Aviation inquiry 10-007:
Boeing 737-800, ZK-PBF and Boeing 737-800, VH-VXU, airspace incident,
near Queenstown Aerodrome, 20 June 2010

The Transport Accident Investigation Commission is an independent Crown entity established to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future. Accordingly it is inappropriate that reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

The Commission may make recommendations to improve transport safety. The cost of implementing any recommendation must always be balanced against its benefits. Such analysis is a matter for the regulator and the industry.

# Final Report

10-007
Boeing 737-800, ZK-PBF and
Boeing 737-800,VH-VXU
airspace incident
near Queenstown Aerodrome
20 June 2010

Approved for publication: 13 March 2012

# Transport Accident Investigation Commission

## About the Transport Accident Investigation Commission

The Transport Accident Investigation Commission (the Commission) is an independent Crown entity responsible for inquiring into maritime, aviation and rail accidents and incidents for New Zealand, and co-ordinating and co-operating with other accident investigation organisations overseas. The principal purpose of its inquiries is to determine the circumstances and causes of occurrences with a view to avoiding similar occurrences in the future. Its purpose is not to ascribe blame to any person or agency or to pursue (or to assist an agency to pursue) criminal, civil or regulatory action against a person or agency. The Commission carries out its purpose by informing members of the transport sector, both domestically and internationally, of the lessons that can be learnt from transport accidents and incidents.

## Commissioners

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|---|---|
| Chief Commissioner | John Marshall, QC |
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| Commissioner | Captain Bryan Wyness |
| Assessor | Pat Scotter |

## Key Commission personnel

| | |
|---|---|
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# Important notes

## Nature of the final report

This final report has not been prepared for the purpose of supporting any criminal, civil or regulatory action against any person or agency. The Transport Accident Investigation Commission Act 1990 makes this final report inadmissible as evidence in any proceedings with the exception of a Coroner's inquest.

## Ownership of report



## Citations and referencing

Information derived from interviews during the Commission's inquiry into the occurrence is not cited in this final report. Documents that would normally be accessible to industry participants only and not discoverable under the Official Information Act 1980 have been referenced as footnotes only. Other documents referred to during the Commission's inquiry that are publicly available are cited.

## Photographs, diagrams, pictures

Unless otherwise specified, photographs, diagrams and pictures included in this final report are provided by, and owned by, the Commission.


Source: mapsof.net

Location of incident

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## Abbreviations

| | |
|---|---|
| AIP | Aeronautical Information Publication New Zealand |
| Airways | Airways Corporation of New Zealand |
| ATC | air traffic control |
| CAA | Civil Aviation Authority |
| Commission | Transport Accident Investigation Commission |
| Director | Director of Civil Aviation |
| ft | foot/feet |
| ICAO | International Civil Aviation Organization |
| IFR | instrument flight rules, or an aircraft being operated under those rules |
| Pacific Blue | Pacific Blue Airlines |
| PANS-OPS | ICAO Procedures for air navigation services – aircraft operations |
| Qantas | Qantas Airways |
| RNAV | area navigation |
| RNP | required navigation performance |
| UTC | coordinated universal time |
| VFR | visual flight rules, or an aircraft being operated under those rules |
| VOR/DME | very high frequency omni range / distance measuring equipment |

## Glossary

| | |
|---|---|
| altitude | height above mean sea level expressed in ft |
| area navigation | a navigation method that permits aircraft operation on any desired flight path within the coverage of ground or space-based navigation aids, or within the capability of self-contained aids, or a combination of these |
| circling | an extension of an instrument approach procedure that provides for visual manoeuvring around an aerodrome to align ane aircraft with the runway |
| configuration | the position of (typically) the flaps and the landing gear; e.g., whether they are extended or retracted |
| elevation | the vertical distance of a point or a level, on or fixed to the surface of the Earth, measured from mean sea level |
| fix | a geographical position |

| | |
|---|---|
| instrument approach procedure | a series of predetermined manoeuvres by reference to flight instruments with specified protection from obstacles, from the initial approach fix to a point from where a landing can be completed, and thereafter, if a landing is not completed, to a position at which holding or enroute obstacle clearance criteria apply |
| instrument flight rules | prescribed operating procedures for a flight that is piloted solely by reference to instruments |
| lateral | to the side |
| minima | the minimum meteorological conditions required, usually stated in terms of the height of the cloud base and the flight visibility |
| minimum descent altitude | a specified altitude in a non-precision approach or circling approach below which descent may not be made without the required visual reference |
| missed approach point | that point in an instrument approach procedure at or before which the prescribed missed approach procedure must be initiated in order to ensure that the minimum obstacle clearance is not infringed |
| non-precision approach | an instrument approach procedure that uses lateral guidance but not vertical guidance |
| orbit | fly a circular or race-track pattern at a constant altitude |
| protected | in regard to the missed approach, means ATC has ensured that traffic separation will continue in the event that the subject aircraft flies the missed approach. Protection of the missed approach procedure would remain in place until the aircraft carrying out the approach has landed |
| required navigation performance | a statement of the navigation performance accuracy necessary for operation within a defined airspace |
| separation | the spacing of aircraft to achieve their safe movement in flight and while taking off and landing. This is achieved by the controller applying vertical, horizontal or visual separation. Horizontal separation is achieved by applying longitudinal, lateral, geographical or radar separation |
| threshold | the beginning of that portion of the runway useable for landing |
| visual flight rules | prescribed operating procedures for flight in visual meteorological conditions |
| visual meteorological conditions | weather equal to or better than minima specified in terms of visibility, distance from cloud, and cloud ceiling |
| waypoint | a specified geographical position used to define an area navigation route |

## Data summary

### Aircraft particulars

| | | |
|---|---|---|
| Aircraft registration: | ZK-PBF | VH-VXU |
| Type: | Boeing 737-800 | Boeing 737-800 |
| Operator: | Pacific Blue Airlines (Pacific Blue) | Qantas Airways (Qantas) |
| Type of flight: | scheduled domestic passenger | scheduled international passenger |
| Persons on board: | 88 | 162 |
| Pilot's total flying experience: | 18 790 hours | not requested |

| | |
|---|---|
| Date and time | 20 June 2010, 1345[1] |
| Location | vicinity of Queenstown Aerodrome<br>latitude: 45° 01.3´ south<br>longitude: 168° 44.3´ east |
| Injuries | nil |
| Damage | nil |

[1] Times in this report are in New Zealand Standard Time (UTC+12 hours) and expressed in the 24-hour mode.

# 1. Executive summary

1.1. On 20 June 2010, a Boeing 737-800 aeroplane operated by Pacific Blue was being flown on a conventional instrument approach to Queenstown Aerodrome. When making an instrument approach, pilots must see the runway before they may descend below the minimum descent altitude and they must maintain visual reference with the runway until landing. If visual reference is lost, they must execute a missed approach procedure.

1.2. Because of the mountainous terrain, the minimum descent altitude for the conventional instrument approach to Queenstown is about 3500 feet above the aerodrome. The terrain prevents pilots descending straight ahead from the minimum altitude and landing. Instead, they must circle while descending until their aircraft is in a position to land.

1.3. When the Pacific Blue aeroplane arrived at the minimum descent altitude, the pilots could see lower cloud in the Queenstown basin, but the runway was clear. However, because low cloud patches would have obstructed their manoeuvring to the final approach for runway 23, the pilots reported to air traffic control (ATC) that they would attempt to land on the reciprocal runway 05.

1.4. Meanwhile the controller had cleared another Boeing 737-800 aeroplane operated by Qantas to begin an approach behind Pacific Blue. The Qantas pilots were flying a 'required navigation performance' approach based on global navigation satellite system technology, which allowed them to descend to a much lower minimum altitude. At the time, Pacific Blue had not applied to the Civil Aviation Authority (CAA) for authorisation to use that technology. The controller cleared Qantas for its approach based on an expectation that the Pacific Blue pilots, having commenced circling, would land or, if unable to land, would remain in the aerodrome visual circuit.

1.5. Lower cloud was likely to have prevented the Pacific Blue pilots maintaining visual contact with runway 05, so they discontinued the circling and climbed directly to intercept the prescribed missed approach track for the instrument procedure they had flown. They had not planned to enter or remain in the visual circuit as the controller had expected and, because of their position when they commenced the climb, probably could not have done so because of their proximity to terrain.

1.6. The controller then instructed Qantas to conduct the missed approach for its procedure and at the maximum rate of climb, in order to maintain separation from the Pacific Blue aeroplane. The Queenstown ATC tower has no radar facility, because the surrounding mountains are incompatible with that.

1.7. The Transport Accident Investigation Commission (Commission) did not investigate further whether the minimum required 1000 ft vertical separation between the 2 aeroplanes was breached, because it was clear that the potential for such a breach was high and that alone was a safety issue that needed addressing.

1.8. The Commission's **key findings** addressed the following issues:

- the weather conditions were not suitable for Pacific Blue to descend below the minimum descent altitude
- the air traffic controller had not ensured that the required minimum separation would be maintained between the 2 aeroplanes
- the Pacific Blue pilots and the air traffic controller had different understandings of what would occur in the event Pacific Blue did not land after circling
- the various publications used by pilots and controllers that described instrument approach procedures and circling procedures were not consistent, which was a hazard likely to lead to misunderstandings between pilots and air traffic controllers
- the circling manoeuvring that is required after a non-precision approach at Queenstown is a demanding procedure that ought to be reviewed for suitability

- a wider review of the Queenstown air traffic management system and operational procedures would be prudent, given the special features associated with operations at the aerodrome and the increasing number of commercial jet aeroplane operations.

1.9. The Commission made **recommendations** to the Director of Civil Aviation (the Director) that he:

- ensure that the current development of a strategic plan for air traffic management and the risk assessment of Queenstown flight operations address the safety issues identified in this report
- eliminate the use of similar titles for different instrument approach procedures to the same runway
- require the procedural and compliance aspects of non-precision approaches at Queenstown to be re-evaluated
- ensure that common operational material published by different organisations be accurately reproduced from the source documents
- require a system to be installed to provide controllers with real-time observations of the weather conditions behind Deer Park Hill.

1.10. The Commission identified the following **key lessons** in this inquiry:

- a pilot must not descend below the applicable instrument approach minimum descent altitude unless certain that the conditions are suitable for a landing
- pilots must understand the operational assumptions in the design of instrument approach procedures, and how those assumptions determine the limits of safe manoeuvring
- organisations that re-publish mutually important operational information from authoritative sources must ensure that the information is accurately reproduced so that all users interpret the information correctly and apply it consistently.

## 2. Conduct of the inquiry

2.1. On 21 June 2010, the CAA notified the Commission of this incident. An inquiry was opened that day.

2.2. The investigator in charge interviewed the Pacific Blue pilots and senior operational managers of the airline at its Christchurch head office in June 2010, and a further meeting was held with Pacific Blue management in August 2010.

2.3. The involved ATC staff were interviewed at Queenstown Aerodrome in June 2010. Relevant ATC data was reviewed at Queenstown and at the Airways Corporation of New Zealand (Airways) national centre at Christchurch.

2.4. Recorded flight data was obtained from both airlines and analysed with the assistance of the Australian Transport Safety Bureau. The details of the Qantas pilots were not obtained because their aeroplane was incidentally involved.

2.5. Three meetings were held with representatives of the CAA and Airways during the inquiry, and a preliminary draft was reviewed by an independent air traffic safety specialist.

2.6. On 14 December 2011, the Commission approved the circulation of a draft final report to interested persons for their comment. Submissions were received from the captain and first officer of the Pacific Blue aeroplane, Pacific Blue Airlines (the name of which was changed to Virgin Australia Airlines (NZ) Limited in 2011), Airways and the CAA. Their submissions were considered in preparing the final report.

2.7. The Queenstown Airport Corporation reviewed the draft final report and did not make a submission.

2.8. On 13 March 2012 the Commission approved the publication of the report.

# 3. Factual information

## 3.1. Instrument approach procedures – general description

3.1.1. An instrument approach is a series of predetermined manoeuvres for the orderly transfer of an aircraft operating under instrument flight rules (IFR) from the beginning of the initial approach to landing. The procedure design provides specified clearance from terrain and obstacles.

3.1.2. There are 2 main types of instrument approach procedure – non-precision and precision. A non-precision approach provides lateral course guidance only and the pilot controls the height of the aircraft to be at or above certain altitudes at certain points along the course. Non-precision approaches may involve aircraft having to manoeuvre or circle after reaching the minimum descent altitude in order to align with the runway. This requires the pilot to have visual reference with the runway and the surrounding terrain.

3.1.3. A precision approach allows the pilot to fly a more exact approach path, because vertical guidance is given as well. This brings the aircraft lower and closer to the runway before reaching the minimum altitude. At the end of a precision approach the aircraft will be aligned with the runway for a 'straight-in' landing.

3.1.4. The instrument approach procedures are depicted on 'approach charts' that show the prescribed altitudes and tracks to be flown, as well as obstacles and some terrain. In addition, they show the missed approach procedure to be flown if the aircraft does not land.

3.1.5. An aircraft's vertical position is normally referenced to altitude. The approach minimum descent altitude is the lowest altitude to which a pilot may descend before acquiring the required visual reference to make a safe landing. If the required visual reference is not achieved by the missed approach point, or cannot be maintained after that point, the missed approach procedure must be flown (see Figure 1).

3.1.6. For a particular type of approach procedure, the minimum descent height above an aerodrome varies according to the height and proximity of the terrain and obstacles surrounding the aerodrome. For example, an approach to an aerodrome located on an extensive Tibetan plateau will have a higher minimum descent altitude, because Tibet is well above sea level, but could have a much lower minimum descent height than a similar type of approach to an aerodrome like Queenstown, which is closer to sea level but closely surrounded by high mountains (see Figure 2).

3.1.7. Circling to land is considered more difficult and is statistically less safe than a straight-in landing. This is because the aircraft will normally be at a low height above the aerodrome and must remain within a specified distance from the runway in order to be assured of obstacle clearance while maintaining the minimum descent altitude. The procedure assumes that the pilot will maintain visual contact with the runway while circling. If visual contact is lost, the pilot must immediately carry out the published missed approach procedure, but is assured of terrain clearance by being within the circling area and above the minimum descent altitude.

