CIVIL AVIATION AUTHORITY
OF NEW ZEALAND

AIRCRAFT ACCIDENT REPORT

CAA OCCURRENCE NUMBER 11/1504

DYN'AERO MCR 01 CLUB

ZK-SML

CONTROLLED FLIGHT INTO TERRAIN

MOUNT DUPPA

09 APRIL 2011

Foreword

As a signatory to the Convention on International Civil Aviation 1944 ("the Chicago Convention") New Zealand has international obligations in respect of the investigation of accidents and incidents. Pursuant to Articles 26 and 37 of the Chicago Convention, the International Civil Aviation Organisation ("ICAO") issued Annex 13 to the Convention setting out International Standards and Recommended Practices in respect of the investigation of aircraft accidents and incidents.

New Zealand's international obligations are reflected in the Civil Aviation Act 1990 ("the Act") and the Transport Accident Investigation Commission Act 1990 ("the TAIC Act").

Section 72B(2)(d) and (e) of the Civil Aviation Act 1990 Act also provides:

> **72B Functions of Authority**
>
> (2) The Authority has the following functions:
>
> (d) To investigate and review civil aviation accidents and incidents in its capacity as the responsible safety and security authority, subject to the limitations set out in section 14(3) of the Transport Accident Investigation Commission Act 1990:
>
> (e) To notify the Transport Accident Investigation Commission in accordance with section 27 of this Act of accidents and incidents notified to the Authority:

Following notification to the Transport Accident Investigation Commission ("the Commission") of any accident or incident which is notified to the Authority, an investigation may be conducted by the Commission in accordance with the TAIC Act. CAA may also investigate subject to the requirements of the TAIC Act.

The purpose of an investigation by the Commission is to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future, rather than to ascribe blame to any person.

CAA however investigates aviation accidents and incidents for a range of purposes under the Act. Investigations are primarily conducted for the purpose of preventing future accidents by determining the contributing factors or causes and then implementing appropriate preventive measures - in other words to restore safety margins to provide an acceptable level of risk. The focus of CAA safety investigations is therefore to establish the causes of the accident on the balance of probability.

Accident investigations do not always identify one dominant or 'proximate' cause. Often, an aviation accident is the last event in a chain of several events or contributing factors, each of which may contribute to a greater or lesser degree to the final outcome.

CAA investigations may also inform other regulatory-safety decision making or enforcement action by the Director.

In the case of a fatal aviation accident, the final CAA investigation report will generally be highly relevant to an inquiry, and in some circumstances, an inquest, conducted by a Coroner.

Contents

Glossary of abbreviations

AGL	Above Ground Level
C	Celsius
CAA	Civil Aviation Authority
E	east
EFIS	Electronic Flight Instrument System
ft	foot or feet
GPS	Global Positioning System
hPa	hectopascals
km	kilometre(s)
m	metre(s)
MHz	megahertz
NASA	National Aeronautics and Space Administration
NZST	New Zealand Standard Time
S	south
SSR	Secondary Surveillance Radar
UTC	Coordinated Universal Time
VHF	very high frequency
VFR	Visual Flight Rules
WGS	World Geodetic System

CIVIL AVIATION AUTHORITY OF NEW ZEALAND

Data summary

Aircraft type, serial number and registration:	Dyn'Aero MCR 01 Club, s/n 393, ZK-SML
Number and type of engines:	One, 100 HP Rotax 912 ULS3
Year of manufacture:	2009
Date and time of accident:	9 April 2011, 1345 hours[1] (approximately)
Location:	Mount Duppa, Bryant Range Latitude[2]: S 41° 13.03' Longitude: E 173° 30.28'
Type of flight:	Private
Persons on board:	Crew: 1
Injuries:	Crew: 1 fatal
Nature of damage:	Aircraft destroyed
Pilot-in-command's licence:	Advanced Microlight Pilot Certificate
Pilot-in-command's age:	86 years
Pilot-in-command's total flying experience:	316 hours, 265 on type
Information sources:	Civil Aviation Authority Field Investigation
Investigator in Charge:	Mr C Grounsell

[1] All times in this report are NZST (UTC + 12 hours) unless otherwise specified.

