IN THE CORONERS COURT
OF VICTORIA
AT MELBOURNE

Court Reference: COR 2015 4584

FINDING INTO DEATH WITHOUT INQUEST

Form 38 Rule 60(2)
Section 67 of the Coroners Act 2008

Findings of:	Sarah Gebert, Coroner
Deceased:	Ms L*
Date of birth:	[redacted] 1996
Date of death:	8 September 2015
Cause of death:	*Multiple Injuries sustained in an Aviation Incident*
Place of death:	1787 Old Melbourne Road, Millbrook, Victoria
Catchwords	Aircraft incident

* This is a redacted version of the original signed finding. Names have been replaced with initials to preserve the privacy of Ms L's family.

Introduction

1. Ms L (also known as [redacted]) was born on [redacted] 1996. She was 19 years old at the time of her death and lived with her family in [redacted]. She is survived by her parents and brother, [redacted].

2. [redacted].

3. Ms L was enrolled at the Royal Melbourne Institute of Technology (**RMIT**) University Flight Training course located at Point Cook and wanted to become a Commercial Pilot.

4. Ms L played many sports and was the coach of a local under 10 boys basketball team. She had a very close group of friends who would meet regularly. She was described as bright and very driven.

5. On 8 September 2015, Ms L was fatally injured in an aircraft accident near Millbrook, whilst on her first navigational solo flight.

The Coronial Investigation

6. Ms L's death was reported to the coroner as it appeared to fall within the definition of a reportable death in the *Coroners Act 2008* (**the Act**). A reportable death includes a death that appears to be unnatural or violent, or to have resulted, directly or indirectly, from an accident or injury.

7. A coroner independently investigates reportable deaths to establish, if possible, identity, medical cause of death and surrounding circumstances. Surrounding circumstances are limited to events which are sufficiently proximate and causally related to the death. The purpose of a coronial investigation is to establish the facts, not to cast blame or determine criminal or civil liability. Coroners make findings on the balance of probabilities, not proof beyond reasonable doubt.[1]

8. Victoria Police assigned Detective Senior Constable (**DSC**) Brian Malloch to be the Coroner's Investigator for the investigation into Ms L's death. DSC Malloch conducted

[1] This is subject to the principles enunciated in *Briginshaw v Briginshaw* (1938) 60 CLR 336. The effect of this and similar authorities is that coroners should not make adverse findings against, or comments about, individuals unless the evidence provides a comfortable level of satisfaction as to those matters taking into account the consequences of such findings or comments.

inquiries on my behalf,[2] including taking statements from witnesses and submitting a coronial brief of evidence. The coronial brief includes statements from Ms L's brother, the forensic pathologist who conducted a medical examination, RMIT personnel and students as well as investigating officers.

9. Additional material obtained by the Court included a statement from the Civil Aviation Safety Authority (**CASA**), data from the Australian Bureau of Meteorology, aviation licence and records of Ms L, aviation registration records held in relation to the aircraft, Cessna 172, registered VH ZEW and RMIT University Flight Training Reference Material (Associate Degree Semester 2 2015).

Australian Transport Safety Bureau Report

10. I also considered the Australian Transport Safety Bureau (**ATSB**) Safety Report, *Collision with terrain ZEW*, Final dated 17 April 2018 (**ATSB Report**). The ATSB is Australia's national transport safety investigator which was established by the *Transport Safety Investigation Act 2003* (**TSI Act**).

11. The ATSB conducts its safety investigations in accordance with the provisions of the TSI Act and with a focus on improving safety. Under the TSI Act, it is not a function of the ATSB to apportion blame or provide a means for determining liability in safety matters. The ATSB does not investigate for the purpose of taking administrative, regulatory or criminal action.

12. The ATSB is funded by the Australian Government to improve transport safety in Australia including through:

    (a) independent 'no blame' investigation of transport accidents and other safety occurrences;

    (b) safety data recording, analysis and research; and

    (c) fostering safety awareness, knowledge and action.

13. Consistent with the Act, a coroner should liaise with other investigative bodies (such as the ATSB) to avoid unnecessary duplication and expedite investigations. [3] Having considered

[2] The investigation was originally conducted by Acting State Coroner Caitlin English.
[3] S. 7 of the Act.

the ATSB Report, I am in agreement with the ATSB's findings and propose to adopt the recommendations made.

14. After considering all the material obtained during the coronial investigation, I determined that I had sufficient information to complete my tasks as coroner and that further investigation was not required.

15. I have based this finding on the evidence contained in the coronial brief, other documents obtained by the Court as well as the ATSB Report.