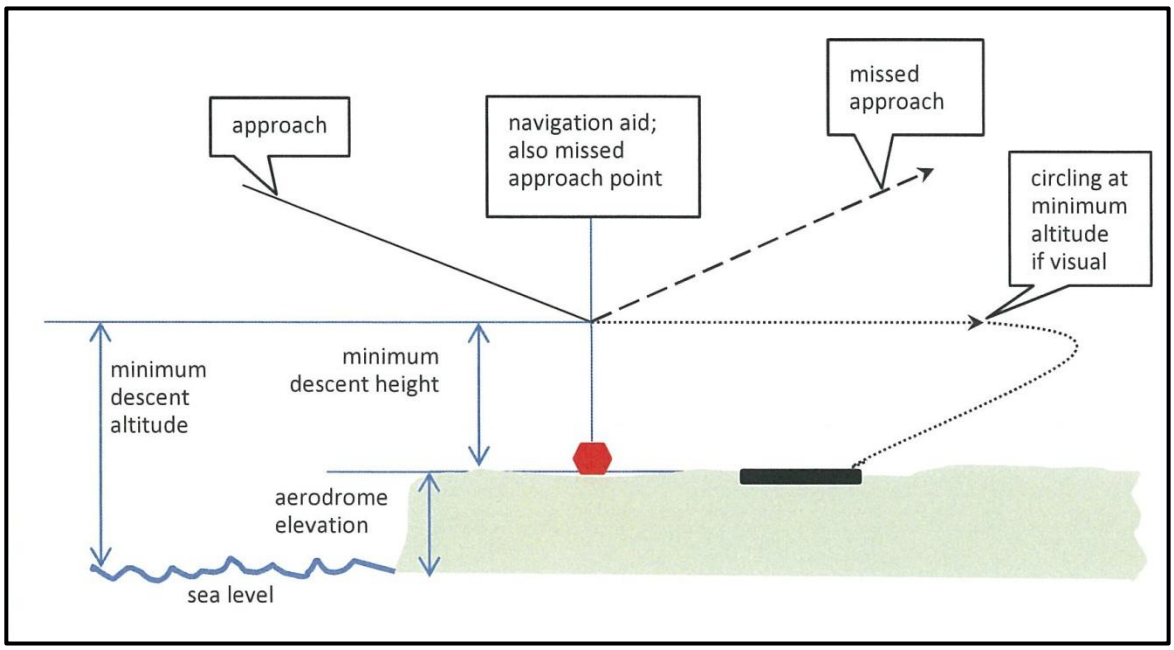


Figure 1
Key terms in an instrument approach

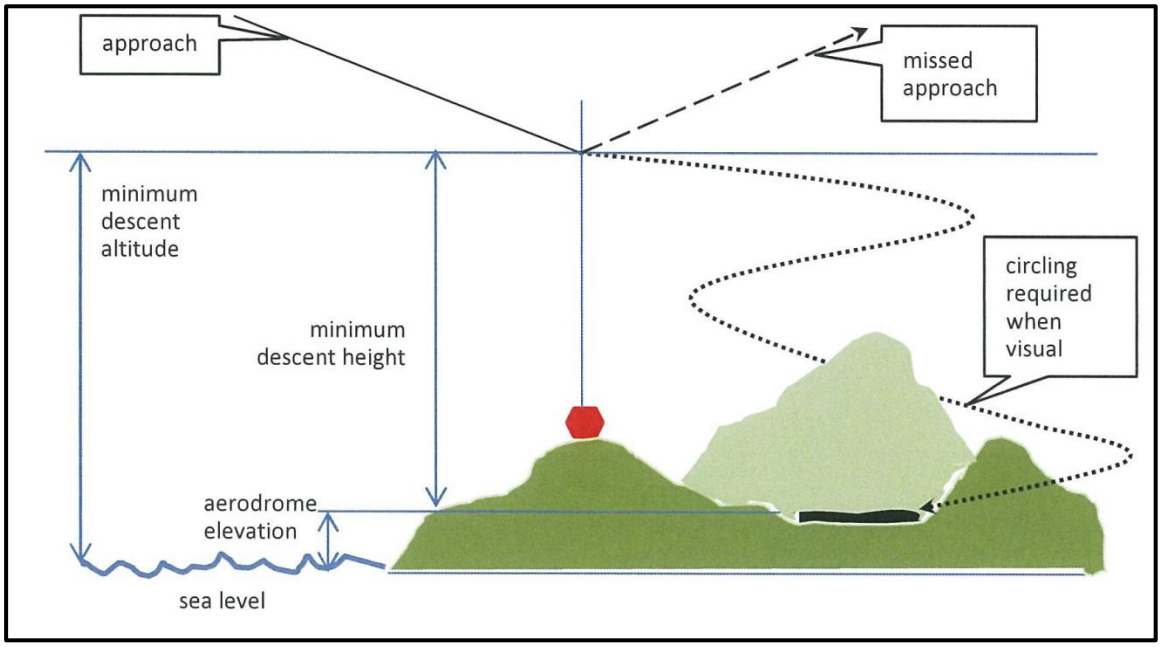


Figure 2
Example of instrument approach in mountainous terrain

## 3.2. History of the flights

3.2.1. On 20 June 2010, a Boeing 737-800 aeroplane, registered ZK-PBF and operated by Pacific Blue, was used on a scheduled service from Auckland to Queenstown. On board were 6 crew members and 82 passengers. The flight was conducted under IFR and the captain was the pilot flying, as required by the operator's procedures for Queenstown flights.

3.2.2. The air traffic controller was under training and being supervised by an instructor. The controller cleared the flight to conduct the VOR/DME (very-high-frequency omni-range/distance measuring equipment) 'ALFA' instrument approach procedure, circling for runway 23 (see Figures 3 and 4).[2] The reported meteorological conditions at Queenstown included cloud patches at 1000 ft, the cloud base at 5000 ft and visibility of 40 kilometres, above the airline's requirement of 10 kilometres.[3] The pilots considered that the conditions were 'a bit marginal' and had discussed the published procedure in case they could not land and had to carry out a 'missed approach'. However, the controller had earlier indicated twice that they would become visual and should be able to land.

3.2.3. The pilots made visual contact with the terrain when about 500 ft above the procedure minimum descent altitude of 4700 ft, which was approximately 3500 ft above the aerodrome elevation. The captain said that they saw the hill tops in the Lake Hayes basin, the Frankton Arm of Lake Wakatipu and the airport, and that there was low cloud close to the threshold (approach end) of runway 23.

3.2.4. The flight continued to descend to the minimum descent altitude then orbited at that altitude while the pilots reassessed the extent of the cloud in relation to their approach to runway 23.

3.2.5. At the same time, another Boeing 737-800, registered VH-VXU and operated by Qantas, was inbound to Queenstown from Sydney with 6 crew members and 156 passengers on board. This flight was also operating under IFR and its pilots had estimated they would land about 5 minutes after Pacific Blue. Qantas had been cleared previously to descend to 12000 ft on the 'RNP [required navigation performance] ZULU approach runway 23', but this was amended to the 'RNP ZULU approach runway 05' (see Figure 5).[4] QANTAS estimated that the aeroplane would be at position 'Coronet', a few miles northwest of the VOR/DME station, at 1345.[5]

3.2.6. At about this time, 2 radio transmissions were made together, one of which might have been Pacific Blue reporting visual contact. After Pacific Blue had commenced manoeuvring below the instrument procedure minimum descent altitude, the pilots saw that the low cloud near the threshold to runway 23 was more extensive than they had previously thought. The controller could not see the aeroplane, which was overhead at that stage, and asked the pilots if they were now circling for runway 05, but was told they were still circling for runway 23.

3.2.7. The controller then cleared Qantas for the 'RNP ZULU approach runway 05' and to 'descend in accordance with the profile'. This meant Qantas was cleared to descend to the minimum altitude for that approach, which was 2183 ft or lower, depending on the specific capability of that flight.

3.2.8. Twenty seconds later, Pacific Blue advised it would now track overhead the aerodrome and 'try' an approach to runway 05. It did not request a revised clearance to the different runway, as it should have done, and ATC did not explicitly re-clear it. The pilots then asked ATC about the cloud to the south and over the Frankton Arm, because they found it difficult to discern the height of the cloud tops, and were told the cloud was quite thick to the south but the Frankton Arm looked clear.

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[2] The runway designation is the magnetic heading in the take-off direction, rounded to the nearest 10 degrees.

[3] The cloud base is the height above ground of the lowest layer of cloud covering more than half the sky. By convention, the units are feet.

[4] The correct approach titles and correct radiotelephony references were 'RNAV [area navigation] approach runway ...' (International Civil Aviation Organization (ICAO) (2006b), Part III, s.5, para. 1.4.2.5). RNP referred to Qantas being specially approved for approaches with much lower minima than the VOR/DME approach.

[5] By convention, the units for flight procedure distances are nautical miles. One nautical mile is approximately 1.85 kilometres.

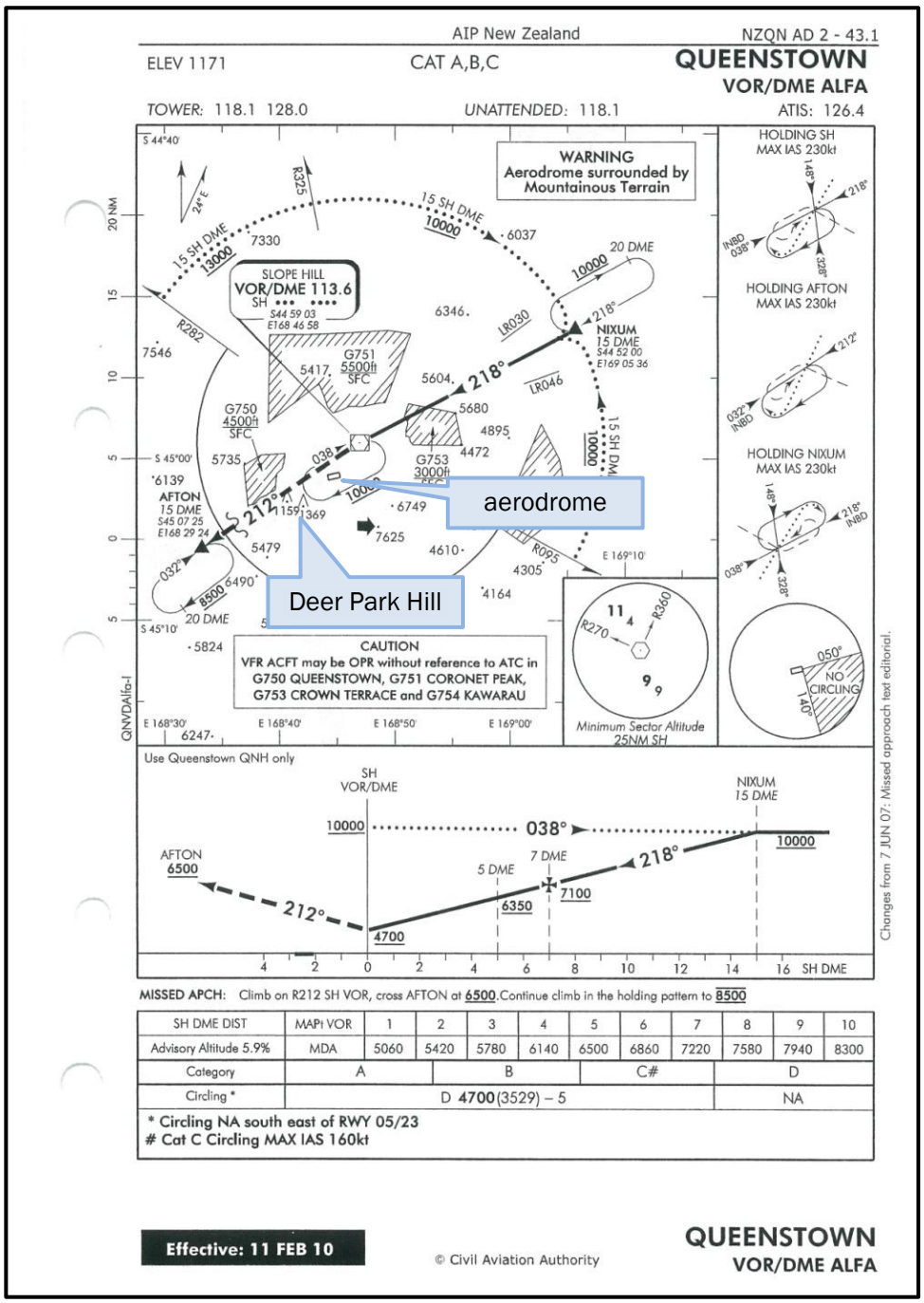


Figure 3
Approach flown by Pacific Blue
(All approach and aerodrome figures are from Aeronautical Information Publication New Zealand)

3.2.9. ATC was required to separate IFR flights in the Queenstown airspace, but as the Queenstown facility was not equipped with radar, other vertical and horizontal separation procedures were applied. The controller expected Pacific Blue to land off the circling approach or, if it did not land, to join the large aircraft figure-8 visual circuit at 4000 ft (see Figure 6).[6] The controller then instructed Qantas to report passing 6000 ft, which she anticipated would occur when Qantas was near Coronet. Her plan was that if Pacific Blue had not landed or had joined the visual circuit when Qantas made the report, she would instruct Qantas to carry out a missed approach in order to maintain at least 1000 ft vertical separation.

3.2.10. The controller advised Qantas that it might have to conduct a missed approach because Pacific Blue was unable to land on runway 23 and was now circling for runway 05. The Qantas pilots advised that in that event they would divert to Christchurch. The controller later

[6] Incorrect references to 'height' in the reproduced figure were later corrected by the publisher.

explained that the gap between the estimated times of arrival of the flights had been about 5 minutes, but had reduced because Pacific Blue had orbited and would now have to back-track on the runway after landing, in order to reach the terminal taxiway. This would have delayed the Qantas landing.

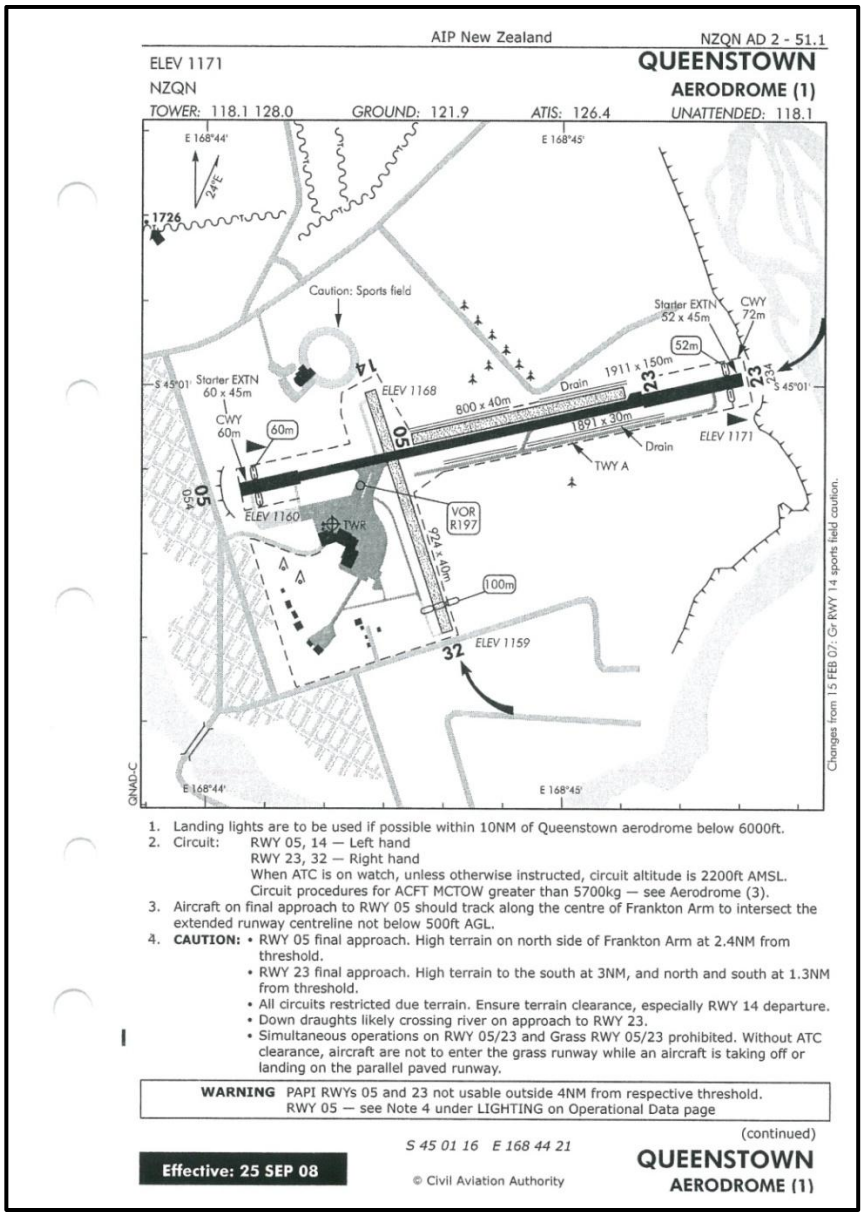


Figure 4
Queenstown Aerodrome layout

3.2.11. 'Deer Park Hill' was a hill immediately south of the aerodrome. After Pacific Blue had flown overhead the aerodrome and turned to go behind Deer Park Hill, the pilots saw that they would likely lose visual contact with the runway because of low cloud. At 1345 they advised ATC that they had commenced a missed approach and were tracking to position AFTON, the missed approach holding point 15 miles from the VOR/DME.

