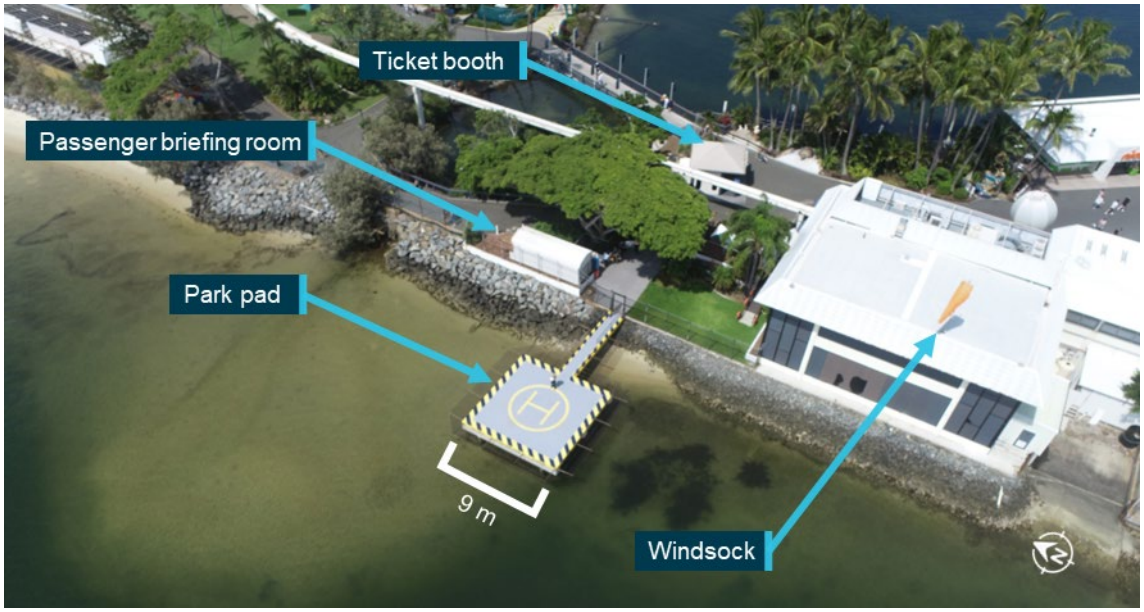


Source: Google Earth, annotated by the ATSB

Park pad

The park pad (Figure 27) was located within the Sea World theme park, and had a ticket booth and passenger handling facilities to capture walk-in sales from theme park visitors. The passenger handling process was replicated from the main heliport, however refuelling was conducted at pad 4 at the main heliport.

Figure 27: Park pad



Source: ATSB

Traffic flow

Neither the heliport or the park pad were certified aerodromes, nor were they required to be.

Any location that meets CASR 91.410 (notwithstanding any applicable local laws) can be used as an aerodrome. The Civil Aviation Safety Authority's (CASA) guidelines for helicopters in AC 91-29 v1.1 (2022) *Guidelines for helicopters - suitable places to take off and land*, stated that:

> 2.2.1 Regulation 91.410 authorises a place for use as an aerodrome if it is suitable for the landing and taking-off of aircraft and that the aircraft can land at or take off from the place safely, having regard for all of the circumstances of the proposed landing or take off including the prevailing weather conditions.

The operator published approach and departure tracks for Sea World heliport in an annex to their aircraft operations manual (Figure 28). Paths for approach and departure from the park pad were not included.