Background

16. At the time of her death, Ms L was a Student Pilot enrolled in the RMIT University Flight Training, Associate Degree of Air Transport (Airline Pilot) Program, for 2015.

17. RMIT University hold a current Australian CASA Air Operator's Certificate of Approval.[4] Students such as Ms L, are trained for Civil Aviation Safety Authority (**CASA**) Licences. This includes the Recreational Pilot Licence (**RPL**), Private Pilot Licence (**PPL**), Commercial Pilot Licence and Air Transport Pilot Licence.

18. Ms L's flight instructor had held a pilot's licence for approximately 6 years and was a Grade 2 Flight Instructor.

19. Ms L was amongst 14 students in her training group and was described by her instructor as bright and one of the best in her class. She had great attention to detail and strived for perfection. She was described as being ahead in the theory and was always pushing ahead to learn more.

20. Ms L was liked by students and staff and would bring cakes and cookies she had made to share.

21. Ms L was fit and well and gained all the required medical clearances.

22. On 10 August 2015, Ms L passed the general flight proficiency tests. She had applied for a RPL which was approved shortly after her death.

23. The RPL is the most basic level of pilot licence under the *Civil Aviation Safety Regulations 1998*. The training standards for the grant of a RPL places emphasis upon the knowledge

[4] An Air Operator's Certificate is an authorisation granted by CASA under section 27 of the *Civil Aviation Act 1988* to conduct commercial activities prescribed by regulation 206 of the *Civil Aviation Regulations 1988*.

and skills required to operate a basic light aircraft. The RPL knowledge standards do not include topics related to aircraft systems and autopilot knowledge. The RPL standards do not cover, and are not intended to cover, a knowledge of special aircraft features beyond a basic or minimum level.[5]

24. The next stage of Ms L's training was to gain her PPL. This involved gaining competency in flight navigation.

25. Student pilots at Ms L's level of competency are taught how to enter flight plans in their navigation system, engage the autopilot and disengage the autopilot. At this level, the engaging/disengaging of the auto pilot is conducted on the ground prior to the flight.

26. The use of the autopilot by RPL students was limited to times of high workload or for turning the aircraft 180 degrees following inadvertent entry into cloud. When a student uses autopilot navigation, they are taught to continue to keep a visual check of their surroundings and not to rely on the navigation instrument. They are not taught more to ensure they learn the basics of visual navigation and are not tempted to use the navigation system.

27. Ms L completed the Nav 1 and Nav 2 components of the course. She did not pass Nav 3, which was unexpected for her, as she attempted this section when another student withdrew and therefore did not have adequate time to prepare. It was determined that she was not ready for a solo flight (Nav 4), so she proceeded to Nav 5. If she demonstrated competence in this component, she could proceed to Nav 4.

28. On 4 September 2015, she took her Nav 5 accompanied by her instructor, and went from Point Cook to Moorabbin then Essendon and to the Mortlake Township. She was shown to be very competent throughout the entire flight.

CIRCUMSTANCES IN WHICH THE DEATH OCCURRED

29. On 7 September 2015, the night before the accident, her brother said that a friend of their mothers visited and Ms L told them she was going to do her first navigational solo flight the following day. She was described as being very excited.

30. For the purpose of the solo flight (Nav 4), students are required to prepare a flight plan which is checked prior to the flight. On 8 September, Ms L's flight plan was checked, and apart from the addition of fuel to get to another airport in the event that Point Cook became unavailable (which was a common error), the plan was correct and Ms L knew it perfectly.

[55] Letter dated 12 October 2018, CASA.

31. Ms L appeared very confident and excited (*bounding* around the building) about her first solo flight and was in a good frame of mind. She asked a friend and fellow student for a good luck hug before she left.

32. At approximately 2.10pm, Ms L commenced her solo flight in a Cessna Aircraft Company 172S, registration VH-ZEW. The aircraft was equipped with a Garmin 1000 Navigation system. The system has two screens which are mounted in such a way that the pilot is still able to have a view outside of the plane. Whilst operating the system, the pilot is still aware of their surroundings.

33. Ms L departed Point Cook Airfield, Victoria via waypoints that included Ballarat Airport.

34. At about 10 minutes before the accident, another pilot operating an aircraft in the local area overheard Ms L providing a position report by radio and did not report any difficulty.

35. The GPS data taken from the aircraft showed that Ms L's aircraft, whilst on the third leg of the planned journey, cruising at about 3,000 ft above mean sea level, started to descend rapidly. The aircraft impacted rising terrain at about 2,200 ft and was destroyed, causing Ms L to be fatally injured. Witness accounts place the accident at around 3.30pm.