3.2.12. The controller acknowledged the report and stated, 'For separation, remain visual if able.' The Pacific Blue pilot said 'We'll do our best. [We are] intercepting the 212 radial' (the published missed approach track). The controller then asked the pilot if he could join the figure-8 circuit, but he repeated that the flight was intercepting the 212 radial and was clear of terrain. The controller immediately instructed the Qantas flight to commence a missed approach with the best rate of climb. The instructor controller then took over from the trainee.

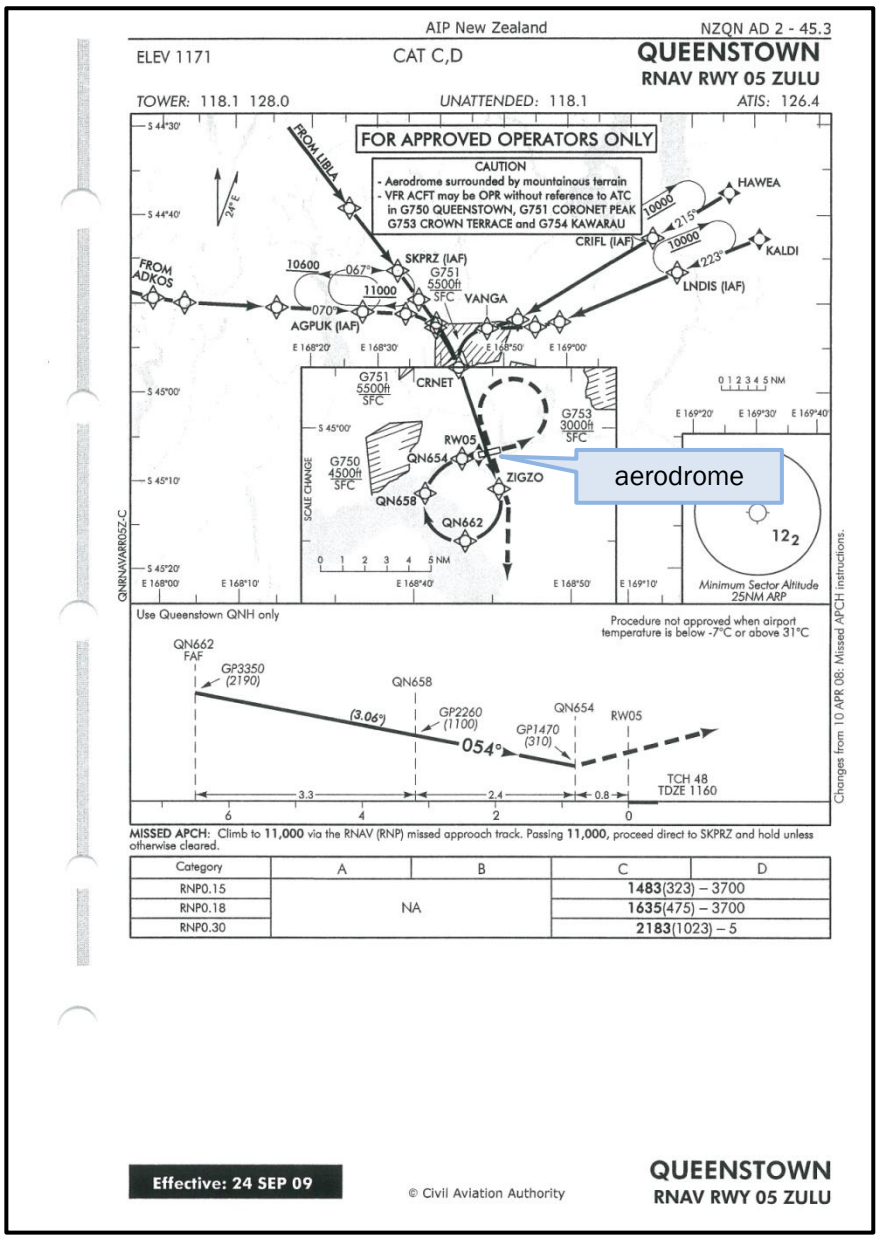


Figure 5
Approach flown by Qantas

3.2.13. The Pacific Blue pilots told ATC that they 'could not maintain visual contact in the basin above about 5000 or 6000 feet'. The captain said later that had ATC instructed them beforehand to fly the figure-8 circuit, they might have been able to comply, but having commenced the missed approach it would have been difficult to turn right without getting too close to terrain. However, they intercepted and flew the missed approach track before they entered cloud.

3.2.14. Pacific Blue was not authorised for the same high-precision approaches as Qantas, so its pilots did not know all of the positions referred to by ATC and Qantas, and were concerned initially that Qantas might be on an approach that came over the lake in the opposite direction to the missed approach track they were flying.[7] At one point the Pacific Blue pilots observed a target on their traffic display, a couple of miles behind and 800 ft or 900 ft above them.[8] The collision avoidance systems fitted to the aeroplanes did not generate any traffic advisories or warnings.

[7] This was the similarly named 'RNAV runway 05' approach.

[8] The traffic display was part of the Airborne Collision Avoidance System, equipment that was mandatory for aeroplanes of this size.

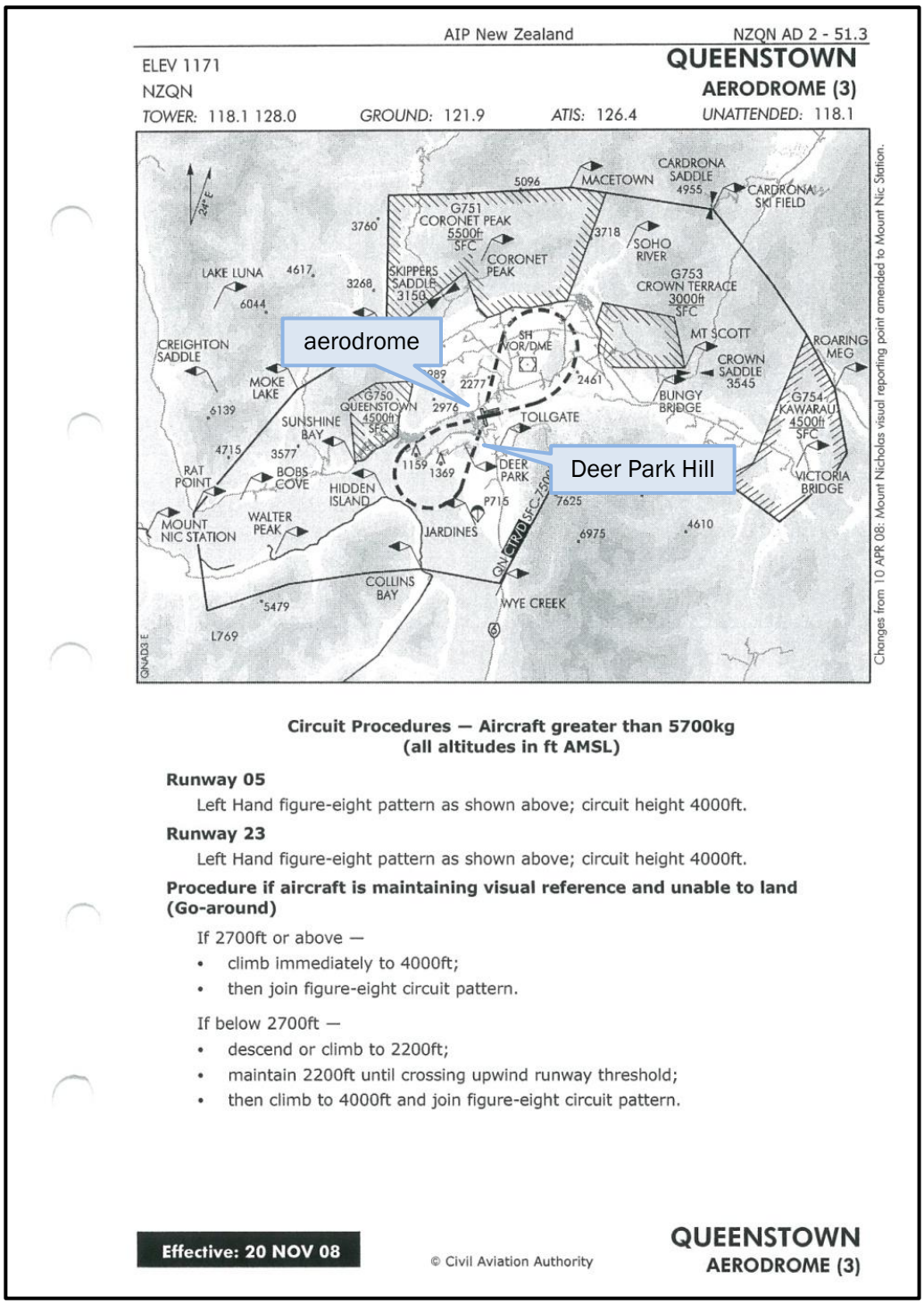


Figure 6
Visual circuit for large aircraft

3.2.15. Airways reported the incident as a possible loss of separation because Pacific Blue 'did not follow the published missed approach procedure' and the controllers were not certain that the minimum separation of 1000 ft had been maintained. At the time, Airways had a multilateration surveillance system under trial that showed the positions of the 2 aeroplanes and their altitudes.[9] The data was unverified, but helped the controllers to manage the situation.

[9] A multilateration surveillance system uses multiple remote sensing units to track and display the positions of transponder-equipped targets. The system can be used in locations usually incompatible with radar, such as mountainous terrain and built-up ground environments.

3.2.16. The Pacific Blue captain said later that he believed he had flown the published missed approach procedure. The first officer agreed, and queried the wisdom of turning back towards the aerodrome and VOR/DME, which was the start point of the missed approach procedure, if meteorological conditions were known to be poor.

3.2.17. The Commission obtained copies of the incident reports submitted by the captains to their respective airlines. The Qantas report noted they were on the 'RNAV 05' approach, whereas the flight was cleared for (and flew) the 'RNAV runway 05 ZULU' approach. That error is discussed later in the context of similar names for different approaches.

3.2.18. The incident occurred in daylight at 1345.

## 3.3. Recorded flight data

3.3.1. The Commission reviewed recorded flight data from both aeroplanes.[10] Figure 7 shows parts of the flight paths of both aeroplanes during the incident. The path for Pacific Blue is not smoothed because the position data obtained was less accurate than that for Qantas. The 2 positions marked (**O** and **O**) are for the same time and were used to synchronise the data. The pressure altitude was the only recorded parameter that was corrected (but not validated).[11]

3.3.2. The Pacific Blue pilots initiated the missed approach shortly after the aeroplane had turned towards the west behind Deer Park Hill, and when it was at an altitude of approximately 3400 ft. The speed did not exceed the procedure maximum of 160 knots until the aeroplane was established on the published missed approach track.

3.3.3. A comparison of the recorded data from the 2 aeroplanes showed that the minimum horizontal separation was about 2.7 miles, with an associated vertical separation of more than 3800 ft. This occurred about 30 seconds after Pacific Blue had commenced the missed approach and when Qantas was descending through 7600 ft immediately east of the aerodrome.

3.3.4. The Qantas missed approach was commenced just southeast of the aerodrome and at about the time the flight had previously estimated for position 'Coronet', which was nearly 6 miles north. The aeroplane was then passing approximately 7100 ft, with a speed of 185 knots. A comparison with the RNAV runway 05 ZULU approach chart suggested that the aeroplane was above the correct approach profile, but the reason for this was not examined. The vertical separation between the aeroplanes then was about 2000 ft, but it decreased because of Pacific Blue's higher rate of climb at that time.

3.3.5. The vertical separation remained between 1600 ft and 1800 ft until Qantas climbed above about 8200 ft, and it then decreased to a minimum of about 1000 ft when the aeroplanes were about 4.2 miles apart, but about to head in opposite directions. Although one Pacific Blue pilot recalled seeing an indicated altitude difference of about 800 or 900 ft, the minimum vertical separation was not calculated more exactly because of the recorder time base and position data approximations.[12]

[10] Recorded data was analysed with the help of the Australian Transport Safety Bureau.

[11] Recorded pressure altitudes were corrected by deducting 216 ft to give the altitude indicated to the pilots.

[12] The relative height of the other aeroplane was shown on the Airborne Collision Avoidance System display.

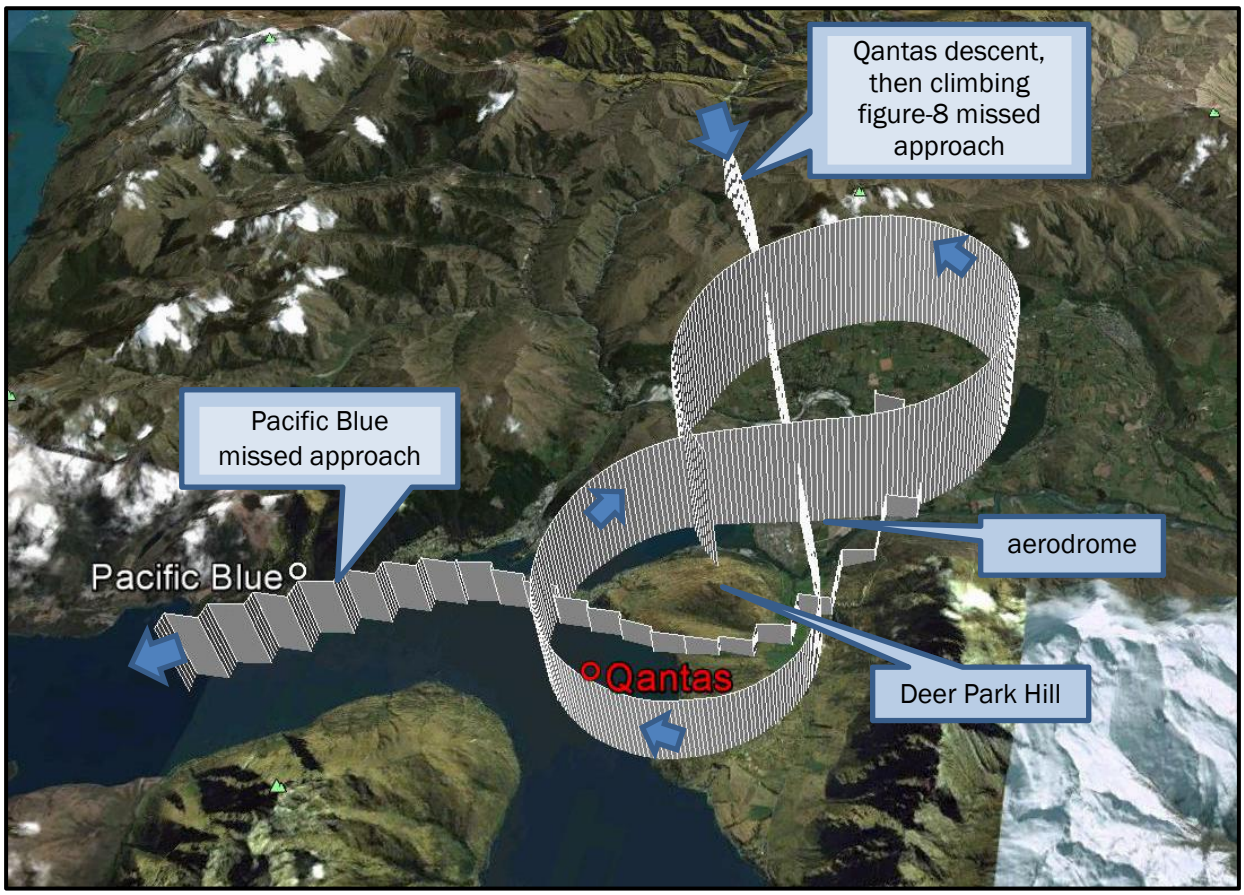


Figure 7
Flight paths of both aeroplanes
(Image courtesy of the Australian Transport Safety Bureau)

3.3.6. Pacific Blue was climbing through about 6300 ft when the aeroplane intercepted the prescribed missed approach track approximately 7 miles from the VOR/DME, which was the start point for the missed approach procedure. The procedure design minimum altitude at 7 miles was 5528 ft.[13]

## 3.4. Personnel information

3.4.1. The Pacific Blue captain held Australian and New Zealand airline transport pilot licences, with a Boeing 737-800 rating obtained in 2006. He had been hired by the airline in January 2009 as a direct-entry captain on the Boeing 737-800. His medical certificate, renewed in January 2010, included a restriction that he wear spectacles when flying, which he said he was doing on the incident flight. As at 20 June 2010 he had accrued 18 790 flying hours, including 2370 hours on the B737-800. His previous line check had been completed in September 2009 and his previous instrument rating check had been completed in December 2009. The captain commuted from Australia for each roster period, but maintained accommodation in Auckland, his roster base. The 4 days prior to 20 June had been free of duty, and although he had returned to Auckland the night before the incident flight, he had considered himself fit for duty.