[2] WGS-84 co-ordinates

Synopsis

At 2135 hours on 09 April 2011 the Civil Aviation Authority (CAA) was notified of a missing microlight aircraft.

The pilot, who was the owner of the aircraft, was conducting a cross country flight from North Shore Aerodrome to Ashburton Aerodrome to visit a friend. When the pilot failed to arrive at Ashburton Aerodrome by the expected time, the pilot's friend contacted the emergency services and a search was commenced. The aircraft was located two days later approximately 15 nautical miles north-east of Nelson on the north-west slope of Mount Duppa which forms part of the Bryant Mountain Range. The pilot was found to be deceased.

The Transport Accident Investigation Commission was notified shortly thereafter, but declined to investigate. A CAA Field Investigation was commenced the following day.

1. Factual information

1.1 History of the flight

1.1.1 On Saturday 09 April 2011 the aircraft departed North Shore Aerodrome for a cross country flight to Ashburton Aerodrome. The purpose of the flight was for the pilot to visit his friend, a microlight flying instructor who had taught the pilot to fly.

1.1.2 At 0751 hours prior to departing for North Shore Aerodrome, the pilot obtained an aviation weather briefing for his intended route from MetFlight.

1.1.3 The pilot phoned his friend in Ashburton at approximately 0800 hours and discussed the route that the pilot intended to fly.

1.1.4 At 1030 hours the pilot was observed by his wife carrying out a pre-flight inspection on the aircraft. Members of the local aero club then observed the aircraft taking off at approximately 1100 hours.

1.1.5 At 1235 hours, Airways Corporation NZ SSR data depicts the aircraft tracking from the vicinity of Hawera on a direct track to D'Urville Island. The aircraft tracks on the eastern side of D'Urville Island and crosses French Pass where the SSR data is lost for a brief period due to the low altitude of the aircraft.

1.1.6 At 1339 hours SSR data is regained with the aircraft in the vicinity of Cape Soucis on a southerly heading, SSR data is lost at 1344 hours with the aircraft approaching the Bryant Range and Mount Duppa.

1.1.7 The pilot did not file a flight plan for his intended flight and there were no recorded radio communications with any Air Traffic Services during the flight.

1.1.8 When the aircraft did not arrive at Ashburton Aerodrome by the expected time, and having received no communication from the pilot, the pilot's friend contacted the Rescue Coordination Centre at 1750 hrs to advise that the aircraft was

overdue. The Rescue Coordination Centre then initiated an extensive search for the aircraft.

1.1.9 The aircraft was located two days later by an RNZAF Iroquois Helicopter crew at 1414 hours on Monday 11 April 2011. An RNZAF crew member was winched down to the crash site where it was confirmed that the pilot was deceased.

1.1.10 The accident occurred in daylight, at approximately 1345 hours on 09 April 2011, approximately 15 nautical miles north-east of Nelson on the north-west slope of Mount Duppa which forms part of the Bryant Mountain Range, at an elevation of 3600 feet. Latitude: S41° 13.03´, Longitude E173° 30.28´.

1.2 Injuries to persons

Injuries	*Crew*	*Passengers*	*Other*
Fatal	1	0	0
Serious	0	0	0
Minor/None	0	0	

1.3 Damage to aircraft

1.3.1 The aircraft was destroyed.

1.4 Other damage

1.4.1 Nil.

1.5 Personnel information

1.5.1 The pilot held a valid Advanced Microlight Pilot Certificate and a current Medical Validation. He had logged approximately 316 hours total flight time and 265 hours on type in his pilot's log book.

1.5.2 The pilot had flown approximately 45 hours in the previous 90 days.

1.5.3 On the day of the accident, he was reported by family to be in good spirits and was looking forward to the flight.

1.6 Aircraft information

1.6.1 Dyn'Aero MCR 01 Club Microlight aircraft, serial number 393 was manufactured in March 2009 by Dyn'Aero France. The aircraft was purchased new by the pilot and registered as ZK-SML. A Flight Permit was issued on 05 August 2009 by the CAA.

