# Analysis of the Winds on 9 August 1981 in the Southern Barrington Tops Region

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Minor Revisions by Glenn Horrocks, August 2015

## Introduction

Cessna VH-MDX crashed in the southern Barrington Tops region on 9 August 1981. It has never been found despite many searches for it over the years. In 2013 a major effort was undertaken by Police Rescue, BWRS and RAAF to find all available evidence around this incident and conduct a major search exercise in an attempt to find the aircraft.

This document describes a detailed analysis done as part of this investigation to establish what wind was present in the Southern Barrington Tops region that night. The winds are important for three reasons:

1. The wind has an effect on the aircraft motion.
2. Areas of rising or sinking air (as the wind travels over mountain ranges) will cause the aircraft to gain or loose altitude.
3. Areas of turbulence will cause rough flight and increase the probability of loosing control of the aircraft.

Current predictions of the final few minutes of VH-MDX indicate the aircraft flew into the Upper Williams River valley on a track with a descent rate (due to icing) which would not have allowed the aircraft to clear the ranges around the valley. This means the specific questions this analysis is intended to answer is:

1. To establish the wind speed and direction at the range of altitudes flown by VH-MDX (0-10000 feet).
2. To establish if the flow separates from the Carey's Peak ridge or whether it says attached.

The flow separation is critical in determining where the crash site is likely to be. The table below describes the implications of the existence of the flow separation. Figure 1 shows graphically what attached flow compared to a flow separation looks like, and Figure 2 shows the implications of this for an aircraft flying close to a ridge line in a cross wind.

| Separation exists? | *No, flow remains attached* | *Yes* |
|---|---|---|
| **Wind sink rate on lee side of ridge** | Strong | Gentle |
| **Implication for VH-MDX** | Likely to be pulled down quickly | Likely to continue flying for a distance |
| **Implication for likely crash site** | Likely to be close to the top of the lee side of the ridge | Likely to be at the bottom of the valley or on the far side. |