36. Police attended the scene and immediately commenced an investigation. DSC Malloch noted that the location of the plane crash appeared to be in the crater of an extinct volcano (known as Black Mount). The plane appeared to have first impacted on the lower side of the crater and travelled uphill for a distance of 50 to 60 meters before coming to a rest.

37. Members of the ATSB also attended and examined the scene.

38. Investigations revealed that the aircraft was last serviced on 24 August 2015. There was nothing noted to be out of the ordinary in the service and no defects were found. The manufacturer recommended service life of the engine is 2200 hours and the aircraft had completed 2194.2 hours. There is however no evidence to suggest that there were any mechanical issues with respect to the aircraft that caused or contributed to the incident.

39. According to the ATSB Report, a post-accident analysis of the aircraft weight and balance indicated that the aircraft was within limits during the entire flight.

40. Whilst questions were raised regarding the suitability of the weather for a solo flight on the day of the accident, it appears that the weather was above minimum requirements for flying

conditions. Witnesses in the area of the accident indicated that Ms L's aircraft was not obscured by cloud in the final moments of the flight.

41. The flight data log memory card was successfully downloaded by the ATSB. The downloaded information provided the data for the entire flight, including autopilot and engine parameters, recorded at one second intervals up to about 13-16 seconds prior to the impact. The ATSB Report noted that the downloaded information did not show any anomalies with the flight and engine parameters that would indicate a mechanical or avionics issue with the aircraft.

42. In addition, the ATSB Report noted that the data indicated a normal flight through all planned waypoints up until about 8 seconds before recording stopped, when the aircraft started climbed slightly before descending from 3,000ft AMSL (altitude/elevation above mean sea level) at an increasingly rapid rate. The maximum vertical descent rate recorded was about 2,500 ft/min. The aircraft travelled a distance of about 900 metres and descended a further 640 ft following the end of the recording. The time from the start of the descent until impact with terrain was estimated to be no more than about 20 seconds.

43. Witnesses observed that Ms L had stopped the aircraft's descent and was in the process of recovery when the aircraft impacted the rising terrain.

44. According to the ATSB Report, the recorded automatic flight control system (**AFCS**) data during the accident flight showed that:

    (a) Ms L had conducted an autopilot function check as part of the pre-flight checks just prior to take-off;

    (b) the autopilot was utilised for about one third of the flight in total, with various heading and vertical modes selected; and

    (c) the autopilot had been switched on and off 14 times, not including the ground function test.

45. The use of the autopilot for about one third of the flight, as noted above, was considered by the *flight training organisation* to be excessive and beyond the instruction to only use it for brief periods during high workload situations.[6]

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[6] ATSB Report at p, 31.

46. It is apparent from the above data that Ms L was using the auto pilot outside her training level and instruction. Given the level of information provided to students at Ms L's level regarding the operation of the auto pilot system, it is likely that she had a limited understanding of its operation.[7] A combination of these matters, may have led to the unsafe operation of the aircraft.

IDENTITY

47. On 9 September 2015, [redacted] visually identified Ms L, born [redacted] 1996, who he had known for 13 years.

48. Identity is not in dispute and required no further investigation.

CAUSE OF DEATH

49. On 11 September 2015, Dr Jia Hao Wu, practising as a trainee pathologist[8] at Victorian Institute of Forensic Medicine, conducted an autopsy on the body of Ms L and provided a written report, dated 8 October 2015. In that report, Dr Wu concluded that a reasonable cause of death was *Multiple Injuries sustained in an Aviation Incident.*

50. There was no autopsy evidence of any significant natural disease that would cause or contribute to the cause of death or the aviation incident. No common drugs, poisons or ethanol were detected in the post-mortem toxicology results.

51. I accept Dr Wu's opinion as to cause of death.

Summary of Regulatory Findings

ATSB Findings

52. The ATSB conducted an investigation of the accident involving Ms L. A briefing of the investigation was provided to the Court on 31 August 2018.

53. The ATSB found:

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[7] The ATSB Report referred to the Federal Aviation Administration (FAA) research paper *Automation in General Aviation,* that *insufficient autopilot training and a lack of conceptual model (how it works) may have undesired effects that lead to autopilot mishandling, misdiagnosis of autopilot issues and slow reaction times. In the context of the VH-ZEW (ZEW) accident, the lack of underpinning knowledge may have led to the inexperienced student pilot unintentionally mishandling the operation of the autopilot. As a result of this, it would have taken some time to recognise that the autopilot had placed the aircraft in an out-of-trim condition, with limited time available to correct the situation. A slower reaction time may have been exacerbated by the lack of an audible alert for mistrim situations.* p. 33.