3.4.2. The Pacific Blue first officer held a New Zealand commercial pilot licence (aeroplane) issued in June 2000. He had obtained a B737-800 type rating in September 2008 and had been hired by the airline in October 2008. His medical certificate, renewed in January 2010, had a restriction that he wear spectacles when flying, which he said he was doing on the incident flight. As at 20 June 2010 he had accrued 4500 flying hours, including 1300 hours on the B737-800. His previous line check had been completed in May 2010 and his previous instrument rating check had been completed in March 2010. He had had the 45 hours prior to the 20 June flight off duty, and had considered himself well-rested before the incident flight.

[13] The minimum altitude was determined from information given by a procedures design specialist at Airways.

3.4.3. About 40 of Pacific Blue's 150 pilots were qualified to operate into Queenstown. To qualify, a captain had to complete a computer-based training package and a flight simulator session and observe, from the flight-deck jump-seat, one or more arrivals into and departures from Queenstown. Depending on previous experience, the candidate then had to operate a number of training flights into and out of Queenstown before a check flight. First officers, at the time, had to complete the computer-based training package only. Both of the incident pilots met the company's currency requirement for operating the flight.

3.4.4. The simulator training was intended to place 'emphasis on the IFR arrival and departure procedures' and 'to provide familiarisation with the transition to [visual meteorological conditions] flight and manoeuvring considerations from the minima to touchdown.'[14] The captain said his training had covered the International Civil Aviation Organization (ICAO) Procedures for air navigation services –aircraft operations (PANS-OPS) procedure for loss of visual reference below the minimum descent altitude, and the figure-8 circuit procedure.[15] The simulated cloud bases were at or above the minimum descent altitude, with no low cloud to obscure ground features.

3.4.5. The Pacific Blue captain had completed the ground training in November 2009 and the route training requirements in February 2010. He had flown into the aerodrome more than 15 times since and had completed a Queenstown line check and simulator revision in July 2010.

3.4.6. The first officer on the incident flight had not 'crewed up' for any simulator training set at Queenstown. He had met the company's Queenstown qualification in September 2009 and had operated into Queenstown 4 times since.

3.4.7. The other jet operators into Queenstown required first officers to complete a simulator training package before being cleared to operate as crew into the aerodrome.

3.4.8. Although its previous training programme had been approved by the CAA, following this incident Pacific Blue amended the aerodrome qualification requirement to include simulator training for first officers, and recurrent simulator training for both ranks. The CAA later made simulator training a mandatory part of the aerodrome qualification for pilots of large aircraft performing air transport operations into Queenstown.

3.4.9. All air traffic controllers in New Zealand are trained and employed by Airways. The ATC instructor had been issued with a New Zealand air traffic controller licence on 2 February 2009 and held aerodrome and approach controller ratings, and an air traffic service instructor rating issued in April 2010. All of his ATC experience had been gained at Queenstown Aerodrome. His previous annual proficiency assessment had been completed on 15 July 2009, and he completed the next assessment on 12 July 2010. He held a current medical certificate with a requirement to wear spectacles, which he said he was doing at the time of the incident. While instructing, an instructor was fully responsible for the position being trained.

3.4.10. The ATC trainee had had no aviation experience prior to commencing training in 2009. She had been issued with an air traffic trainee licence on 9 September 2009 and had been at the Queenstown Aerodrome since January 2010 for on-the-job training as a tower and approach controller. The instructor considered she had completed approximately 60-70% of the required objectives and experience by 20 June 2010 and was progressing well. The trainee held a current medical certificate with no restrictions.

3.4.11. In addition to the trainee controller and the instructor, another controller was in the tower acting as the Co-ordinator. The Co-ordinator had been issued with a New Zealand air traffic controller licence on 22 September 2009 and held the appropriate aerodrome and approach controller ratings. All of his controlling experience had been at Queenstown Aerodrome. His previous annual proficiency assessment had been completed on 19 March 2010. He held a current medical certificate with no restrictions.

[14] Pacific Blue Operations Manual Suite Volume C1, Flight Crew Route Guide, p.3A-1, 5 Sep 2009.

[15] ICAO Procedures for air navigation services – aircraft operations, Doc 8168.

3.4.12. The instructor and trainee had started their duty at 1000 that day and returned from a break approximately 25 minutes before the incident. The coordinator had started duty at 1145. The instructor said the traffic was light and he did not know of any issues affecting the controllers' fitness for duty.

3.4.13. As the Qantas flight was incidentally involved, the flight crew details were not requested.

## 3.5. Aerodrome information

3.5.1. Queenstown Aerodrome is located between the Frankton Arm of Lake Wakatipu and the Arrowtown Basin, at an elevation of 1171 ft, and surrounded by mountainous terrain rising to more than 7600 ft in the Remarkables Range, less than 8 kilometres from the aerodrome. There are 2 runways, but only the sealed runway 05/23 is suitable for large aeroplanes. Runway lighting was not installed at the time of this incident, but was installed in 2011.

3.5.2. Between 2000 and 2010 the number of international aircraft movements at Queenstown increased by 524%, bringing a 666% increase in passengers. Domestic aircraft movements increased by 17% and domestic passengers by 77%.[16] International passenger growth increased by 50% in the year to June 2011.[17] The great majority of movements were by scheduled airlines, but corporate and charter aircraft averaged one movement a day.

3.5.3. The Aeronautical Information Publication New Zealand (AIP) stated (AIP, p.NZQN AD 2-13), 'Flight procedures for Queenstown are detailed on the … Arrival/Departure chart', but in fact none is given on that chart (AIP, p.NZQN AD 2-31.1).[18] The AIP Aerodrome pages stated the circuit directions, which included a right-hand circuit for runway 23, but also included a different circuit procedure for aircraft with mass greater than 5700 kilograms (see Figure 6).

3.5.4. The different circuit for larger aircraft arose from airline concerns that a jet aeroplane going around from its final approach to the main runway 05/23 could conflict with an aircraft on the downwind leg of the circuit for the crossing grass runway. The internal 'Request for Change' submitted by the aerodrome chief controller noted there was a right-hand circuit for runway 23 promulgated under Civil Aviation Rules[19], but added 'terrain prohibits large aircraft carrying out [the published] circuits, so the airlines have adopted a figure-8 type circuit pattern.'

3.5.5. The proposal was supported by an aerodrome users' group meeting at which 3 major airlines were represented, and the request was approved by the Airways' Air Traffic Services Policy and Standards Group in 2004.[20]

3.5.6. The AIP chart depicted the figure-8 circuit in relation to prominent terrain features and stated the altitude to be flown. There was no speed or other requirement specified, so the ceiling and visibility minima for visual flight rules (VFR) in the vicinity of an aerodrome in a control zone were assumed to apply.[21] The circuit, although described on the chart current then as left-hand, resulted in right-hand base turns to runway 05 and runway 23, and an initial left turn off runway 23. These turns were contrary to the directions published for light aircraft. Notwithstanding the likely presence of ATC during large aircraft operations at Queenstown, the Commission has previously commented on the safety issue of opposed circuits.[22]

3.5.7. The CAA was not identified as an interested party when the procedure was proposed, even though the connection with Civil Aviation Rules Part 93 was noted by Airways in the original request for change. Part 93 required the Director's approval for the establishment or withdrawal of a right-hand circuit, and the procedure required both types of change. Airways and CAA staff commented during this investigation that the figure-8 circuit was seen as a

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[16] Traffic statistics provided by Queenstown Airport Corporation Limited, 22 August 2011.
[17] Annual Review 2011 of Auckland International Airport Limited, part-owner of Queenstown Aerodrome.
[18] The AIP is a CAA document, published on its behalf by Airways.
[19] Civil Aviation Rules Part 93 – Special aerodrome traffic rules and noise abatement procedures, sub-part H, Right-hand aerodrome traffic circuits.
[20] The 3 airlines were Air New Zealand, Qantas and Mount Cook Airline. Pacific Blue did not commence domestic operations until 2007.
[21] These are to remain 2 kilometres horizontally and 500 ft vertically clear of cloud, with a minimum flight visibility of 5 kilometres (although, for the operators concerned, the minimum visibility was 10 kilometres).
[22] See, for example, Commission reports 08-001 and 10-005.

tactical intervention available to controllers at any time and therefore its use did not require the specific approval of the Director.

3.5.8. At the time of the incident, the AIP chart showing the figure-8 circuit had a sub-heading 'Procedure if aircraft is maintaining visual reference and unable to land (go-around)'. Most pilots consider a 'go around' to be a discontinued landing attempt from the final approach, and distinguish that from a 'missed approach' which can be started from any point in an instrument approach or circling approach. The chart was placed in the visual approach procedures of the AIP, and was not referred to in the instrument approach procedures. This meant that a pilot of an IFR flight would not necessarily know that ATC expected the figure-8 circuit to be followed in the event of a missed approach while circling. The Jeppesen flight procedures guide, used by Pacific Blue and Qantas and likely used by the majority of operators of itinerant jet aeroplane flights into Queenstown, placed the figure-8 procedure with VFR arrival procedures in its chart binder.[23] A pilot conducting a crew briefing prior to an instrument approach would not normally review the VFR procedures for that aerodrome.

3.5.9. In response to observations made during this investigation, the chief controller initiated an AIP change to correct the description of the figure-8 circuit and clarify its purpose. On 10 February 2011, the chart sub-title was amended to read, 'Procedure if aircraft is maintaining visual reference or circling from an instrument approach and unable to land.' The supporting documentation for the change request noted that, if the change were not implemented, there was 'a high risk of misinterpretation by pilots unfamiliar with the procedure'. The request also stated that 'no one has been asked to consult on this [change]', and the potential for the procedure to be misinterpreted had not been identified earlier due to the procedure's 'very rare use.'

3.5.10. The ATC instructor said that all operators had, at one time or another, flown the figure-8 pattern. A CAA publication intended mainly for VFR pilots noted, 'Airline traffic may fly a non-standard circuit. They normally make a large figure-eight approach.' (CAA, 2008, p.20).

3.5.11. Pacific Blue had categorised Queenstown Aerodrome as a category 'X' aerodrome, the only such aerodrome in its route network at that time. Before flying into a category X aerodrome, a captain had to have completed the approved airport training programme discussed above. Other airlines operating into Queenstown had a similar categorisation and required special training for their pilots.

3.5.12. The Pacific Blue operations manual stated 'Pacific Blue aircraft may circle visually in the event of a missed approach/go-around within the [Queenstown] aerodrome traffic circuit, by day only.'[24] However, that manual elsewhere described the Queenstown visual circuit as 'a visual go-around procedure [applied] to provide separation from light aircraft circuit traffic.'[25] The incident pilots knew of the procedure and the captain had flown it in a flight simulator, but they understood it to be a VFR procedure. They said they had briefed to fly the published missed approach procedure for the VOR/DME approach if they did not land after circling and did not know that ATC expected them to remain in the visual circuit in that event.

3.5.13. The Pacific Blue operations manual contained a further reference to the figure-8 circuit:[26]

> In the event of an engine failure after take-off, manoeuvre via the figure eight special procedure circuit.'

3.5.14. On 2 July 2010 Pacific Blue issued a Flight Crew Operational Notice that clarified the present ATC use of the figure-8 circuit for protecting the missed approach.[27]

3.5.15. Fleet management representatives of most of the other Part 121 operators using Queenstown Aerodrome at the time of the incident advised informally that they considered the figure-8 circuit as a go-around procedure once in the circuit, although one operator referred to an unspecified 'non-standard procedure for missed approaches into the circuit' as an arrival

[23] Jeppesen is a leading publisher of international flight procedures guides that are based on the national AIP.
[24] Pacific Blue, Operations Manual Suite, Volume C1, Flight Crew Route Guide, p.2-48, effective 25 Feb 2010.
[25] Pacific Blue Operations Manual Suite Volume C1, Flight Crew Route Guide, p.3-ZQN-10, 5 Sep 2009.
[26] Pacific Blue Operations Manual Suite Volume C1, Flight Crew Route Guide, p.3-ZQN-11, 5 Sep 2009.
[27] Pacific Blue FCON item 060/10 –effective 02 Jul 10.

'threat' to be briefed by its pilots prior to approach. Qantas and Jetstar did not permit their aeroplanes to fly the figure-8 pattern at any time. The majority were uncomfortable with manoeuvring at relatively low level in mountainous terrain, especially as a missed approach was most likely to arise because meteorological conditions were unsuitable for a landing.

## 3.6. Meteorological information

3.6.1. MetService advised that on 20 June 2010 a low pressure system was moving east over the South Island with an associated front moving south.[28] The automatic weather station at Queenstown Aerodrome reported light rain and drizzle in the 2 hours preceding the incident, with cloud detected between 4000 and 5000 ft above the aerodrome. At and after 1400, lower patches of cloud and a rapidly lowering cloud base were detected.

3.6.2. On those days that it operated services to Queenstown, Pacific Blue flight operations management received 3 updates of forecast and actual (current) weather, with attached screen-shots (when conditions permitted) from a webcam that showed Deer Park Hill.

3.6.3. At 1315, while under the control of a different ATC position, one of the Pacific Blue pilots had called Queenstown Tower to check the weather conditions before commencing the approach. They informed Queenstown ATC that they had received the earlier broadcast weather information 'Foxtrot'. The controller said, 'conditions are pretty much as mentioned in Foxtrot' and 'there is low cloud about 1000 feet right throughout the basin and to the south of Deer Park.'[29]

3.6.4. A few minutes later the broadcast information was changed to 'Golf', one change being increased cloud at 1000 ft above ground. Having been told by ATC that conditions were still like those broadcast in information 'Foxtrot', the Pacific Blue pilots did not listen for 'Golf' prior to the control of their flight being transferred to Queenstown Tower. The information was as follows:

> Information Golf at time 1318: expect a VOR/DME approach A, runway 23, runway wet, surface wind 210 degrees magnetic at 3 kt, visibility 40 kilometres in drizzle, cloud: few at 200 ft, scattered at 1000 ft, broken at 5000 ft, overcast 7000 ft, temperature 7°C, dew-point 6°C, [altimeter setting] 1005 hectoPascal, forecast 2000 ft wind 190 degrees at 10 kt. ATC training in progress.

3.6.5. At 1347, shortly after the incident, the broadcast information was amended again, to report generally lower cloud layers and to add a reference to cloud in the final approach area for runway 23. The controller said later that the cloud patches had been fluctuating.

3.6.6. The Pacific Blue captain provided a sketch of the cloud conditions he had seen in the Queenstown basin. Although the lower slopes of the major ranges were visible, low cloud obscured much of the eastern half of the basin, and to the south of the aerodrome only Frankton Arm and the summit of Deer Park Hill were visible. The captain later estimated that the top of the low cloud had been 1500 ft above ground.

3.6.7. The visibility from the control tower at Queenstown is restricted through an arc of approximately 35 degrees to the south, because the summit of Deer Park Hill is only 2 kilometres away and more than 1500 ft above the aerodrome. The operator of Queenstown Aerodrome and Airways advised that previous attempts to find a viable method for remotely observing conditions behind Deer Park Hill had not been successful.