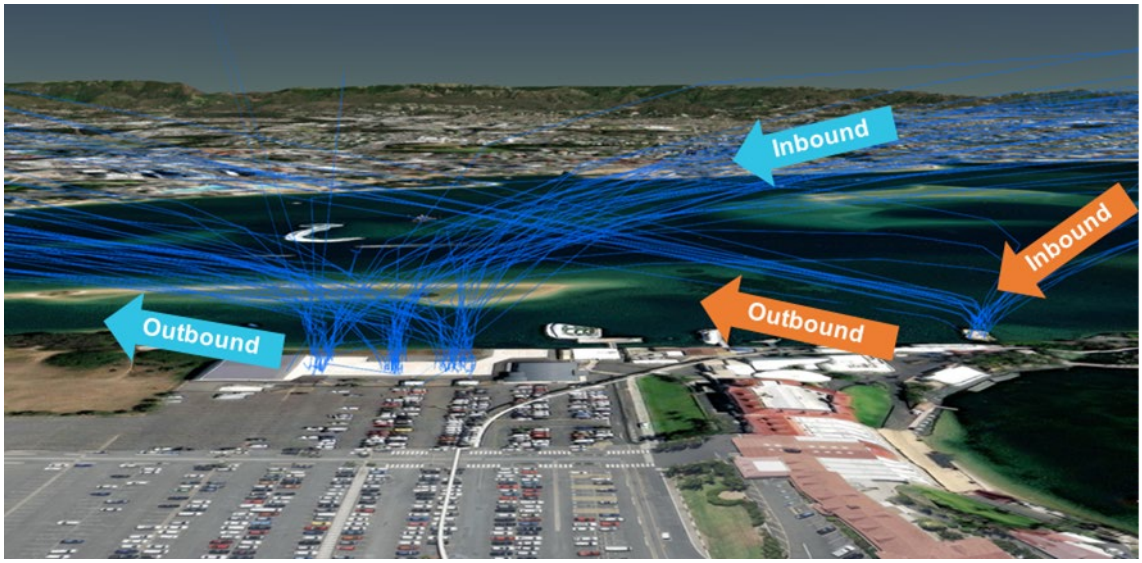
Figure 28: Operator's declared Sea World heliport approach and depart paths

Source: Operator

Historic tracking data of helicopters in the scenic flight operation was obtained by the ATSB and analysis is continuing.

Analysis of tracking data for flights conducted from 26 December 2022 to 2 Jan 2023 in XH9, XKQ and one of the operator's AS350 helicopters showed that intersecting paths flown to and from the helipads had no vertical or horizontal separation at the point where the helicopters collided (Figure 29). The operator stated that the intersecting flight paths conducted at Sea World were controlled through communication and rules of the air as at any aerodrome with intersecting runways.

Figure 29: Traffic flow to and from the park pad and heliport 26 December 2022 to 2 Jan 2023



Source: ATSB

CASA post-accident review

Following the accident, as the pilot of XKQ was the operator's chief pilot, a key position for the AOC, all Part 119 and Part 138 operations were suspended. The operator appointed a new chief pilot and completed their transition to Part 133. They also created a new definition of the role of 'Pad Boss' specifically to ensure that aircraft separation was maintained.

Following a review, CASA advised the ATSB that:

> Sea World Helicopters (SWH) was permitted to recommence operations at the discretion of the HOFO / HOTAC once he was satisfied that all training of pilots and new processes had been completed.
>
> CASA is satisfied that the amendments to the base operating procedures will provide suitable separation in both time and distance, between arriving and departing helicopters. A position of "Pad Boss" has been created specifically to ensure that this separation is maintained.

Scenic flight operations resumed on 4 April 2023.

Operator's flight procedures

Lighting on the EC130 helicopters was stipulated in the Operator's *Flight Crew Operations Manual* at 3.1.2

> 3.1.2 Unless stated otherwise in the FLM or specific circumstances are present, the following procedures shall be applied:
>
> …
>
> b) Anti-collision beacons shall be left ON at all times, even after shut down to warn of accidental battery activation;
>
> c) Strobe lights and Nav lights are to be activated before start and deactivated after shut down;
>
> d) Landing lights shall be ON prior to departure and OFF once aircraft has landed;
>
> ...