1.6.2 The aircraft was powered by a Rotax 912 ULS3 engine driving a MT MTV-6-A three blade variable pitch composite propeller. Up to 09 April 2011 the airframe, engine, and propeller had accrued 352 hours of flight time.

1.6.3 The most recent scheduled maintenance was a 100 hour and Annual Inspection which had been carried out on 13 December 2010.

1.6.4 The aircraft was constructed primarily from carbon fibre composite materials. The aircraft was fitted with long range fuel tanks with a maximum fuel capacity of 220 litres, giving the aircraft a theoretical range of approximately 2000 nautical miles.

1.6.5 The aircraft was fitted with an MGL Avionics Stratomaster Odyssey EFIS[3] system utilising a single display screen. The aircraft was also fitted with a two axis autopilot.

1.6.6 A Ballistic Recovery Systems Inc. emergency parachute recovery system was also installed in the aircraft.

1.7 Meteorological information

1.7.1 At midday on the day of the accident, a large anticyclone was centred in the Tasman Sea. A south to south-west airstream covered the North Island and the north of the South Island, however a localised low level northerly airstream affected the top of the South Island.

1.7.2 Satellite imagery taken at approximately 1100 hours on the day of the accident shows extensive Stratocumulus type cloud cover surrounding the upper South Island. Refer to figure 1 below.

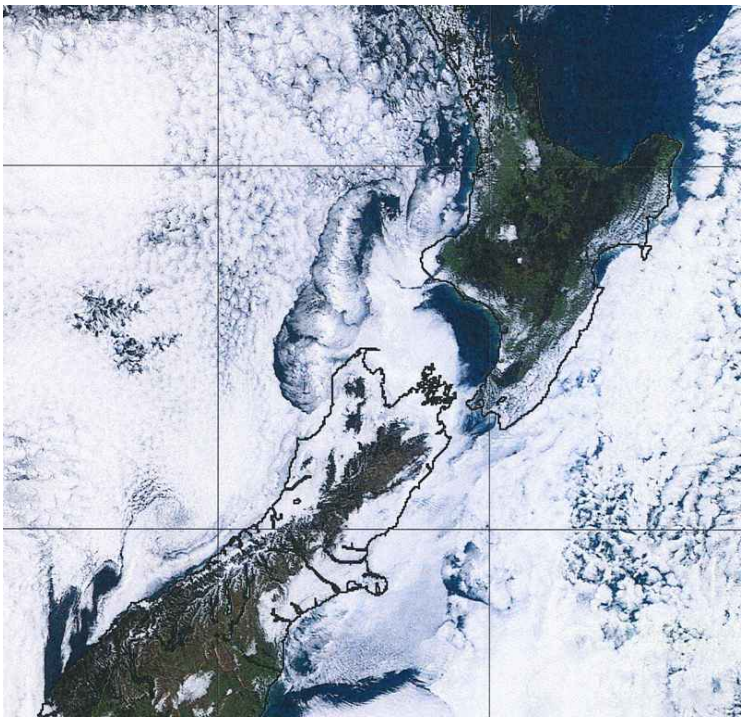

Figure 1: Satellite Imagery

[3] An Electronic Flight Instrument System (EFIS) is an instrument display system in which the display technology used is electronic rather than mechanical gauges.

1.7.3 The Terminal Aerodrome Forecast for Nelson Aerodrome issued at 0943 hours and valid from 0900 hours to midnight, forecast a northerly wind of 10 knots and cloud broken at 3000 feet AGL, visibility was given as 30 km.

1.7.4 Earlier weather information obtained by the pilot on the morning of the accident forecast the cloud in the Nelson region to be areas of broken Cumulus and Stratocumulus cloud forms with the base at 2500 feet AGL with the tops at 7500 feet AGL. The actual weather report from Nelson Aerodrome for conditions observed at 0730 hours indicate that the visibility was 20 km with scattered cloud at 3000 feet AGL and overcast at 3600 feet AGL.

1.7.5 Two experienced pilots, both of whom had either been flying or driving through the Bryant Range area around the time of the accident, described the weather conditions being extremely poor with a low cloud base of approximately 1200 feet AGL and a light drizzle. The majority of the Bryant Range including Mount Duppa was obscured by cloud.