## 3.7. Aids to navigation

### General

3.7.1. The VOR/DME approach at Queenstown is a non-precision approach that was inaugurated in 1994 and is available for general use by suitably rated pilots and equipped aircraft. The high terrain and mountain weather dictate unusually high approach minima. Similarly high cloud

[28] MetService is a company certificated by the CAA to provide aviation meteorological products such as forecasts.

[29] The ATC comment was taken from information obtained by Pacific Blue and not disputed by Airways, but made outside the time period of ATC information requested by the Commission.

base and visibility requirements exist for IFR departure procedures, with pilots required to fly a visual segment until reaching the minimum altitude to ensure terrain clearance.

3.7.2. The high minimum descent height and location of the VOR/DME do not permit a straight-in landing off the approach. Therefore, an unusual amount of visual manoeuvring (circling) is required before landing. A number of pilots who had flown the procedure in the first few years after its approval suggested that circling in earlier models of the Boeing 737 and in other types was managed so that the runway was always kept in sight, particularly when circling south of Deer Park Hill for runway 05.[30] The Commission asked the CAA if there were any conditions or assumptions associated with the initial approval of the approach, and which might have addressed circling requirements, but no relevant documentation was found.

3.7.3. The continued refinement of aircraft navigation systems led ICAO to develop the concept of performance-based navigation, which uses aircraft equipment and airspace characteristics to define the required navigation performance for enroute and terminal procedures. RNAV approach procedures with much lower Required Navigation Performance minima have been progressively introduced at Queenstown Aerodrome since 2005. An operator provides special training to its pilots and requires a CAA authorisation before it can conduct Required Navigation Performance approaches, but the procedures provide the following benefits:

- greater ATC and aircraft operational efficiency
- much lower minimum approach heights
- fewer missed approaches
- departures under meteorological conditions similar to the approach minima
- greater accuracy of procedure tracking.

3.7.4. The Commission obtained copies of the incident reports submitted by the captains to their respective airlines. The Qantas captain had written that they were on the 'RNAV 05' approach, whereas the flight was cleared (and flew) the 'RNAV ZULU approach runway 05'. The similar-sounding approaches have completely different tracks, but their titles meet the ICAO charting procedures (ICAO, 2006b, Part 1, s.4, para 9.5.3).

### Instrument approach procedures

3.7.5. The operating rules for, and design of, instrument approach procedures are found in the 2 volumes of ICAO PANS-OPS. These approach procedures assured terrain and obstacle clearance only if the aircraft were flown in accordance with the relevant design and operating assumptions. The only subjects in the CAA syllabus of ground training for a pilot licence instrument rating that were directly relevant to understanding these assumptions were the following (CAA, 2010, p.21):

> - [Pilots must be able to] state when descent below decision altitude or minimum descent altitude may be made on an instrument approach.
> - [Pilots must be able to] describe the missed approach procedures and limitations.

3.7.6. The source of information for both topics was given as the AIP, which repeated the requirements of Civil Aviation Rule 91.413(c) for descent below the minimum descent altitude. The Rule stated, in part:

> **91.413 Take-off and landing under IFR**
>
> (c) ***Operation below ... minimum descent altitude***. Where a ... minimum descent altitude is applicable, a pilot-in-command must not operate an aircraft at any aerodrome below the minimum descent altitude ... unless—
>
> (1) the aircraft is continuously in a position from which a descent to a landing on the intended runway can be made at a normal rate of descent using normal manoeuvres that allows touchdown to occur within the touchdown zone of the runway of intended landing; and

[30] The pilots referred to were not, and had not been, employees of Pacific Blue.

(2) the flight visibility is not less than the visibility published in the applicable AIP for the instrument approach procedure being used; and

(3) … at least one of the following visual references for the intended runway is distinctly visible and identifiable to the pilot—

(i) the approach lighting system; or

(ii) the threshold markings; or

(iii) the threshold lights; or

(iv) the runway-end identification lights; or

(v) the visual approach slope indicator; or

(vi) the touchdown zone or touchdown zone markings; or

(vii) the touchdown zone lights; or

(viii) the runway or runway markings; or

(ix) the runway lights.

(d) ***Landing.*** A pilot-in-command must not land an aircraft when the flight visibility is less than the visibility published in the applicable AIP for the instrument approach procedure used.

3.7.7. The Pacific Blue standard operating procedures included a restatement of rule 91.413(c). As Queenstown Aerodrome at the time of the incident was not equipped with any lighting apart from the precision approach path indicator (a form of visual approach slope indicator), the runway or threshold itself had to be distinctly visible and identifiable while operating below the minimum descent altitude.

### Missed approach

3.7.8. A specific missed approach procedure is designed for, and is a part of, each instrument approach procedure. The missed approach is flown when the approach is discontinued and provides a track and climb profile that ensures obstacle clearance until the aircraft reaches a safe altitude.

3.7.9. Obstacle clearance is ensured throughout the procedure, as long as the design assumptions are met. One of those assumptions is that the missed approach will be initiated at, or before, the missed approach point, (e.g. the VOR/DME), and at an altitude not lower than the minimum descent altitude. Turns and/or speed limitations may also be prescribed. PANS-OPS stated, 'It is expected that the pilot will fly the missed approach procedure as published' (ICAO, 2006a, 6.1.4).

3.7.10. Civil Aviation Rule 91.413(e) addressed missed approach procedures and conditions, stating:

**91.413 Take-off and landing under IFR**

(e) ***Missed approach procedures***. A pilot-in-command must immediately execute the missed approach procedure published in the applicable AIP if—

(1) the requirements of paragraph (c) [given in paragraph 3.7.6 above] are not met at either of the following times:

(i) when the aircraft is being operated below minimum descent altitude; or

(ii) upon arrival at the missed approach point … and any time after that until touchdown; or

(2) an identifiable part of the aerodrome is not distinctly visible to the pilot during a circling manoeuvre at or above minimum descent altitude, unless the inability to see an identifiable part of the aerodrome results only from normal manoeuvring of the aircraft during approach.

3.7.11. The AIP reference to missed approach procedures stated (AIP, p.ENR 1.5-30):

The published missed approach procedure **must** be executed [emphasis in AIP]:

(a) if, at the missed approach point … the pilot has not established visual reference with any portion of the runway or visual landing aids …: or

(b) an identifiable part of the aerodrome is not distinctly visible to the pilot during a circling manoeuvre at or above minimum descent altitude; or

(c) at any time during the final approach when directed by ATC.

3.7.12. The AIP reference differs from Rule 91.413 by omitting Rule condition (e)(1)(i) and most of condition (e)(1)(ii), which relate to a loss of visual reference when operating below the minimum descent altitude, and also omits the exception in (e)(2) for loss of visual reference caused solely by normal manoeuvring (e.g. banking a high-wing aeroplane) when at or above the minimum descent altitude.

3.7.13. The Pacific Blue operations manual added a further option, stating, 'The published missed approach procedure [for the approach being flown] **or, if applicable, a visual missed approach** must be initiated under the following circumstances …' [31] [emphasis added], but elsewhere the manual noted that at Queenstown 'all missed approach procedures track over [the VOR/DME]'.[32]

### Visual manoeuvring (circling)

3.7.14. Circling describes the phase of flight after an instrument approach has been completed, during which the aircraft is manoeuvred to align with the landing runway. Circling is a visual flight manoeuvre, but an aircraft operating under IFR remains an IFR flight while circling. Each circling situation is different because of the many variables, such as runway layout, terrain and weather conditions. However, circling typically entails manoeuvring the aircraft from the missed approach point to a point in the normal aerodrome circuit pattern that intercepts a visual descent profile to the landing runway, at which point the aircraft can be descended from the minimum descent altitude.

3.7.15. The circling area is defined by connecting tangents to arcs centred on the runway ends at the aerodrome (see Figure 8). The radius of the arcs is related to the aircraft category and speed, wind speed and a nominal 20 degrees bank angle for the turn. In the case of a Boeing 737-800, the radius is 4.2 miles. Circling may be prohibited in a sector if terrain dictates, as the Remarkables Range does at Queenstown. The highest terrain or obstacle within the circling area is used to determine the minimum height for circling, which must be maintained until the aircraft intercepts the visual descent profile.

3.7.16. PANS-OPS stated, 'After initial visual contact, the basic assumption is that the runway environment should be kept in sight while at minimum descent altitude/height (minimum descent altitude/H) for circling. The runway environment includes features such as the runway threshold or approach lighting aids or other markings identifiable with the runway' (ICAO, 2006a, 7.2.2).

3.7.17. The circling approach at Queenstown was not typical, because the minimum descent height, being 3500 ft above the aerodrome, and the close terrain required 'extensive manoeuvring'.[33] This meant that a pilot had to descend from the minimum descent altitude well before joining a normal aerodrome circuit pattern (or abnormal circuit, in the case of runway 05) to avoid an excessive rate of descent before intercepting a visual descent profile. The typical flight paths, descending in an orbit or passing behind Deer Park Hill, usually involved a turn away from the runway and the pilot losing sight of the runway.

3.7.18. The instructor controller said that after a pilot had reported 'visual' on the VOR/DME approach at Queenstown, the controller would issue circuit joining instructions, such as 'join right base runway 23'. He said it was assumed that a pilot who reported 'visual' could manoeuvre visually and would land. The report of 'visual', meaning a pilot could see the ground, was not a request for a visual approach, for which a specific request was required.

[31] Pacific Blue Operations Manual Suite Volume A1, Flight Crew Operating Manual, p.7-31, 20 May 2010.
[32] Pacific Blue Operations Manual Suite Volume C1, Flight Crew Route Guide, p.3-ZQN-6, 25 Feb 2010.
[33] Pacific Blue Operations Manual Suite Volume C1, Flight Crew Route Guide, p.3-ZQN-9, 5 Sep 2009.

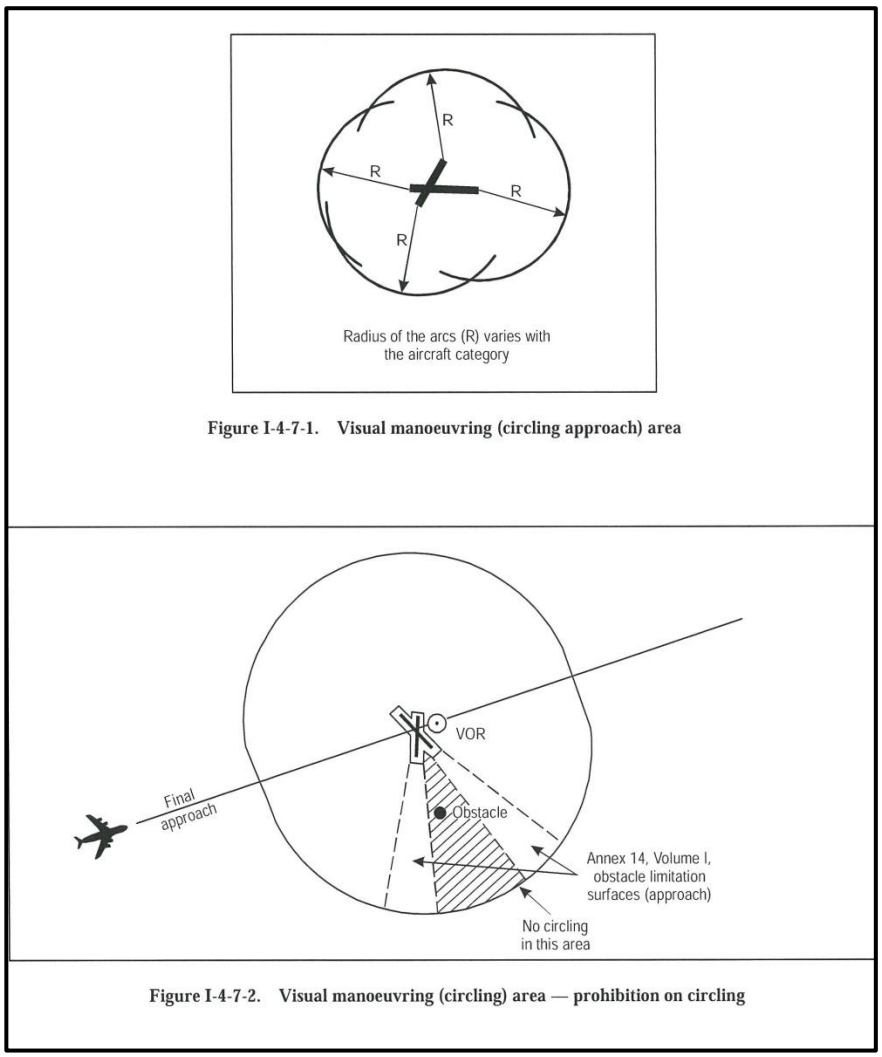


Figure 8
Circuling area construction, and example
(Figure taken from PANS-OPS (ICAO, 2006a, p.I-4-7-6))

3.7.19. The circling minimum descent altitude ensured obstacle clearance only when operating within the circling area from which the minimum descent altitude was determined. When operating below the minimum descent altitude, the circling area was irrelevant, because obstacle clearance then depended on the pilot having visual reference. Therefore, PANS-OPS and the national rules stated, in part (ICAO, 2006a, 7.3.3):

> Descent below minimum descent altitude/H should not be made until:
>
> - visual reference has been established and can be maintained;
> - the pilot has the landing threshold in sight; and
> - the required obstacle clearance can be maintained and the aircraft is in a position to carry out a landing.

3.7.20. The Pacific Blue operations manual listed the weather requirements for circling at Queenstown, but not the preferred thrust/speed or configuration when manoeuvring visually in the basin.

3.7.21. The Manual of Air Traffic Services (Airways, p.RAC 3-46, 8 April 2010), and similar AIP text, stated:

> A pilot on a circling approach may be instructed to join the aerodrome circuit when:
>
> - MET conditions are equal to or better than circling minima; **and** [emphasis in original]

- The pilot has reported visual or is seen by the aerodrome controller to have established visual reference.

### Missed approach commenced from circling

3.7.22. The Pacific Blue standard operating procedures repeated the PANS-OPS mandatory requirement to execute a missed approach if visual reference with the intended landing runway were lost while operating below the minimum descent altitude or beyond the missed approach point.[34] The typical circling tracks at Queenstown Aerodrome did not allow pilots to keep the runway in sight at all times.

3.7.23. In the event of a missed approach commenced when the aircraft was below the minimum descent altitude, the pilot would have to maintain visual contact with terrain until able to join the published missed approach track and meet the altitude criteria. If that could not be done, the pilot would have to attempt to stay within the circling area while climbing back to the minimum descent altitude.

3.7.24. The PANS-OPS procedure for a missed approach commenced from circling stated, in part (ICAO, 2006a, 7.4.1):

> If visual reference is lost while circling to land from an instrument approach, the missed approach specified for that particular approach shall be followed. The transition from the visual (circling) manoeuvre to the missed approach should be initiated by a climbing turn, within the circling area, towards the landing runway, to return to the circling altitude [minimum descent altitude] or higher, immediately followed by interception and execution of the missed approach procedure.

3.7.25. Pacific Blue's pilot training manual[35] and the Jeppesen guide repeated the PANS-OPS procedure, as did the Manual of Air Traffic Services, adding (Airways, p.RAC 3-48, 8 April 2010):

> No other missed approach procedure other than that applicable to instrument training aircraft is permitted.

3.7.26. However, the Manual of Air Traffic Services also included the following note (Airways, p.RAC 3-48, 18 November 2010):

> Unless instructions are issued to the contrary, an aircraft on an instrument approach and instructed to 'GO AROUND' should carry out the published missed approach procedure, whilst an aircraft operating VFR or an IFR aircraft on a visual approach should continue in the circuit. The latter should be confirmed by a positive circuit clearance/instruction.