Lighting and lookout was in the Operator's *Aircraft Operations Manual* at 7.15:

> **7.15 Maintenance of Look-out and use of external lights –**

7.15.1 PIC's are to maintain a constant look-out at all times. Before departure, PIC's will ensure strobes and landing lights are switched on.

Collision avoidance procedures were also carried in the Operator's *Aircraft Operations Manual* at 7.6:

7.6 Collision Avoidance

7.6.1 The responsibility for collision avoidance, sequencing, and knowledge of local procedures lies solely with the PIC.

Later in the aircrew operations manual traffic collision avoidance devices (TCAD) are discussed:

7.10 TCAD

7.10.1 Pilots are to use the TCAD equipment where supplied for collision avoidance in all phases of flight. Pre landing checks should include reference to the TCAD to ensure path clearance.

Radio procedures were discussed in the *Flight Crew Operations Manual* at 2.3.5:

2.3.5 The pilot in command shall ensure that a listening watch is maintained at all times from immediately prior to the time at which the helicopter commences to move for a flight until the helicopter stops on the apron after a flight, or in the case of communicating with an ATC unit, the pilot shall personally maintain a listening watch at all times the helicopter is under control of that ATC unit. Pilots shall use the radio telephony procedures and phases detailed in the AIP.

Radio procedures were also detailed in the *Aircrew operations manual* at 9.2 and 9.3:

9.2 Position Reporting

9.2.1 The PIC should make a Position Report including location-altitude and intentions, at each turning point, reporting point of when in the vicinity of a high traffic area. This call should be made on the relevant area frequency.

Communications at Non-controlled Aerodromes

9.2.2 When at or near a non-towered aerodrome the PIC shall check that the radio is on the correct frequency and listens to broadcasts. Under CAR166C, a radio broadcast is required whenever it is reasonably necessary to avoid a collision or the risk of a collision.

a) For minimum compliance, the PIC should broadcast their intentions:

- Before or during taxiing;
- Immediately before entering a runway, whether active or not;
- Inbound 10nm or earlier from the aerodrome immediately before joining the circuit;
- On a straight-in approach, on final, by 3nm from the threshold;
- On a base-join approach, before joining on base when flying near, but not intending to land at, a non-towered aerodrome, where the PIC intends to fly through the vicinity but not land;

b) When making radio calls state the name of the aerodrome, your aircraft's type, call sign and position, and your intention;

- Repeat the name of the aerodrome;
- Use standard phraseology and don't chat;

c) When flying VFR, identify yourself if you hear an IFR PIC intending to make an instrument approach;

d) As needed, make other broadcasts such as:

- Turning downwind base and final;
- Clear of runway.

There was no radio or separation procedure specific to the scenic flight operations. An ATSB review of recorded CTAF calls from previous flights and interviews with pilots showed that a taxi

call prior to lifting, a departure call over Sea World Grass, and an inbound call at Porpoise Point were standard calls for the operator's scenic flights.

Calls on short final or passing behind other helicopters were not standard or mandated by the written procedures. The operator's pilots reported using calls passing behind another helicopter on an as-required basis, based on the passing pilot's assessment of the requirement.

With respect to ensuring calls could be made and heard, the operator's *Aircraft Operations Manua*l carried instruction on a pre-flight radio check.

9.3 Pre-flight Radio Check

9.3.1 Refer to FLM.

The helicopter manufacturer's *Aircraft Flight Manual* for the EC130B4 made no reference to a pre-flight radio check. Operator pilots reported that on their first flight of the day they would check that other stations were receiving their transmissions by calling other aircraft or ground crew with access to an office-based VHF radio.

Safety action

Sea World helicopters

The operator reviewed their processes and procedures with reference to other high intensity operations undertaken by the group (such as aerial firefighting and low level power line operations). Following that review they implemented:

- a new position of 'Pad Boss' traffic advisory role
- air traffic systems added as supplement to each helicopter avionic system
- increased communication protocols for SWH pilots
- aircraft visibility
  - high intensity strobe lighting added to all SWH aircraft
  - Airbus strobe painting system added to main rotor blades
- introduction of mandatory human factors awareness course for all staff
- updated briefing videos and ground crew training on seatbelt fitment.