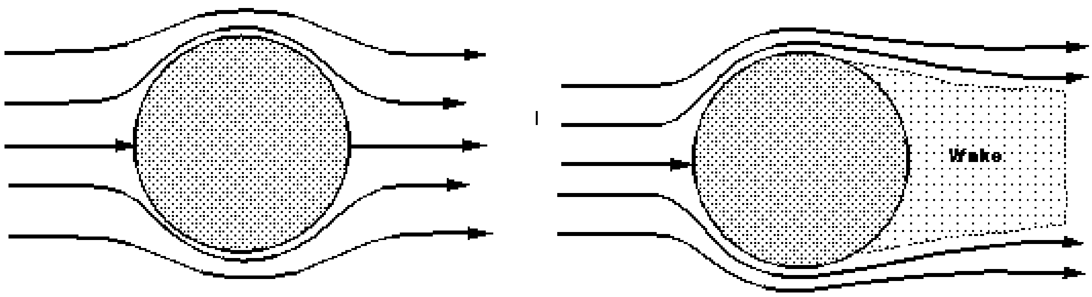


**Figure 1 - Example of flow separation. Left - no flow separation, Right - flow separation.**

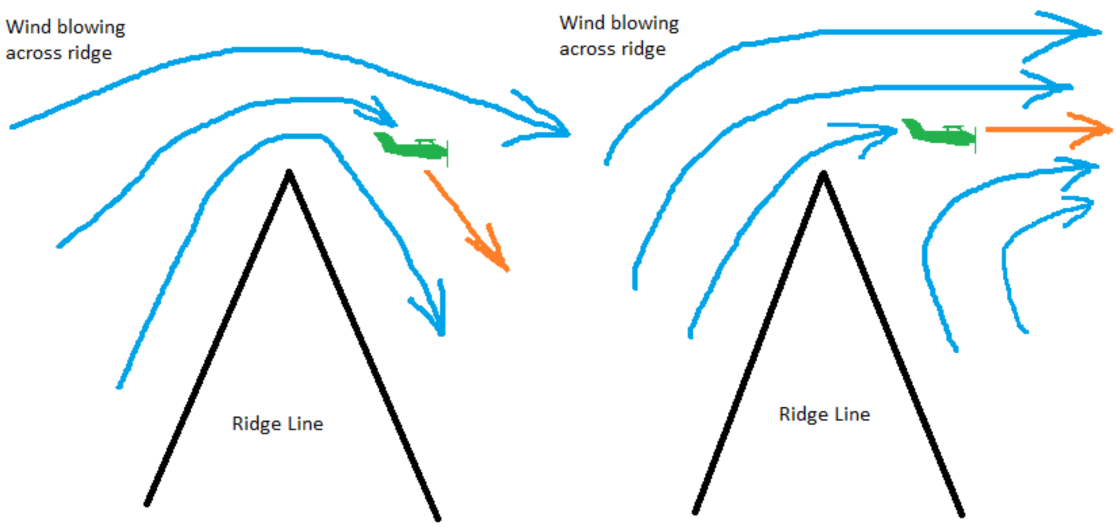


**Figure 2 - Implications of flow separation from a ridge line on aircraft flight. Blue arrows show wind direction, Red arrow shows direction wind pushes the aircraft. Left - no separation, Right - separation.**

## *Description of Model*

A GIS dataset containing the elevation of a 100km x 100km region centred on the Southern Barrington Tops region was obtained at a 100m resolution for a total of a million elevation points. This generates a massive 3D map of the earth's surface, as shown in Figure 3 and Figure 4.

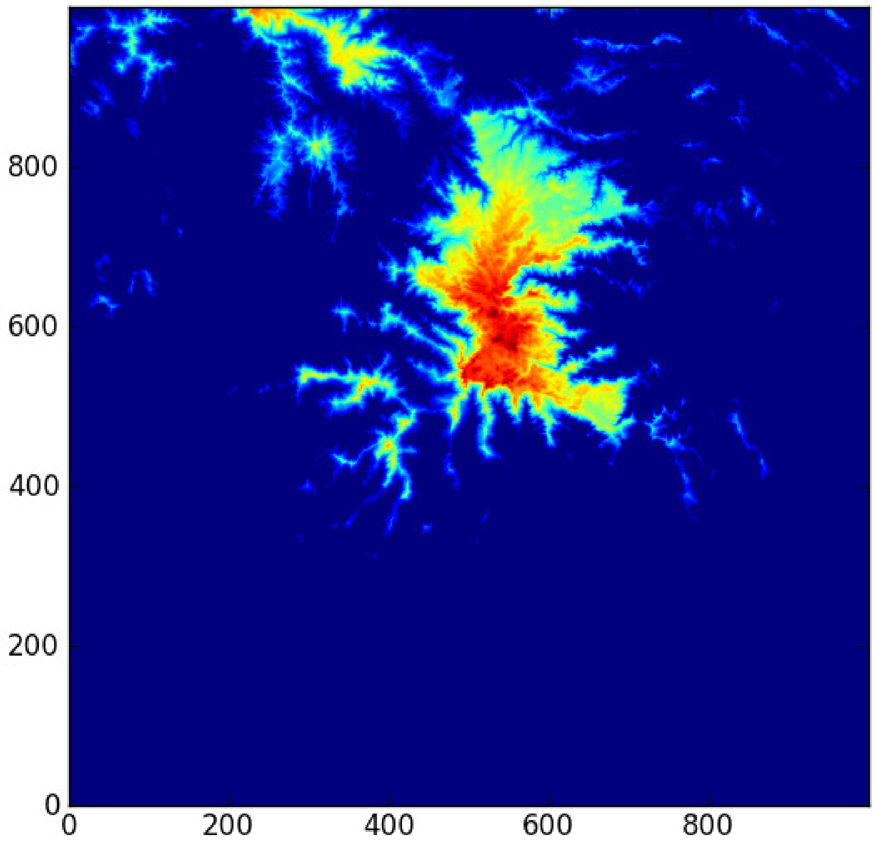


**Figure 3 - Elevation map of region. Red = high elevation, Blue = low elevation. The Upper William River is in the middle of the mapped region.**