[8] Under the supervision of Dr Sarah Parsons, pathologist.

(a) The site and wreckage inspection identified that the aircraft impacted terrain in a level, slight right-wing low attitude. This indicated that the pilot likely stopped the aircraft's descent and started to initiate a manoeuvre to avoid the terrain.

(b) It is likely that the pilot manually manipulated the flight controls while the autopilot was on engaged in a vertical mode. As a consequence, the autopilot adjusted pitch trim[9] to oppose manual controls inputs, which led to a mistrim condition. That is, the autopilot re-trimmed the aircraft against pilot inputs, inducing a nose-down mistrim situation, which led to a rapid descent.

(c) The aircraft's low operating height above the ground, due to the extent and base of the cloud, along with rising terrain in front of the aircraft, gave the pilot limited time to diagnose, react, and recover before the ground impact.

(d) There was no advice, limitation, or warning in the aircraft pilot operating handbook or avionics manual to indicate that if a force is applied to control column while the autopilot is engaged, that the aircraft's autopilot system will trim against the control column force, and possibly lead to a significant out of trim situation.

(e) Training requirements for autopilot systems was rudimentary at the RPL level due to stipulated operational limitations for its use. At the time of the accident there was no regulatory requirement for pilots to demonstrate autopilot competency at the RPL level.

54. The ATSB Report noted that in July 2017 the CASA Flight Examiner Handbook was amended so that the RPL assessment scope and conditions section includes the stated requirement that '*where the aircraft is fitted with an autopilot system, the applicant must demonstrate competency in the system.*'[10] In addition, it noted that the relevant Manual of Standards was in the process of being amended to reflect the changes in the handbook.

55. Following the accident, the ATSB Report also noted that RMIT University conducted flight tests to determine autopilot reaction to pilot flight control inputs, following which RMIT University amended its standard operating procedures to include the following:

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[9] Unlike other vehicles, an aircraft can move in three dimensions. The three types of motion are: roll, yaw and pitch. The pitch describes the motion where the nose of aircraft moves up or down, which in term causes the tail to move up or down in the opposite direction. If the aircraft is trimmed, the flight controls are in a state where no force needs to be exerted in order to continue straight and level flight. Aerodynamic and gravitational moments about all three axes are nulled out.

[10] At the time of the accident, the flight examiners handbook did not include a requirement for examiners to test student pilot auto flight systems knowledge.

Warning: *Pilots are to note that if a force is applied to control column whilst the autopilot is engaged, that the aircraft's autopilot system will trim against the control column force that the pilot has applied. This can lead the aircraft to be in a significantly mistrimmed situation, and loss of control is possible. The GFC700 Autopilot will give no audible indication when this mistrim situation is developing.*

ATSB Recommendations

56. The ATSB made two formal safety recommendations: one to the aircraft manufacturer [Cessna Aircraft Company (Textron)] and one to the instrument panel manufacturer (Garmin).

57. The ATSB identified the following safety issue underpinning the recommendations:

> *The lack of manufacturer written advice, limitations, cautions, or warnings (written or aural) about autopilot response to manual pilot control inputs meant that pilots may be unaware that their actions can lead to significant out of trim situations, and associated aircraft control issues.*

58. The ATSB made two recommendations as follows:

(a) ATSB safety recommendation to Cessna Aircraft Company (Textron)

The ATSB recommends that Cessna Aircraft Company, in conjunction with Garmin, implement changes to their operations manuals so that all aircraft types fitted with their autopilots have the limitations, cautions and warnings applied consistently.

(b) ATSB safety recommendation to Garmin

The ATSB recommends that Garmin, in conjunction with aircraft manufacturers, takes action to ensure that all aircraft types fitted with their autopilots have the limitations, cautions and warnings documented in the aircraft's operating manuals. Further, the ATSB recommends that Garmin consider the use of audible warnings to enhance pilots' awareness of mistrim situations brought on by the autopilot system.

CASA

59. CASA is a government body that regulates Australian aviation safety. CASA license pilots and register aircraft. It is an independent statutory authority.

60. CASA provided a response to questions[11] raised by the Court in a letter dated 12 October 2018 regarding the ATSB Report.