1.8 Aids to navigation

1.8.1 The MGL Avionics Stratomaster Odyssey EFIS system fitted to the aircraft was capable of displaying GPS moving map, synthetic terrain and terrain proximity warnings. The Odyssey featured a 16-channel GPS receiver, with a host of moving map navigation features. The pilot was able to create his intended flight route on his laptop computer and then download the information into the aircraft system.

1.8.2 The MGL Avionics Stratomaster Odyssey EFIS system was not certificated[4] and therefore was not permitted to be used as a primary means of navigation reference. It was permitted to use the system as an aid to primary navigation i.e. map and compass, but not as a primary reference for navigation in flight.

1.8.3 A copy of the pilot's intended flight plan was retrieved from his laptop computer, this provided detailed information about the route that the pilot intended to fly.

1.9 Communications

1.9.1 The aircraft was fitted with a VHF Transceiver. After departure from North Shore Aerodrome, there were no recorded communications from the aircraft.

1.10 Aerodrome information

1.10.1 Nil.

[4] Certification of equipment occurs when the equipment meets a required design standard of the applicable Civil Aviation organisation. In the case of Permit to Fly aircraft (Microlights), the use of non-certificated equipment is permissable.

1.11 Flight recorders

1.11.1 Due to the damage sustained by aircraft in the accident, no flight data information was able to be recovered directly from the aircraft. Secondary Surveillance Radar (SSR) data was recovered which provided useful flight information for both the aircraft search phase and the CAA Safety Investigation.

1.12 Wreckage and impact information

1.12.1 The aircraft had entered the beech forest canopy from level flight and had struck a large beech tree at a height of approximately 8 metres up from the ground. Impact forces had caused the aircraft's composite structure to disintegrate spreading wreckage a distance of 20 metres from the point of impact. The majority of the fuselage was found either in or at the base of the tree, while pieces of the wings which were significantly fragmented were found scattered along the debris trail forward from the initial point of impact.

1.12.2 The engine minus the propeller and reduction gearbox had come to rest approximately 20 metres beyond the initial impact point. The exhaust system which remained attached to the engine showed signs of ductile deformation which indicated that the engine was running at the time of impact with the tree.

1.12.3 The engine reduction gearbox remained attached to the propeller hub, the propeller blades had separated from the hub. One propeller blade which had come to rest nearby, showed signs of rotational damage consistent with having struck a solid object while being driven by the engine.

1.12.4 The emergency recovery parachute was found entwined in the tree branches above the fuselage wreckage. However, due to the position of the parachute in relation to the wreckage, it was determined that the system had most likely activated during the breakup of the aircraft and had not been intentionally deployed by the pilot.

1.13 Medical and pathological information

1.13.1 Post-mortem examination concluded that the pilot died of injuries consistent with a high-energy impact.

1.13.2 There were no indications of a pre-existing condition that could have resulted in incapacitation or affected the pilot's ability to operate the aircraft normally.

1.13.3 Toxicological testing showed no alcohol or drugs present in the blood.

1.13.4 Carbon Monoxide saturation was less than 5% (which is the saturation seen in the normal population not exposed to excess carbon monoxide) confirming that he has not inhaled significant quantity of fumes from the cockpit of the aircraft prior to the crash, or smoke and fumes from the post-crash fire.

1.14 Fire

1.14.1 An intense fuel fed fire occurred on impact with the tree. Parts of the aircraft were completely consumed by fire. Both wing fuel tanks had been partially consumed by the fire. The beech forest tree canopy immediately above the crash site had also been destroyed by the intensity of the fire.

1.14.2 Due to the disruption of the aircraft caused by the impact forces, it was not possible to determine the source of ignition. However, the most likely sources would be fuel contact with hot engine components, electrical arcing caused by disruption to the electrical system, or activation of the emergency recovery parachute system.

1.15 Survival aspects

1.15.1 The aircraft was fitted with a four point safety harness, however the impact forces were of a magnitude that the pilot was ejected from the aircraft.