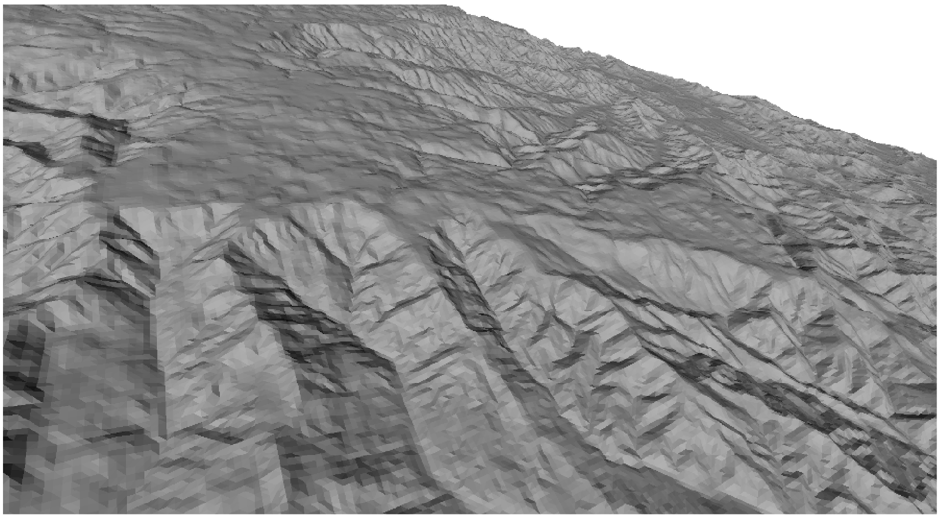

**Figure 4 - 3D render of the elevation map. This is a view looking at the Upper Williams River (in the centre of the image) from the south west.**

To model the wind present on that day the commercial CFD software CFX was used. It is a software package developed to simulate fluid flow in industrial processes, but can equally be used for modelling flow of air.

The first step of the analysis is to mesh the geometry. Many options were tried to mesh a geometry of this massive scale and the only software which succeeded was ICEM. After a trial mesh was generated using ICEM the providers of the ICEM software, LEAP Australia gave me use of the software to complete this task. I thank LEAP for their generosity, ICEM is the only software which could handle it (and it handled it quite easily, I might add).

Meshes were generated of the 100km x 100km region, consisting of 16.1 million nodes and a resolution at ground level of 8m. The domain extended to 10,000m altitude.

Note this is based on the wind profile reported in the ARFOR (Area Forecast, national archives document 204, available at http://recordsearch.naa.gov.au/SearchNRetrieve/Interface/DetailsReports/ItemDetail.aspx?Barcode=12067179). The Area Forecast profile is shown in Table 1.

**Table 1 - 9 August 1981 Area Forecast wind profile**

| *Altitude (Feet)* | **Wind Velocity (knots)** | **Wind Direction (M)** |
|---|---|---|
| *0* | 0 | 260 |
| *2000* | 30 | 260 |
| *5000* | 35 | 250 |
| *7000* | 40 | 250 |
| *10000* | 45 | 250 |
| *14000* | 55 | 250 |
| *18500* | 70 | 250 |

There are many details of the analysis which will not be discussed here as they are unlikely to be of interest to most readers. Anybody interested in further details of the analysis is encouraged to contact the author.

## *Results*

The results of this simulation are shown in Figure 5 to Figure 8.

Figure 5 shows that in the area of the Corker Lookout on the Carey's Peak Ridge the flow separates due to the sharp drop in altitude on the lee (eastern) side of the ridge.

Figure 6 shows a more magnified view of the lee side of the hill, confirming the flow has separated.

Figure 7 shows the wind velocity vectors experienced at the aircraft (both position and altitude) during the predicted flight path based on starting at 48NM from Williamtown airbase at 320°. Note that we now believe the radar fix was 45NM, not 48NM, but that will not change the wind velocity experienced at the aircraft significantly.

Figure 8 shows streamlines starting at the 5000 feet altitude. Streamlines are the path a long streamer would follow when dragged by the wind, so indicate wind direction. Note that in the middle of the Upper Williams River Valley the streamlines turn north. This indicates the wind is from the south (as opposed to the prevailing wind from the WSW) as the wind is turned to flow up the river valley. It is important to note that the wind velocities associated with this local wind flow are slow, and so are little different to still air relative to the aircraft's air speed.