61. In addition to noting the amendment to the CASA Flight Examiner Handbook in July 2017, (see paragraph 53), CASA considered that if the flight training operator, flight instructors and the pilot under instruction observe the regulatory requirements then the risk of an incident occurring due the pilot being potentially unfamiliar with the aircraft's special systems should be significantly reduced.

62. CASA was of the view that current regulatory requirements are sufficient and made the following observations,

> *...that the current regulatory requirements are appropriate and sufficient to ensure that flight training organisations are aware of their training obligations to pilots under instruction. In addition, CASA conducts surveillance activities of flight training operators to ensure that such operations remain compliant.*
>
> *With the recent expiration of the transition period (being 31 August 2018) for flight training operator to be authorised to conduct flight training activities under Parts 141 and 142 of the CASR, the framework for the conduct of training has been further prescribed and standardised.*
>
> *CASA regularly conducts industry aviation safety forums across Australia that are attended by a cross-section of pilots including instructors and flight training operators. These forums address current safety issues and raise awareness on good safety practices. The subject of glass cockpits and human factors was included in a recent round of forums. Along with many other relevant subjects CASA is also considering the specific subject of the use of autopilot systems and human factors as a topic for future forums.*

[11] The questions put to CASA by the Court included: What CASA's responses have been to the ATSB report and to the reported circumstances of this death. Whether CASA has considered if flight training organisations should amend standard operating procedures to include communicating more information about the autopilot and the importance of flight instructors making students aware of this.

FINDINGS

63. Having investigated the death, without holding an inquest, I find pursuant to section 67(1) of the Act that Ms L, died on 8 September 2015 at 1787 Old Melbourne Road, Millbrook, Victoria, from *Multiple Injuries sustained in an Aviation Incident*, in the circumstances described above.

64. I convey my sincere condolences to the family of Ms L for the tragic loss of their much loved and talented family member.

COMMENTS

65. Pursuant to section 67(3) of the Act, I make the following comments connected with the death:

66. The ATSB safety message noted that,

> *Avionics and aircraft manufacturers should increase pilot awareness of automated systems by providing written warnings surrounding known issues and including visual and aural alerts in auto flight systems to increase pilot awareness of non-standard inputs. Fundamentally, pilots should be aware that if the automation is not performing as expected, then the safest option under most circumstances is to disengage the system and manually fly the aircraft.*

67. The ATSB Report noted the following:

(a) that the inclusion of limitations, cautions, and warnings in the aircraft documentation, along with aural warnings would likely enhance pilot awareness of such situations and the associated hazards. Following on from those inclusions, it is of paramount importance that pilots are educated about the hazards involved in the manual manipulation of the flight controls with the autopilot on.

(b) that student pilots are not likely to be aware of issues surrounding manual manipulation of the flight controls with the autopilot on. It is therefore important to implement methods that enhance pilots' awareness of the issue, including aircraft and avionics systems operating manuals having the requisite limitations, cautions and warnings in place.

68. Essential to this matter, the ASTB found that there was no advice, limitation, or warning in the aircraft pilot operating handbook or avionics manual to indicate that if a force is applied

to control column while the autopilot is engaged, that the aircraft's autopilot system will trim against the control column force, and possibly lead to a significant out of trim situation.

69. Given these matters, I endorse the recommendations made by the ATSB.

RECOMMENDATIONS

Pursuant to section 72(2) of the Act, I make the following recommendations connected with the death:

1. Cessna Aircraft Company (Textron)

   That Cessna Aircraft Company, in conjunction with Garmin, implement changes to their operations manuals so that all aircraft types fitted with their autopilots have the limitations, cautions and warnings applied consistently.

2. Garmin

   That Garmin, in conjunction with aircraft manufacturers, takes action to ensure that all aircraft types fitted with their autopilots have the limitations, cautions and warnings documented in the aircraft's operating manuals. Further, that Garmin consider the use of audible warnings to enhance pilots' awareness of mistrim situations brought on by the autopilot system.

PUBLICATION

Pursuant to rule 64(3) of the *Coroners Court Rules 2009*, I order that a redacted version of this finding be published on the internet.

I direct that a copy of this finding be provided to the following:

Canaan Lawyers on behalf of the senior next of kin, Mr L

Garmin (recipient of recommendation)

Sessna Aircraft Company (Textron) (recipient of recommendation)

Royal Melbourne Institute of Technology

Australian Transport Safety Bureau

Civil Aviation Safety Authority

Detective Senior Constable Brian Malloch, Victoria Police, Coroner's Investigator

Signature:

SARAH GEBERT
CORONER
Date: 20 September 2019