3.7.27. The AIP repeated the Manual of Air Traffic Services' statement that a pilot who initiated a go-around while making a visual approach had to remain in the circuit (AIP, p.AD 1.5).

3.7.28. PANS-OPS noted that the actual manoeuvre required to establish on the missed approach course would depend on where the aircraft was when visual reference was lost. The instructor controller said he expected that a pilot carrying out a missed approach would remain in visual conditions in the figure-8 visual circuit until ATC could issue other instructions.

3.7.29. The Pacific Blue captain said later that he had been trained to stay within the circling area when commencing a missed approach from below the minimum descent altitude. Therefore he stayed within 4 miles of the runway end and climbed quickly to intercept the missed approach track, all the time maintaining visual contact with the terrain.

### Protection of the missed approach

3.7.30. The AIP stated that 'ATC will at all times protect the missed approach', adding (AIP, p.ENR 1.5-33, section 4.20, 12 Feb 09):

> Where actual meteorological conditions are at or above the published circling minima for the aircraft category and type of approach ATC may protect the missed approach by

[34] Pacific Blue Operations Manual Suite, Volume A1, page 7-31, paragraph 7.9.5.2, effective 20 May 2010.
[35] Boeing B737NG Flight Crew Training Manual, page 5-69, effective 30 June 2010.

> requiring an arriving aircraft to circle visually within the aerodrome traffic circuit … provided circling is permitted for the aircraft category and type of approach, with the following exceptions: …
>
> (b) for Category C aircraft the MET conditions must be equal to or better than a ceiling of 2000 ft and visibility of 8 [kilometres] or the circling minima for the aircraft approach category and type of approach, whichever is the higher …
>
> This procedure will not be used by ATC when:
>
> - [meteorological] conditions (e.g. turbulence, crosswind) are such that there is doubt an aircraft may be able to circle visually; or
> - the pilot may be unfamiliar with the aerodrome; or
> - when a pilot advises both Approach Control and Tower, each on first contact, that they do not wish to carry out such a procedure.
>
> Aircraft unable or no longer able to carry out this procedure must advise Approach Control or Tower immediately.

3.7.31. The Manual of Air Traffic Services expressed the provision and its conditions differently (Airways, p.RAC 5-42, 10 April 2008):

> When conditions are at or above the published circling minima for an arriving aircraft's approach category and type of approach, the missed approach may be protected by **instructing** the pilot to circle visually within the aerodrome traffic circuit … … [emphasis added].

and noted:

> *The pilot may decline circling at any stage during the approach if it is considered unsafe. In this circumstance, separation must be established by the quickest means practicable and essential traffic information given if applicable. Confirmation of ability to circle should be established earlier rather than later*.
>
> A controller shall not use this procedure when:
>
> - [meteorological] conditions such as fluctuating cloud base, severe turbulence or strong cross winds are reported to an aircraft or broadcast … ; or
> - It is known or suspected that the pilot is unfamiliar with the aerodrome; or
> - The pilot advises approach or aerodrome control at any time that they are unable to carry out this procedure.

3.7.32. The conditions on 20 June 2010 were better than the published circling minima for Pacific Blue and none of the exceptions to ATC use of this procedure applied. However, the Pacific Blue pilots did not advise ATC that they would not use this procedure, and the controller did not instruct them to use it. As a consequence of this investigation, Airways revised the Manual of Air Traffic Services and AIP to clarify the weather criteria and other restrictions applicable to the use of the procedure. A new restriction was that an aircraft shall not be instructed to enter the aerodrome traffic circuit when 'there is any cloud in the circuit area that could cause the pilot to lose sight of an identifiable part of the aerodrome.'

3.7.33. The instructor confirmed that, to protect the missed approach, controllers at Queenstown had relied on a pilot who reported 'visual' being able to enter or remain in the figure-8 circuit. However, usually no specific instruction was given to pilots to do so, and none was given in this case.

3.7.34. There was a clear belief among Part 121 operators that ATC at all times protected the published missed approach for the instrument approach procedure of all flights, irrespective of other ATC action to separate traffic. They understood that the correct action when going around from a circling manoeuvre was to stay within the circling area while climbing to the minimum descent altitude and to then establish on the published missed approach track.

### ATC amendment or termination of missed approach procedure

3.7.35. ATC could issue alternative missed approach instructions to pilots of aircraft involved in instrument training only, and in sufficient time for the pilot(s) to brief the revised procedure (AIP, p.ENR 1.5-32).

3.7.36. The Manual of Air Traffic Services stated (Airways, p.RAC 3-48, 8 April 2010):

> The missed approach is a critical stage of flight and pilots should be given time to establish on the missed approach procedure, as published, before any instructions are issued by ATC.

3.7.37. After a missed approach had been initiated, ATC was not permitted to instruct the pilot to fly a procedure other than that published unless the aircraft was under radar control or had reached the minimum missed approach holding altitude (Airways, p.RAC 3-49, 18 November 2010). There was no ATC radar facility at Queenstown, and the minimum missed approach holding altitude for the VOR/DME procedure flown by Pacific Blue was 8500 ft.

### ATC separation of arriving aircraft

3.7.38. The Queenstown control area and control zone were classified category D airspace in which ATC had to apply separation between IFR flights. As there was no radar capability in the vicinity of Queenstown, vertical separation of 1000 ft or horizontal separation criteria were applied. Visual separation standards, including composite visual-geographical separation, were not practical for jet aircraft in the Queenstown basin. Composite visual separation requires the controller to have an aircraft continuously in sight, so if the sun, weather or terrain might interfere with the controller's ability to sight the aircraft concerned, composite visual separation is not to be used (Airways, p.RAC 5-5, 25 November 2004).

3.7.39. The Manual of Air Traffic Services rules for providing separation between arriving aircraft included the following (Airways, p.RAC 5-40, 4 June 2009):

> A second aircraft shall not be cleared for an instrument approach until the preceding aircraft:
>
> Is in communication with and sighted by the aerodrome controller and reasonable assurance exists that a normal landing can be accomplished, provided the vertical spacing between aircraft shall never be less than the applicable vertical separation minima until visual separation can be applied; or
>
> Is on a visual approach and reasonable assurance exists that a normal landing can be accomplished, provided the vertical spacing between the aircraft shall never be less than the applicable vertical separation minima … until visual separation can be applied; or …
>
> **If on completion of an instrument approach the first aircraft is required to execute a visual circling manoeuvre to the runway-in-use, care must be taken to ensure that there is no likelihood of confliction by a following aircraft on instrument approach.** [emphasis in original].

3.7.40. The instructor said later that a following aircraft would not be cleared for its approach until the preceding aircraft was manoeuvring visually.

## 3.8. Organisational and management information

3.8.1. Pacific Blue is a New Zealand-registered airline based at Christchurch, and a partner of Virgin Australia. The airline commenced operations in 2004 between New Zealand and Australia and some Pacific island destinations. Domestic services between New Zealand main centres started in 2007, with Queenstown services added from September 2009.

3.8.2. Pacific Blue holds an air operator certificate issued by the CAA and its aeroplanes are on the New Zealand aircraft register. The Chief Executive, Manager Aircraft Operations and many of the senior operational managers and pilots are former employees of New Zealand airlines and have personal experience of Queenstown operations.

3.8.3. The airline's risk register referred to the complexity of operations at Queenstown and made numerous references to the need to stabilise its pilot experience levels in order to mitigate some of the related hazards, such as collision with terrain, weather assessment and flights in adverse weather. A frequently identified 'treatment' for those risks was the introduction of Required Navigation Performance procedures, which the airline had hoped to achieve by winter 2011.

## 3.9. Other occurrences

3.9.1. Two other occurrences illustrated the difficulty in assessing weather conditions behind Deer Park Hill. On 22 June 2010, a Pacific Blue Boeing 737 was reported to have flown at low level soon after taking off from Queenstown Aerodrome runway 23 and while following the Bowen 3 departure procedure.[36] Information received at the time suggested the flight encountered low cloud shortly after take-off, but then the aeroplane climbed rapidly from a position behind Deer Park.[37]

3.9.2. On 13 July 2011, a Pacific Blue flight departing Queenstown Aerodrome on the Bowen 3 procedure encountered rapidly reducing flight visibility soon after take-off. The pilots decided that the safest course of action was to continue the climb following the procedure.[38]

## 3.10. Other information

3.10.1. During this inquiry, the Commission heard that the CAA had a number of its departments conducting risk assessments relevant to Queenstown operations, and that Airways was in the process of completing a Queenstown Tower Five Year Strategic Plan 2011-2016. The CAA advised that its risk assessments, which had different completion dates, included, but were not limited to, the following areas:

- the safety investigation of recent occurrences (including the subject of this inquiry)
- the installation of runway lighting and a likely proposal for night operations
- a safety review of conventional flight operations (e.g., VOR/DME approaches)
- a review of the minima for Required Navigation Performance operations.

3.10.2. Airways provided a copy of its report on their 5-year strategic plan, which stated the aim was to 'identify the procedures, processes, technology and resources required for Airways to safely manage the projected growth of Queenstown Aerodrome between 2011 and 2016'.[39] The report covered, among many topics, the rapid growth in jet traffic; the proposed and anticipated infrastructure changes by the airport operator; and the inadequacy of the current route structure, equipment and staff to handle that growth.

[36] The Bowen departure procedure included a requirement for the pilot to maintain visual contact with terrain while climbing behind Deer Park Hill until the aircraft had reached a prescribed minimum altitude.
[37] CAA occurrence number 10/2508.
[38] CAA occurrence number 11/3132.
[39] Airways, Queenstown Tower Five Year Strategic Plan 2011-2016, 3 August 2011.

# 4. Analysis

4.1. The mountainous terrain and weather associated with Queenstown Aerodrome make aircraft operations there challenging and potentially more hazardous than at most other airports in New Zealand. The establishment of the VOR/DME and related instrument approaches in 1994 improved access, although the high approach minima meant that jet aeroplanes were not guaranteed to complete every approach.

4.2. Recent advances in RNAV systems mean that true 'all weather' operations are now available for flights approved to use that technology. Those airlines using approved RNAV procedures are tending not to revert to conventional approaches if the required navigation performance is not available, but even though the majority of scheduled services will soon be authorised for RNAV approaches, non-precision approaches will continue to be used for some time.

4.3. The Commission did not investigate further whether the minimum required 1000 ft vertical separation between the 2 aeroplanes had been breached, because it was clear that the potential for such a breach was high and that alone was a safety issue that needed addressing.

4.4. In addition, a mismatch between the understanding of pilots and ATC in regard to their respective operational practices was identified. The investigation also identified some safety issues that had been suspected or recognised by the industry prior to this incident, but not adequately defined or resolved.

4.5. The key feature of this incident was that the pilots of the Pacific Blue aeroplane had a different understanding from the controller of what they would do in the event of commencing a missed approach from a circling manoeuvre. The different understanding resulted from a mismatch between the various documented procedures available to pilots and controllers. The incident also identified other safety issues that are discussed in the following order:

- the suitability of the meteorological conditions for the Pacific Blue flight
- the awareness of meteorological conditions behind Deer Park Hill
- whether Queenstown circling approaches comply with PANS-OPS
- pilot understanding of the design of instrument approach procedures
- the separation of arriving IFR aircraft
- the validity of the figure-8 circuit and its suitability for jet aircraft
- the protection of the missed approach
- the naming of RNAV approaches
- the safety of operations at Queenstown Aerodrome.

### The suitability of the meteorological conditions

4.6. The cloud base and visibility reported in the automated aerodrome information 'Foxtrot' and 'Golf' were better than the approach minima of 4700 ft and 10 kilometres for Pacific Blue's Boeing 737 aeroplanes. Therefore the pilots were justified in commencing the VOR/DME approach. The pilots had not listened to 'Golf', but the controller had twice indicated that they should be able to land and had also said that conditions might be better south of Deer Park Hill. It was not until they had entered an orbit at the minimum descent altitude, having been cleared for a circling approach, that they saw that the actual conditions were worse than they had expected.

4.7. Because of the unusually high minimum descent altitude and the need to circle in mountainous terrain and possibly demanding weather, a pilot's decision to descend for a landing can be more difficult to make at Queenstown than at other aerodromes. Looking down from 3500 ft above the aerodrome, the Pacific Blue pilots had a clear view of the cloud around the aerodrome and behind Deer Park Hill, but had difficulty determining the height of the cloud tops there. However, what they saw, together with the earlier advice from ATC that

there was cloud at 1000 ft above the ground throughout the basin, should have led them to conclude that conditions were marginal for a landing. The pilots were better placed than the controller to assess the conditions, because the controller could not see behind Deer Park Hill; yet a short time later, while circling for runway 05, they asked the controller about the cloud to the south and in the Frankton Arm. This late request and their earlier comment about 'trying' for runway 05 suggested that the pilots had not assessed correctly the conditions while overhead, but that after descending below the approach minimum descent altitude of 4700 ft, they did recognise that the conditions were marginal. The inquiry found that the requirements to be met for descent below an approach minimum descent altitude were not understood correctly by all operators and pilots.

4.8. When lower cloud ahead of the aeroplane made it unlikely that they would be able to maintain visual reference with the runway, the Pacific Blue pilots, as required by Civil Aviation Rule 91.413(e), executed a missed approach.

4.9. Published instrument approach minima are stated in terms of cloud base and flight visibility only, and do not consider lesser amounts of cloud below the minimum descent altitude. A pilot conducting an instrument approach must decide whether conditions are suitable for a landing, in accordance with company procedures. At aerodromes where a circling approach can be flown at the minimum descent altitude, lower cloud patches might not bother a pilot who joins the circuit pattern and can remain at the minimum descent altitude until intercepting the visual descent profile to the runway. Should visual reference with the runway or terrain be lost, the aircraft is already safe at the minimum descent altitude and the pilot needs only to climb to join and fly the published missed approach.

4.10. In contrast, the unusually high minimum descent height at Queenstown means a pilot must start losing some of that height as soon as the decision is made to land, in order to intercept an acceptable final approach path to the runway. The mountainous terrain dictates a circling flight path that, for the most part, bears no resemblance to a normal aerodrome circuit pattern, but that does align with part of the figure-8 visual circuit. While the aeroplane is below the minimum descent altitude, lower cloud can restrict visual reference and the safety of the manoeuvre. If visual reference with the runway or ground is lost, a missed approach is required and that will be started from below the minimum descent altitude. At aerodromes like Queenstown where terrain is such a dominant factor, airline operational procedures should give guidance on the acceptability of cloud below the minimum descent altitude. The Pacific Blue operations manuals did not address this issue.

**Finding:**

The reported meteorological conditions were acceptable for the Pacific Blue flight to commence the instrument approach, but, because of low cloud behind Deer Park Hill, were not suitable for the flight to have descended below the instrument approach minimum altitude.

### Awareness of meteorological conditions behind Deer Park Hill

4.11. The visual circling manoeuvre to runway 05 and the visual segments of instrument departure procedures from runway 23 are almost wholly to the south of Deer Park Hill, out of sight of controllers in the aerodrome tower. When weather conditions are fluctuating or marginal, controllers rely on pilot reports of cloud behind Deer Park Hill. The problem is that under such conditions, fewer VFR flights operate, which reduces the frequency of such reports.

4.12. The inability of Queenstown ATC and flight crews preparing to depart the aerodrome to observe directly the meteorological conditions behind Deer Park Hill deprives them of essential information. This can be critical for IFR departures, as they include visual segments during which pilots are required to maintain visual contact with terrain until reaching the start of the relevant instrument segments. For arrivals and departures, if unsuitable conditions are unexpectedly encountered behind Deer Park Hill, the imperative of terrain clearance might require a pilot to deviate from the published procedure, contrary to the controller's expectation.