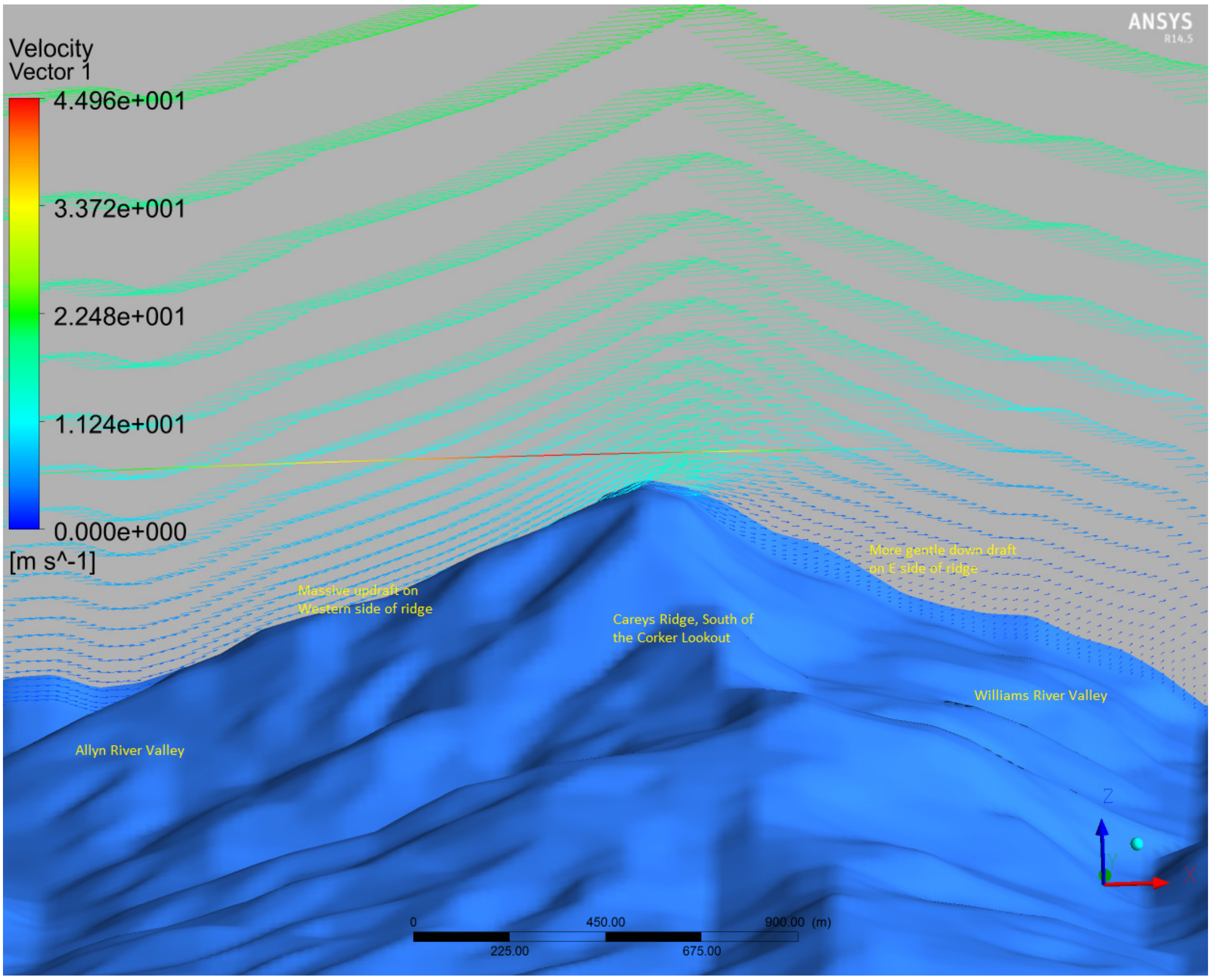


**Figure 5 - Wind conditions predicted over Careys Ridge. Horizontal line shows predicted flight path of VH-MDX.