1.15.2 The accident was not survivable.

1.15.3 The pilot was carrying a McMurdo model 211 GPS Personal Locator Beacon which operates on frequencies 406 and 121.5 MHz. The beacon was located in the aircraft wreckage and had not been manually activated by the pilot.

1.16 Tests and research

1.16.1 Assistance was sought from the New Zealand agent for the MGL Avionics EFIS system installed in the aircraft. While reviewing the aircraft's flight path based on the SSR data on a computer based simulator, two major errors in the EFIS navigation software were discovered.

1.16.2 It was found that the moving map display did not accurately display the 3717 feet spot height for Mount Duppa. Due to the positioning of a map join which passes through the '3', the spot height for Mount Duppa was corrupted and was displayed as 1717 feet. Refer to the spot height next to the aircraft symbol on the map display in figure 2.

1.16.3 A further error affected the synthetic terrain display and warnings. An error of approximately 600 feet existed between the actual terrain height and the modelled terrain height in the EFIS terrain data base for the accident flight. This error led to the synthetic terrain displaying terrain indications associated with the modelled terrain of approximately 600 feet lower than the actual terrain.

1.16.4 The New Zealand agent for MGL Avionics Ltd immediately contacted the manufacturer and reported these errors. It transpired that the New Zealand terrain data used by MGL Avionics Ltd was based on publically available terrain data available from NASA. The NASA terrain data used averages of the surrounding spot heights which had induced errors leading to the under reading of the actual terrain heights displayed on the EFIS.

Figure 2: EFIS screen display

1.16.5 In response to this, MGL Avionics Ltd amended the New Zealand terrain data base by using higher resolution NASA terrain data to reflect the actual spot heights which greatly improved the terrain accuracy. As soon as the amended data base was available, all New Zealand users of the MGL Avionics Enigma and Odyssey systems were notified and supplied with the amended data base.

1.17 Organisational and management information

1.17.1 Nil.

1.18 Additional information

1.18.1 Nil.

1.19 Useful or effective investigation techniques

1.19.1 Nil.

2. Analysis

2.1 It is evident that the accident occurred as a result of the aircraft having flown into the north-western slope of Mount Duppa from controlled flight in poor weather conditions.

2.2 SSR track data depicts that the aircraft was initially tracking south-west from the vicinity of Hawera at approximately 3000 feet on a direct track to the northern tip of D'Urville Island. This track follows the flight path indicated by the pilot's EFIS flight plan.

2.3 The aircraft has then descended to approximately 1000 feet following the eastern side of D'Urville Island and then continued to track through French Pass. SSR contact was then lost until the aircraft is in the vicinity of Cape Soucis at an altitude of 2400 feet climbing to 3600 feet towards the south.

2.4 From D'Urville Island, the aircraft had deviated to the west of the pilot's intended flight planned track. When the aircraft transponder was again received by the SSR near Cape Soucis, the southerly heading that the pilot was flying put him on track for his likely next intended way point which was in the vicinity of the Wairau Valley. This indicated that the pilot's primary means of navigation had now likely become the GPS and moving map display on the EFIS and was not flying using VFR procedures.

2.5 The aircraft continued to track on a southerly heading at 3600 feet, and at an airspeed consistent with the cruise speed for the aircraft. Small variations in recorded heading and altitude would suggest that the pilot was not using the autopilot and may have been attempting to follow the contour of the Bryant Range or avoiding areas of cloud.

2.6 The weather conditions reported in the area by the two experienced pilots, indicated that the aircraft would have most likely either been flying in cloud or perhaps between layers of cloud. The slopes of Mount Duppa and the Bryant Range would likely have been obscured by the cloud.

2.7 For Visual Flight Rules flight (VFR), the pilot was required by CAA Rule 91.301 *VFR meteorological minima* to have a minimum of 5000 metres forward visibility, and given his proximity to the terrain, remain clear of cloud and in sight of land or water. Based on the reports from the two pilots, it is unlikely that he would have been able to meet the minimum VFR requirements and was probably operating the aircraft in contravention of the CARs.

2.8 From the evidence available, it would appear that the pilot did not update the weather information at any stage either prior to departure from North Shore Aerodrome or during flight, from that which he had received earlier.