4.13. The conditions behind Deer Park Hill are largely irrelevant to operators who are authorised to conduct Required Navigation Performance approaches, as they can remain in instrument meteorological conditions as late as alignment with the runway. Although the majority of scheduled jet aeroplane services are soon likely to be approved for Required Navigation Performance procedures, the continued use of non-precision approaches and departures that incorporate visual segments suggests that the lack of a reliable system for remotely observing conditions behind Deer Park Hill, for example, a camera system, is a safety issue. A recommendation was made to the Director that he require Airways and the operator of Queenstown Aerodrome to address that safety issue.

**Finding:**

The inability of air traffic controllers and pilots of aircraft taking off to observe the meteorological conditions behind Deer Park Hill, an area in which pilots must be able to maintain visual contact with terrain, is a safety issue that needs to be resolved.

### Whether Queenstown circling approaches comply with PANS-OPS

4.14. The PANS-OPS circling procedure assumes that an aircraft will transition from the instrument approach to join the aerodrome circuit pattern, remaining at or above the minimum descent altitude and that its pilot will keep the runway environment in sight. The minimum descent altitude must be maintained until the aircraft is in a position to descend to the runway at a normal rate of descent and using normal manoeuvres.

4.15. Once a pilot descends below the minimum descent altitude, Rule 91.413(c) must be complied with at all times. This requires identifiable features of the runway to be kept in sight and the aeroplane to be continuously in a position from which only a normal rate of descent using normal manoeuvres is required until landing. This is not a requirement that only need to be satisfied at the point when the decision is made to descend below the minimum descent altitude.

4.16. Most of the manoeuvring after making a non-precision approach to Queenstown Aerodrome is conducted below the minimum descent altitude because of the unusual amount of height to be lost before the aircraft is in a position for a steady descent to align with the runway. The extensive circling is not a normal manoeuvre as envisaged by PANS-OPS, and it can involve orbits, aerodrome flyovers and positioning behind terrain, during which the runway or threshold cannot be kept in sight continuously. Therefore, particularly for pilots of jet aeroplanes, compliance with the PANS-OPS and Civil Aviation Rule 91.413(c) requirements throughout the circling manoeuvre is not always possible.

4.17. The practical considerations when descending from a high minimum descent height in difficult terrain are acknowledged, but the accepted practice at Queenstown conflicts with the Rules because under normal circumstances an identifiable feature of the runway cannot be kept in sight continuously while operating below the minimum descent altitude. The differences between procedure and practice beg the question as to whether a transition from a non-precision approach to a landing at Queenstown Aerodrome is a true 'circling' approach.

4.18. The question applies to all aircraft, but the implication for jet aeroplanes is of more concern because they operate at higher speeds and are less manoeuvrable than smaller aircraft. Whether the initial approval of the VOR/DME approach had some associated assumptions or conditions, as some experienced jet pilots believed, could not be determined, because the records of the project that established the approach could not be found in CAA archives.

4.19. The difficulty in ensuring literal compliance with some of these PANS-OPS procedures at Queenstown was acknowledged by some senior staff of the CAA, Airways and airlines. Tacit acceptance of non-compliant procedures creates an unsafe precedent and can lead to false or inconsistent assumptions being made by participants about the correct procedure. It would be better to acknowledge any special requirements for aircraft operating into Queenstown and to design the procedures accordingly. Therefore, the Commission is recommending that the Director require non-precision approaches at Queenstown to be re-evaluated to determine

whether any rule exemptions or procedural requirements are necessary to enable safe circling manoeuvres.

**Finding:**

Pilots, particularly those of jet aeroplanes, making non-precision approaches to Queenstown Aerodrome cannot fully meet the PANS-OPS requirements for such approaches because the runway cannot be kept in sight at all times when circling below the minimum descent altitude.

### Pilot understanding of the design of instrument approach procedures

4.20. The incident suggested that the Pacific Blue pilots might have misunderstood some aspects of the design of instrument approach procedures e.g. that there is no assured obstacle clearance when operating below the minimum descent altitude, even though the aircraft might remain within the horizontal limits of the circling area; and that obstacle clearance on the missed approach is predicated on the procedure being initiated from not below the minimum descent altitude and no later than the missed approach point (in this case the VOR/DME. However, it was likely that the procedures were not as well understood by pilots generally as they should have been.

4.21. The captain said he believed he took the safest course available to him at the time and place that he abandoned the landing. The action was effectively an 'escape' manoeuvre, which was achieved safely only because the pilots were able to keep the terrain in sight until they intercepted the missed approach track, and the aeroplane had ample climb performance. If the aeroplane had entered cloud, even while following the PANS-OPS procedure of turning towards the aerodrome and the VOR/DME while climbing to the minimum descent altitude, the manoeuvre would have been hazardous. The captain said that making a right turn to join the visual circuit would have been difficult, and Deer Park Hill would also have been an intervening obstacle. The pilots commented that they had kept within the circling radius of the runway end while climbing directly to intercept the missed approach track, but the circling area offered no assurance of terrain clearance while operating below the minimum descent altitude.

4.22. The aeroplane was passing 6300 ft and about 7 miles from the missed approach point (the VOR/DME) when it joined the prescribed missed approach track. The design minimum altitude at 7 miles was 5528 ft; therefore by then the aeroplane was above the missed approach profile.

4.23. Circling approaches into Queenstown Aerodrome appear to deviate routinely from the Civil Aviation Rule 91.413(e) requirements for a mandatory missed approach. One example is losing sight of the runway when operating below the minimum descent altitude, which inevitably happens when flying a descending orbit to position for either runway, and which can also occur when over-flying the aerodrome or passing behind Deer Park Hill for runway 05. Although the Rule allows a pilot to lose sight of an identifiable part of the aerodrome owing to normal manoeuvring of the aircraft e.g. when banked into a turn, that exception applies only when the aircraft is at or above the minimum descent altitude.

4.24. The non-compliance had probably become routine because of the impracticality of achieving a landing at Queenstown if one were to observe the Rule strictly, and because the AIP restatement of the Rule was incomplete and inaccurate, in that it omitted the requirement to carry out a missed approach if the pilot lost sight of the runway while operating below the minimum descent altitude. Although the Rule had precedence, it was likely that pilots, generally, were more familiar with the text of the AIP.

**Findings:**

The Pacific Blue pilots were forced to fly an escape manoeuvre, but maintained visual contact with terrain until they intercepted the prescribed missed approach track at a point where they were above the procedure minimum height.

The incomplete and inaccurate AIP reference to Civil Aviation Rule 91.413(e) was likely a factor in the routine non-compliance with the Rule by pilots making non-precision approaches to Queenstown Aerodrome.

### The separation of arriving IFR aircraft

4.25. The estimated arrival times for the 2 aeroplanes were originally about 10 minutes apart, but the gap had reduced to 5 minutes by the time Pacific Blue was cleared for its instrument approach. The gap was reduced further by Qantas changing to the RNAV 05 ZULU approach, which reduced the distance to touchdown, and then again by Pacific Blue orbiting before circling for runway 05.

4.26. The approach sequence for arriving flights is essentially in order of their estimated arrival times, although a controller has some scope to vary the sequence for overall efficiency. Without radar, ATC relies on pilots' position reports. As Qantas was not using the VOR/DME approach aid, the controller had to convert mentally its RNAV position reports and estimates into a range and bearing from the VOR/DME in order to relate the Qantas flight progress to that of Pacific Blue.

4.27. The controller cleared Qantas for the RNAV runway 05 ZULU approach after seeing Pacific Blue above the aerodrome and after its pilots had confirmed they were circling for runway 23. About 2 minutes after Pacific Blue had advised it was circling for runway 05, the controller added a check against a loss of separation by instructing Qantas to report passing 6000 ft. This instruction was based on the controllers' expectation, which they assumed the Pacific Blue pilots shared, that Pacific Blue would remain in the visual circuit at 4000 ft if it did not land.

4.28. Controllers, generally, expected that a flight would land if its pilot had requested to circle, which was a reasonable expectation given their collective experience. The Queenstown controllers certainly did not expect a circling IFR aircraft to follow the published missed approach procedure if it did not land.

4.29. The belated 6000 ft reporting requirement did not remove the risk of a loss of separation in the unlikely event of a subsequent communications failure between ATC and Qantas. Qantas was cleared for the approach 'in accordance with the profile' and therefore, without further communication, could have descended through the visual circuit altitude to the much lower decision altitude for its approach. If Pacific Blue had been in the figure-8 circuit, the Qantas flight would have been joining an almost identical track. Composite visual separation could not have been applied by the controller under such circumstances, because it was unlikely that the Pacific Blue aeroplane could have been kept in sight continuously.

4.30. Had Pacific Blue joined the visual circuit, the controller expected to preserve vertical separation by instructing Qantas to fly its missed approach, but if there had been a communications problem and Qantas had continued its approach, the controller would not have been able to revert to visual separation of the aeroplanes. The local terrain did not offer an alternative area for Pacific Blue to hold where the controller could keep it in sight. A loss of separation would have occurred.

4.31. Therefore, the approach clearance issued to Qantas did not meet the Manual of Air Traffic Services' requirements for the separation of IFR arrivals.

4.32. The Pacific Blue pilots had not planned to join the figure-8 circuit if they did not land. If, instead of flying the direct escape manoeuvre, they had turned back towards the aerodrome while climbing to the missed approach altitude of 8500 ft, a more hazardous loss of

separation might have ensued, because Qantas had already been cleared to descend through the same area.

4.33. The earlier arrival of Qantas in the vicinity of the aerodrome greatly reduced the 'cushion' that the controller had anticipated between the 2 flights, and contributed to the separation reducing when Pacific Blue discontinued its circling descent for the runway. However, because the Qantas aeroplane was high on its approach profile, the separation did not become critically close.

4.34. The concurrent approaches by aircraft using different approach aids and operating under distinctly different criteria placed a high mental workload on the controllers, particularly as there was training in progress and the weather was marginal. The incident suggested that the procedures used and tools available to the controllers did not give them certainty that the aircraft would be separated at all times until the first aeroplane landed.

4.35. The Pacific Blue pilots executed a rapid climb and followed what they believed was essentially the procedure they had discussed before they commenced the instrument approach. The captain had no choice but to climb, because the manoeuvre was initiated at a point that, in this case, he determined did not allow him to turn back towards the aerodrome. Their aeroplane quickly exceeded the 4000 ft limit of the visual circuit that the controller had assumed they would follow. However, at no prior time had ATC requested or instructed Pacific Blue to enter or remain in the visual circuit in the event of not landing.

**Findings:**

The procedure for circling below the minimum descent altitude after an instrument approach to Queenstown Aerodrome needs to be clarified to ensure pilots and controllers are in no doubt as to their respective actions to achieve separation from other traffic.

The minimum required separation between the 2 IFR aeroplanes was not assured because the approach clearance issued to Qantas did not allow for a potential communications failure and it was based on the controllers' shared assumption that Pacific Blue would, without further instruction, remain in the visual circuit in the event of not landing.

Had the Pacific Blue pilots turned back towards the aerodrome while climbing to the missed approach altitude of 8500 ft, which was possible under PANS-OPS, a more hazardous scenario might have ensued, because Qantas had already been cleared to descend through the same area.

### The validity of the figure-8 circuit and its suitability for jet aircraft

4.36. The figure-8 circuit was introduced to avoid a recognised potential conflict between light aircraft in the aerodrome circuit, particularly the circuit for the crossing runway, and a large (jet) aircraft going around instead of landing on the main runway. However, as IFR aircraft are necessarily operating in visual conditions when circling after an instrument approach, and the Manual of Air Traffic Services and the AIP said a circling IFR aircraft should enter the aerodrome circuit in the event of a go-around, the procedure came to be Airways' default means for protecting the missed approach.

4.37. The intended use of the figure-8 circuit by large aircraft was apparently not clearly explained to airlines, whose policies and practices, together with pilot perceptions, showed that the circuit was seen as a VFR procedure. That view was supported by the procedure chart being placed in the AIP and in the Jeppesen binder well removed from the instrument approach procedures. There was no reference on any chart that the pilot of a large aircraft should, without prior instruction from ATC (which the Manual of Air Traffic Services required), enter or remain in the figure-8 pattern in the event of a missed approach commenced while circling.

4.38. The figure-8 procedure introduced circuit directions for large aircraft that were different from those already published (for light aircraft). Airways and the CAA had the view that the figure-8 circuit was an allowable ATC tactical intervention and therefore not subject to Civil Aviation

Rule Part 93, but the text of the procedure as published in the AIP, and Airways' expectation of using it to protect a missed approach, showed that it was intended to be a permanent procedure. Therefore, the original proposal in 2004 to introduce right-hand circuits should have been submitted to the CAA for the Director's approval.

4.39. The large-aircraft circuit procedure assumed that, in the event of a go-around, a pilot could descend to 2200 ft initially before climbing to 4000 ft. However, low cloud could be the reason for a go-around when manoeuvring after an instrument approach and also prevent compliance with this procedure. Such weather conditions would not necessarily prevent VFR operations in the control zone.

4.40. The chief controller described the figure-8 circuit as very rarely used, which suggests that IFR pilots routinely make good decisions about the suitability of conditions for a circling approach and landing. However, as it is a necessary contingency procedure, Airways should ensure that the procedure is properly approved, described and clearly communicated to potential users.

**Findings:**

Airways had not clearly explained to operators that it expected large aircraft that did not land at Queenstown after circling to enter the visual aerodrome circuit.

The visual circuit procedure put in place by Airways for large aircraft at Queenstown should have had the approval of the Director because it was intended as a permanent change that introduced or varied right-hand circuits.

### The protection of the missed approach

4.41. There was a clear mismatch between what the Pacific Blue pilots expected to do and what the controllers expected them to do in the event that Pacific Blue discontinued the circling. The pilots understood that when they had been cleared for an instrument approach ATC protected the associated published missed approach. That understanding was supported by the statements in the PANS-OPS, the Manual of Air Traffic Services and the AIP that in the event of a missed approach a pilot should fly the published missed approach procedure. However, whether that rule always applied when circling below the minimum descent altitude was unclear.

4.42. The means available to ATC to protect the missed approach can be affected by the instrument procedure minimum descent height. For a low minimum height and a typical circling procedure flown at the minimum descent altitude, the meteorological conditions might not permit ATC to instruct the first aircraft to remain in the visual circuit if it did not land. Therefore, ATC must continue to protect the published missed approach procedure of the circling aircraft, in effect, until it lands.

4.43. Where there is a very high minimum descent height, as at Queenstown, a pilot's decision to descend for circling must be supported by meteorological conditions that are also suitable for the visual circuit. That would allow ATC to protect the missed approaches of both aircraft by instructing the first aircraft to enter the aerodrome visual circuit, or by having an unambiguous published procedure that it will do so. The figure-8 circuit procedure published at the time of this incident did not make that clear, but it was later amended (see paragraph 6.2).

4.44. The need to avoid the difficult ATC situation that could result should the first aircraft then make an emergency climb e.g. if its pilot lost visual contact with terrain, underscored the importance of the first pilot correctly appraising the conditions before descending below the minimum altitude.

4.45. ATC always protected the missed approach of the following aircraft, but if the first aircraft had reported that it was continuing visually, and conditions allowed, its missed approach might be protected by requiring it to enter the aerodrome visual circuit. The Manual of Air Traffic Services differed from the AIP in describing the means of implementing that procedure. The ATC manual required a controller to 'instruct' the pilot to enter the circuit and, although noting

that an IFR aircraft on a visual approach 'should continue in the circuit', the manual added that this 'should be confirmed by a positive circuit clearance/instruction'.

4.46. The Pacific Blue captain doubted that he could have turned right into the figure-8 circuit from the point he commenced a missed approach, had ATC given him earlier notice to do so, which indicated that the aeroplane was not on an appropriate ground track for runway 05. That was likely due to cloud obscuring the landmarks he normally used to position for that runway.

4.47. In spite of the guidance in the Manual of Air Traffic Services, Airways' controllers had taken the AIP interpretation as their default position when weather conditions permitted. The provision works at most New Zealand aerodromes, including other international airports, but at Queenstown the terrain and the nature of the figure-8 circuit demand a more cautious use of this procedure. In any event, to ensure separation, controllers should take positive action rather than rely on what they have incorrectly assumed will be the default response by pilots.