Figure 30: Pad boss oversighting helicopter departure

Source: ATSB

ATSB

Safety Advisory Notice AO-2023-001-SAN-001

On 20 September 2023 the ATSB release Safety Advisory Noticed AO-2023-001-SAN-001

It stated that:

> Constant wear lifejackets, including pouch style lifejackets, must not interfere with the proper fitment of aircraft seatbelts. It is imperative that seatbelts are fitted correctly. Not wearing a seatbelt, or wearing it improperly, can significantly increase the risk of serious or fatal injury in the event of an accident.

The SAN was directed at lifejacket manufacturers to advise them to provide guidance to aircraft operators on how to integrate their products with existing seatbelt restraint systems. It also called on certifying authorities to require lifejacket manufacturers to do so.

This accident highlights the risks associated with incorrect fitment of restraints. A significant number of ATSB investigations involving helicopters and small aeroplanes have identified safety factors associated with accident survivability. See also, Reducing the severity of injuries in accidents involving small aircraft.

Cockpit visibility study

The ATSB identified that a cockpit visibility study was required to determine what limitations or opportunities the pilots had to visually detect and avoid the other aircraft. A safety study was commenced (AS-2023-001) to examine visibility of both aircraft from the point of view of each pilot, and study what influence flight path, visual performance, aircraft structure and cabin configuration may have had. Additionally, it is examining the limitations or opportunities of sighting aircraft from the point of view of observers on the ground.

The study is looking at various facets of visibility:

- recreation of flight path data from video analysis
- recreation of viewing angles and opportunity from tracking data
- verification of video analysis and tracking data analysis against the results of each
- limitations of the human observer
- influence of the observer's environment
- conspicuity devices
- detection devices
- environmental influence on conspicuity devices.

Further investigation

To date, the ATSB has undertaken extensive work to understand and recreate the events of the day in order to identify and examine the context and risk controls that existed at the time.

The ATSB analysis framework looks at a hierarchy of factors arranged in their relative proximity to an event. The investigation so far has concentrated on elements closest to the event, which are individual actions, vehicle/equipment performance, local conditions, and risk controls. This has included:

- interviews with key personnel and witnesses
- examination of aircraft
- examination of aircraft maintenance logs
- examination of postmortem information and hospital records
- repair and examination of avionics
- review of industry understanding of seat belt fitment
- ADS-B and RADAR analysis
- CTAF recording analysis
- video analysis

Investigation into some of these areas is ongoing.

Improvements at a systemic level bring greater benefit than changes at the level of individual action. The next phase of the investigation will examine if there is any contribution or risk at a risk control and systemic levels, and will include:

- design of the operating environment
- design of operating procedures
- onboarding and implementation of aircraft
- drug and alcohol management
- change management
- regulatory environment and input.

Should a critical safety issue be identified during the course of the investigation, the ATSB will immediately notify relevant parties so appropriate and timely safety action can be taken.

A final report will be released at the conclusion of the investigation.

Acknowledgements

The ATSB thanks Marine Safety Queensland for support and provision of facilities and Queensland Police Service and the Queensland Coroner for their support in the recovery and protection of evidence vital to the investigation of this event.