2.9 The aircraft had a high level of sophistication with regard to the navigation, synthetic terrain, and flight instrument display information available to the pilot. It is therefore reasonable to expect that the pilot had a high level of faith in the accuracy of the information that was presented to him. The pilot probably had an over reliance on this information instead of using his basic navigation skills and applying the VFR meteorological minima for flight which he was legally required to do.

2.10 Given the errors that were found in the EFIS system database, the pilot may have thought that he was sufficiently clear of the terrain ahead when in fact he was not. Approaching Mount Duppa the pilot should have received a visual warning from the EFIS that he would not clear the terrain ahead, however, due to the system inaccuracies, the display indicated that he would clear the terrain.

2.11 The synthetic terrain colouring displayed on the EFIS screen will show green for when the aircraft's projected flight path clears terrain by greater than 1000 feet AGL, yellow for terrain clearance within 1000 feet AGL, and red, warning that collision with terrain is imminent. The terrain shown immediately ahead of the aircraft (Mount Duppa) displayed to the pilot at the height he approached it was coloured yellow, the correct colouration should have been red. Refer to the left hand screen display in figure 2.

2.12 The pilot had flown this route previously in ZK-SML with other experienced pilots, however this was the first time he had attempted the flight on his own. It is possible that he had never encountered similar weather conditions on previous flights and was therefore lacking in experience in dealing with such conditions.

2.13 The pilot was also aware that the weather conditions in Ashburton were fine and clear, this may have encouraged him to press on into the deteriorating weather rather than turn back or divert to Nelson. Such decision making by pilots is commonly refered to as 'Get there itis', the technical term for this is plan continuation bias. Plan continuation bias is a determination to reach your destination despite changing circumstances and continuing with a failing plan despite evidence that it's not working.

2.14 The pilot did not file a flight plan for his intended flight nor did he make any radio calls to the Airways Flight Information Service to advise his position on a regular basis. There is no legal requirement for him to do this, however the use of a flight plan and regular position reporting greatly assists in the location of aircraft in search and rescue situations.

3. Conclusions

3.1 The pilot was appropriately licensed, and fit to carry out the flight.

3.2 The pilot continued into deteriorating weather conditions which were probably below the minimum requirements for VFR flight.

3.3 The EFIS terrain data base that the pilot was using had significant errors which may have led the pilot to believe incorrectly that he was clear of the terrain ahead.

3.4 Good weather conditions at his intended destination may have encouraged the pilot to continue his flight perhaps based on a high level of reliance on the information presented by the EFIS.

3.5 The pilot may have been experiencing a degree of the human factor known as plan continuation bias prompted by the reported good weather conditions at his intended destination.

3.6 The pilot did not activate the emergency parachute recovery system, therefore it is likely that he did not consider he was in an emergency situation.

3.7 The aircraft flew into the north-western slope of Mount Duppa while in controlled flight.

3.8 The lack of a flight plan and regular position reporting by the pilot hampered search efforts for the aircraft.

3.9 The delay in finding the crash location had no effect on the outcome regarding pilots' survivability.

3.10 The accident was not survivable.

4. Safety actions

4.1 Immediately after the discovery of the errors in the terrain data base highlighted during the CAA Safety Investigation, MGL Avionics Ltd worked to correct these errors by usitilising higher resolution NASA terrain data. New Zealand users of the MGL Avionics EFIS systems were supplied with a corrected terrain data base file on 01 June 2011.

4.2 CAA Safety recommendation (No. 12A701) was raised on 17 October 2011 for the CAA Sport and Recreation Unit to develop information to reinforce to recreational pilots the operating limitations of aircraft EFIS systems. The dangers of over reliance on these systems in flight will also be highlighted. This information has been published via an article in the January/February 2012 edition of the CAA Vector magazine.

4.3 The CAA had previously published an article in the January/February 2011 issue of the Vector magazine which highlighted the issues of plan continuation bias.

4.4 The CAA Good Aviation Practice booklet Titled *VFR Met* is freely available to all pilots. This booklet provides information with an aim to improving pilots weather-related decision making.

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Date 07 February 2012

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