4.48. From their first contact with the Pacific Blue flight, the controller described low cloud in the Queenstown basin and around the aerodrome. The low cloud ought to have alerted the controllers and the pilots that conditions were probably unsuitable for a jet aeroplane to remain in the visual circuit. For that reason, the controllers could have protected the missed approach for Pacific Blue by another means, such as waiting until Pacific Blue had landed before clearing Qantas for its approach.

4.49. During the incident, the altitude separation at first reduced because Pacific Blue was climbing rapidly while Qantas was still descending. Once Qantas began its missed approach at maximum climb rate, the altitude difference steadied at about 2000 ft before it slowly reduced to a minimum of about 1000 ft.

4.50. Airways later amended the AIP to clarify the general requirement for an aircraft on a missed approach to enter the aerodrome visual circuit. It also noted that an operator could inform Airways if its aircraft would not carry out that procedure generally, or specifically at Queenstown Aerodrome, rather than have individual pilots make that decision on the day.

**Findings:**

Had the controllers realised that the low cloud around the aerodrome made the visual circuit unsuitable for a jet aeroplane, they could have protected the missed approach for Pacific Blue by a more positive means, such as not clearing Qantas for its approach until Pacific Blue had landed.

The controllers and the pilots of the Pacific Blue aeroplane did not share the same understanding of how the published missed approach would be protected while Pacific Blue was circling. The different texts in the AIP and the Manual of Air Traffic Services at that time contributed to that misunderstanding.

### The naming of RNAV approaches

4.51. The introduction of RNAV approaches at Queenstown has created an information gap for operators unfamiliar with them. These approaches are complex, and the complexity extends to the naming of the waypoints that define the procedure tracks. The names are not necessarily related to familiar geographical or radio-navigation aids used for conventional approaches, or to the visual reporting points used by pilots when passing their position to ATC. Therefore, radiotelephony references to waypoints that cannot be visualised by pilots unfamiliar with the associated RNAV procedures will be meaningless to those pilots.

4.52. The Pacific Blue pilots knew little about the RNAV approaches, which led to their concern for the proximity of the Qantas flight when they began the missed approach. That concern was not unfounded, because the Qantas crew, in their internal report on the incident, had abbreviated the approach name to 'RNAV 05' approach, which would have been head-on, whereas they were cleared (and actually flew) the RNAV runway 05 ZULU approach. The error in the incident report might have been an unintentional abbreviation, but a similar error when writing down an actual approach clearance could precede a serious incident.

4.53. The similar titles of the 'RNAV runway 05' and 'RNAV ZULU runway 05' approaches met ICAO requirements, and the same naming convention was used for VOR/DME approaches. Although not relevant to this incident, the naming convention could cause confusion when applied to the titles of different instrument approaches to a particular runway.

4.54. The hazard arises because the runway designation is included in the approach title, whereas non-precision circling approaches are not to specific runways. Such a hazard is similar to the recognised hazard of similar radiotelephony call-signs for different flights or aircraft, which has on occasions led to pilots erroneously acting on ATC instructions meant for other aircraft and to controllers taking action based on mistaken aircraft reports. A recommendation was made to the Director to seek to eliminate this use of similar titles for different approaches to the same runway.

**Findings:**

Pilots who are not approved for or not familiar with RNAV procedures may not understand radioed position reports that refer to RNAV waypoints. The communication gap that this potentially creates is a safety issue.

Although not a factor in this incident, the use of similar titles for different RNAV approach procedures to the same runway is a hazard that could result in an aircraft flying the wrong approach.

### The safety of operations at Queenstown Aerodrome

4.55. The approach and departure flight paths around Queenstown Aerodrome are surrounded by high terrain that severely limits flight path options. For this reason, operational procedures need to be clearly formulated and described, and thoroughly understood and stringently applied by all participants. The potential hazards demand strict operational discipline to reduce the risks to an acceptable level.

4.56. The highly accurate Required Navigation Performance procedures offer significantly improved safety, greater flexibility and an increased chance of aircraft landing. However, they are independent of ground-based navigation aids, so the integration of aircraft using Required Navigation Performance procedures with those using conventional navigation aids in the non-radar airspace places additional demands on controllers, and can leave pilots using conventional navigation aids 'out of the picture'.

4.57. Seemingly unrelated incremental changes and the condoning of a less-strict adherence to procedures can, over time, aggregate to produce unintended adverse effects on system safety and performance. At Queenstown, some operational practices appear to have 'drifted' from the original specifications, and taken together these changes may have raised the risk profile of operations there. Examples of these changes are the long-standing acceptance of circling approaches that at times cannot be in compliance with the Rules, the lack of guidance on the acceptability of approaches when there is cloud below the minimum descent altitude, and the evolution of the figure-8 circuit from being a simple go-around procedure to also the expected procedure if an IFR aircraft discontinues a circling manoeuvre.

4.58. Another example of system drift leading to unintended deviations from the expected standard is the different wording for a given rule or topic that can be found when comparing operational documentation such as:

- PANS-OPS and other ICAO standards
- Civil Aviation Rules
- the AIP
- airline operations manuals
- the Manual of Air Traffic Services.

4.59. The examples given in this report of differences between Civil Aviation Rules and airline manuals, and the Manual of Air Traffic Services and the AIP, have been raised in the context of Queenstown operations, but they affect operations at any aerodrome.

4.60. Air traffic controllers and pilots primarily use their own organisations' manuals, which are governed by, and in part based on, Civil Aviation Rules. The Rules adopt many of the standards and recommended practices of ICAO. The AIP is a mix of mandatory and advisory information, as are the Jeppesen guides, which source much of their information from PANS-OPS and the national AIPs of other countries. In theory, a pilot or controller should be able to perform their duty primarily by reference to their organisation's manuals.

4.61. Although it is intended that the manuals of ATC providers and airlines, and the AIP, will comply with relevant source documents of higher authority, such as the Civil Aviation Rules, there are inconsistencies between some manuals, even for text copied from the same source document. Examples given in this report are the AIP restatement of Civil Aviation Rule 91.413 and of the Manual of Air Traffic Services' means for protecting the missed approach. As this incident showed, 'front-line' operators such as pilots and controllers are unlikely to know that their respective organisation's manuals conflict in regard to some mutually important matters.

4.62. The manuals used by certificated organisations, such as Airways and airlines, are approved by the CAA. However, the CAA considered that the onus was on document holders to ensure that the information and procedures that they published were accurate. The CAA did not have a process, such as audits, to ensure that the content of manuals was accurate, nor to check that common-source material was reproduced consistently by all users. Therefore, the Commission is recommending to the Director that he ensure that operational material published by document holders and approved by the Director is accurate and consistent across all users and complies with the prescribed relevant standards.

4.63. Queenstown Aerodrome has special characteristics that make soundly based and consistently applied procedures essential for safety, so the above evidence of system drift suggests that a review of the entire air traffic management system and operational procedures used there could be timely. Factors that make such a review necessary include, but are not limited to:

- the increase in the number of domestic and international jet aeroplane services at Queenstown
- the predictable corresponding increase in VFR traffic and adventure aviation activities there
- the increasing use of Required Navigation Performance arrival and departure procedures
- the conduct of circling approaches after a VOR/DME approach
- the absence of a radar facility below 10 000 ft
- the conduct of ATC training at Queenstown
- the recent installation of aerodrome lighting and the likely demand for night operations
- the access of VFR traffic and adventure aviation activities to airspace, which is limited by the surrounding high terrain and shared by an increasing amount of jet traffic.

4.64. The Commission acknowledged the current work being undertaken by the CAA and Airways in regard to operations at Queenstown Aerodrome, noting that the 2 projects, between them, covered all of the above issues identified by the Commission. The Commission recommended that the Director of Civil Aviation ensure that the strategic plan being developed by Airways and the risk assessment being conducted by the CAA consider the safety issues identified in this inquiry.

**Findings:**

It is likely that the level of risk with flight operations at Queenstown Aerodrome has increased because of changes in the variety and intensity of operations.

There is no effective means of ensuring that the common operational information and procedures published by certificated organisations for their internal use are accurate and consistent. That deficiency inevitably results in differences that lead to misunderstandings between operational staff, which can compromise the safety of operations.

# 5. Findings

5.1. The reported meteorological conditions were acceptable for the Pacific Blue flight to commence the instrument approach, but, because of low cloud behind Deer Park Hill, were not suitable for the flight to have descended below the instrument approach minimum altitude.

5.2. The inability of air traffic controllers and pilots of aircraft taking off to observe the meteorological conditions behind Deer Park Hill, an area in which pilots must be able to maintain visual contact with terrain, is a safety issue that needs to be resolved.

5.3. Pilots, particularly those of jet aeroplanes, making non-precision approaches to Queenstown Aerodrome cannot fully meet the PANS-OPS requirements for such approaches because the runway cannot be kept in sight at all times when their aircraft are circling below the minimum descent altitude.

5.4. The Pacific Blue pilots were forced to fly an escape manoeuvre, but maintained visual contact with terrain until they intercepted the prescribed missed approach track at a point where they were above the procedure minimum height.

5.5. The incomplete and inaccurate AIP reference to Civil Aviation Rule 91.413(e) was likely a factor in the routine non-compliance with the Rule by pilots making non-precision approaches to Queenstown Aerodrome.

5.6. The procedure for circling below the minimum descent altitude after an instrument approach to Queenstown Aerodrome needs to be clarified to ensure pilots and controllers are in no doubt as to their respective actions to achieve separation from other traffic.

5.7. The minimum required separation between the 2 IFR aeroplanes was not assured because the approach clearance issued to Qantas did not allow for a potential communications failure and it was based on the controllers' shared assumption that Pacific Blue would, without further instruction, remain in the visual circuit in the event of not landing

5.8. Had the Pacific Blue pilots turned back towards the aerodrome while climbing to the missed approach altitude of 8500 ft, which was possible under PANS-OPS, a more hazardous scenario might have ensued, because Qantas had already been cleared to descend through the same area.

5.9. Airways had not clearly explained to operators that it expected large aircraft that did not land at Queenstown after circling to enter the visual aerodrome circuit.

5.10. The visual circuit procedure put in place by Airways for large aircraft at Queenstown should have had the approval of the Director because it was intended as a permanent change that introduced or varied right-hand circuits.

5.11. Had the controllers realised that the low cloud around the aerodrome made the visual circuit unsuitable for a jet aeroplane, they could have protected the missed approach for Pacific Blue by a more positive means, such as not clearing Qantas for its approach until Pacific Blue had landed.

5.12. The controllers and the pilots of the Pacific Blue aeroplane did not share the same understanding of how the published missed approach would be protected while Pacific Blue was circling. The different texts in the AIP and the Manual of Air Traffic Services at that time contributed to that misunderstanding.

5.13. Pilots who are not approved for or not familiar with RNAV procedures may not understand radioed position reports that refer to RNAV waypoints. The communication gap that this potentially creates is a safety issue.

5.14. Although not a factor in this incident, the use of similar titles for different RNAV approach procedures to the same runway is a hazard that could result in an aircraft flying the wrong approach.

5.15. It is likely that the level of risk with flight operations at Queenstown Aerodrome has increased because of changes in the variety and intensity of operations.

5.16. There is no effective means of ensuring that the common operational information and procedures published by certificated organisations for their internal use are accurate and consistent. That deficiency inevitably results in differences that lead to misunderstandings between operational staff, which can compromise the safety of operations.

# 6. Safety actions

## General

6.1. The Commission classifies safety actions by 2 types:

(a) safety actions taken by the regulator or an operator to address safety issues identified by the Commission during an inquiry that would otherwise result in the Commission issuing a recommendation; and

(b) safety actions taken by the regulator or an operator to address other safety issues that would not normally result in the Commission issuing a recommendation.

## Safety actions addressing safety issues identified during this inquiry

6.2. On 10 February 2011, Airways amended AIP page NZQN AD2-51.3, which described the Queenstown figure-8 circuit procedures, to clarify the direction of turns and the procedure altitudes, and amended the chart sub-heading to read:

> '**Procedure if aircraft is maintaining visual reference or circling from an instrument approach and unable to land:** ... ' [emphasis in original].

6.3. On 16 June 2011, Pacific Blue amended its pilot qualification requirements for Queenstown Aerodrome to include initial and recurrent simulator training for first officers.

6.4. On 17 November 2011, Airways amended the Manual of Air Traffic Services and the AIP to state more clearly the minimum weather conditions before the missed approach could be protected by instructing a pilot to enter the aerodrome traffic circuit, and the restrictions upon a controller's use of this procedure. The Manual of Air Traffic Services procedures confirmed that protection of the missed approach shall remain in place until the aircraft has landed.

6.5. On 17 November 2011, the Aerodrome section of the AIP was amended to include the CAA's requirement that pilots of any air transport flight operating to or from Queenstown Aerodrome be qualified for operations there by a comprehensive briefing. a simulator exercise and a minimum of 2 familiarisation flights into and out of the aerodrome.

## Safety actions addressing other safety issues

6.6. Nil

# 7. Recommendations

## General

7.1. The Commission may issue, or give notice of, recommendations to any person or organisation that it considers the most appropriate to address the identified safety issues, depending on whether these safety issues are applicable to a single operator only or to the wider transport sector.

7.2. In the interests of transport safety it is important that these recommendations are implemented without delay to help prevent similar accidents or incidents occurring in the future.

## Recommendations

7.3. On 13 March 2012, the Commission recommended to the Director of Civil Aviation that he:

7.3.1. ensure that the strategic plan being developed by Airways and the risk assessment being conducted by the CAA in regard to Queenstown Aerodrome address the following safety issues in respect of that aerodrome and, if applicable, generally:

i. the variability of procedures used by pilots when circling after a non-precision approach and in the event of not landing off an approach

ii. the separation of aircraft making different types of instrument approach in Queenstown controlled airspace

iii. the appropriateness of the large aircraft visual circuit procedure at Queenstown

iv. the naming convention for RNAV procedure waypoints, which makes waypoint recognition difficult for pilots who are not approved for the procedures (012/12).

7.3.2. take action, in conjunction with certificated instrument flight procedure service organisations, to eliminate the use of similar procedure titles for different instrument approaches to the same runway (013/12)

7.3.3. require non-precision approaches at Queenstown to be re-evaluated to determine whether any rule exemptions or special procedural requirements are necessary to enable safe circling manoeuvres (014/12)

7.3.4. ensure that operational material published by document holders and approved by the Director is accurate and consistent across all users and complies with the prescribed relevant standards (015/12)

7.3.5. require Airways and the operator of Queenstown Aerodrome to install a system that provides controllers with real-time observations of the weather conditions behind Deer Park Hill (016/12).

# 8. Key lessons

8.1. The **key lessons** from this inquiry were:

- a pilot must not descend below the applicable instrument approach minimum descent altitude unless certain that the conditions are suitable for a landing
- pilots must understand the operational assumptions in the design of instrument approach procedures, and how those assumptions determine the limits of safe manoeuvring
- organisations that re-publish mutually important operational information from authoritative sources must ensure that the information is accurately reproduced so that all users interpret the information correctly and apply it consistently.

# 9. Citations

Airways.(n.d). Manual of Air Traffic Services. Wellington.

CAA. (n.d). Aeronautical Information Procdure New Zealand. Wellington.

CAA. (2008). In, out and around Queenstown. Good aviation practice. Wellington.

CAA.(2010). Advisory circular 61-17, Pilot licences and ratings – instrument rating. Rev.7, 14 June 2010. Wellington.

ICAO.(2006a). Procedures for air navigation services – aircraft operations, Vol. 1 Flight procedures. 5th ed. (Doc 8168). Montreal.

ICAO.(2006b). Procedures for air navigation services – aircraft operations, Vol. 2 Construction of visual and instrument flight procedures. 5th ed. (Doc 8168). Montreal.

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