General details

Occurrence details

Date and time:	2 January 2023 – 1356 EST	
Occurrence class:	Accident	
Occurrence categories:	Collision, Collision with terrain, Forced/ Precautionary landing	
Location:	24 km at 341° from Gold Coast Aerodrome, Queensland	
	Latitude: 27.9597° S	Longitude: 153.4253 E

Aircraft details – VH-XKQ

Manufacturer and model:	Airbus Helicopters EC130B4	
Registration:	VH-XKQ	
Operator:	Sea World Helicopters Pty Ltd	
Serial number:	4639	
Type of operation:	Part 133 Air transport operations - Rotorcraft-	
Activity:	Commercial air transport -Non-scheduled-Joyflights / sightseeing charters	
Departure:	Sea World helicopter landing area	
Destination:	Sea World helicopter landing area	
Persons on board:	Crew – 1	Passengers – 6
Injuries:	Crew – 1 fatal	Passengers – 3 fatal, 3 serious
Aircraft damage:	Destroyed	

Aircraft details – VH-XH9

Manufacturer and model:	Airbus Helicopters EC130B4	
Registration:	VH-XH9	
Operator:	Sea World Helicopters Pty Ltd	
Serial number:	3845	
Type of operation:	Part 133 Air transport operations - Rotorcraft-	
Activity:	Commercial air transport -Non-scheduled-Joyflights / sightseeing charters	
Departure:	Sea World helicopter landing area	
Destination:	Sea World helicopter landing area	
Persons on board:	Crew – 1	Passengers – 5
Injuries:	Crew – 1 serious	Passengers – 2 serious, 3 minor
Aircraft damage:	Substantial	

Glossary

AC	Advisory Circular
ACAS	Airborne Collision Avoidance System
ADS-B	Automatic Dependent Surveillance-Broadcast
AGL	Above Ground Level
AHRS	Attitude and Heading Reference System
AIP	Aeronautical Information Package
AOC	Air Operator's Certificate
AOD	Alcohol and Other Drugs
AVTUR	Aviation Turbine fuel
CAO	Civil Aviation Order
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulations
CTAF	Common Traffic Advisory Frequency
DAMP	Drug and Alcohol Management Plan
EAM	Eastern Aero Marine
ERSA	En-Route Supplement Australia
EST	Eastern Standard Time
FAA	Federal Aviation Administration (United States)
FATO	Final Approach and Take Off area
FAR	Federal Aviation Regulations (United States)
GNSS	Global Navigation Satellite System
HAAMC	Head of Aircraft Airworthiness and Maintenance Control
HOFO	Head of Flight Operations
HOO	Head of Operations
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
NZ	New Zealand
OAR	Office of Airspace Regulation
OM	Operations Manual
QLD	Queensland, Australia
QPS	Queensland Police Service
SAN	Safety Advisory Notice
SIN	Safety Information Notice (Airbus)
SMS	Safety Management System
SMSM	Safety Management System Manual

SSAA	Safety Sensitive Aviation Activities
SSR	Secondary Surveillance Radar
TA	Traffic Advisory
TAS	Traffic Advisory System
TCAD	Traffic Collision Avoidance Device
TCAS	Traffic Collision Avoidance System
TSO	Technical Standard Orders (United States)
TTIS	Total Time in Service
VFR	Visual Flight Rules
VRTP	Village Roadshow Theme Parks

Australian Transport Safety Bureau

About the ATSB

The ATSB is an independent Commonwealth Government statutory agency. It is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers.

The ATSB's purpose is to improve the safety of, and public confidence in, aviation, rail and marine transport through:

- independent investigation of transport accidents and other safety occurrences
- safety data recording, analysis and research
- fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia, as well as participating in overseas investigations involving Australian-registered aircraft and ships. It prioritises investigations that have the potential to deliver the greatest public benefit through improvements to transport safety.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, international agreements.

Purpose of safety investigations

The objective of a safety investigation is to enhance transport safety. This is done through:

- identifying safety issues and facilitating safety action to address those issues
- providing information about occurrences and their associated safety factors to facilitate learning within the transport industry.

It is not a function of the ATSB to apportion blame or provide a means for determining liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner. The ATSB does not investigate for the purpose of taking administrative, regulatory or criminal action.

Terminology

An explanation of terminology used in ATSB investigation reports is available on the ATSB website. This includes terms such as occurrence, contributing factor, other factor that increased risk, and safety issue.