**

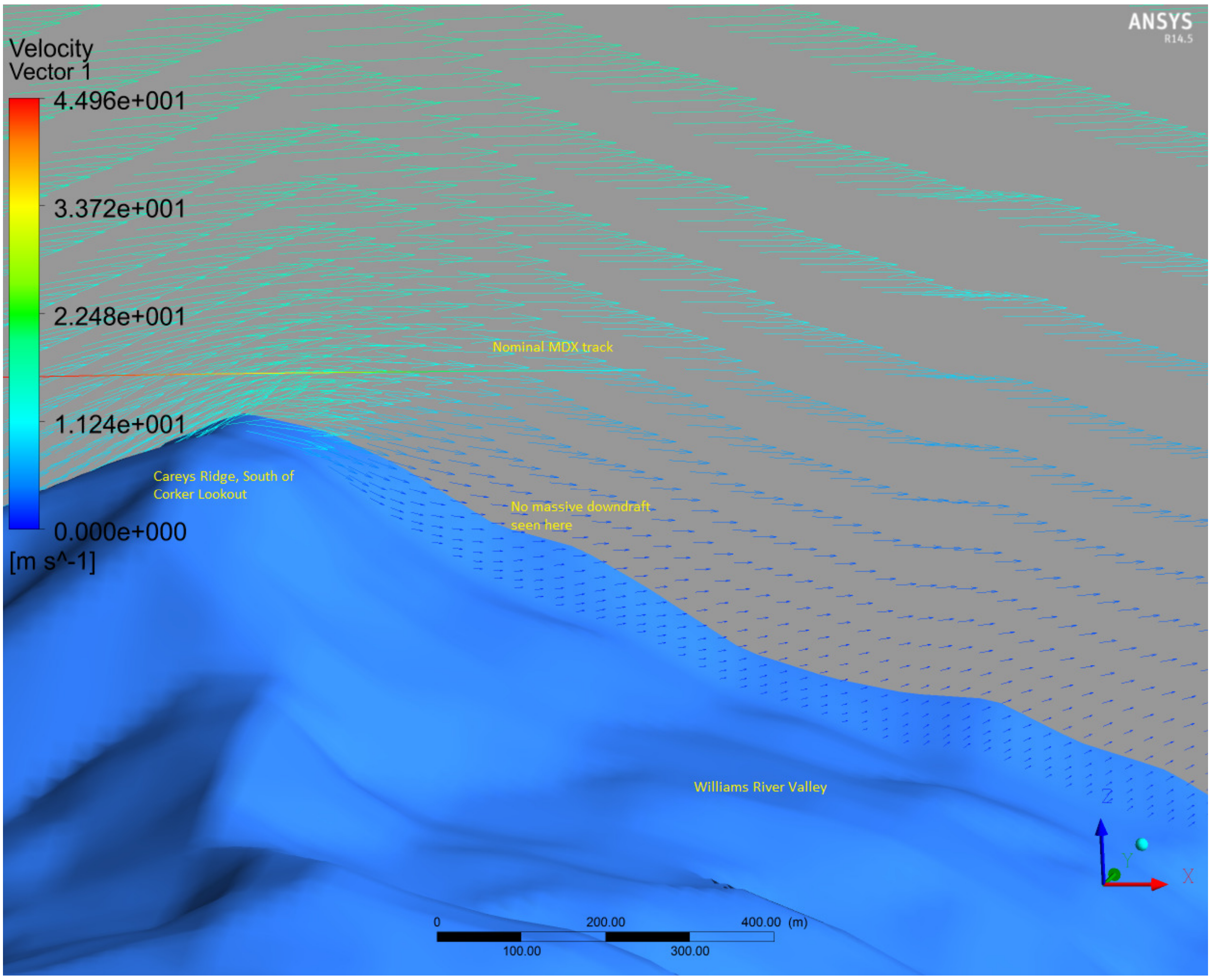


**Figure 6 - Detailed view of predicted wind conditions. The lack of strong downdraft is clearly seen.**

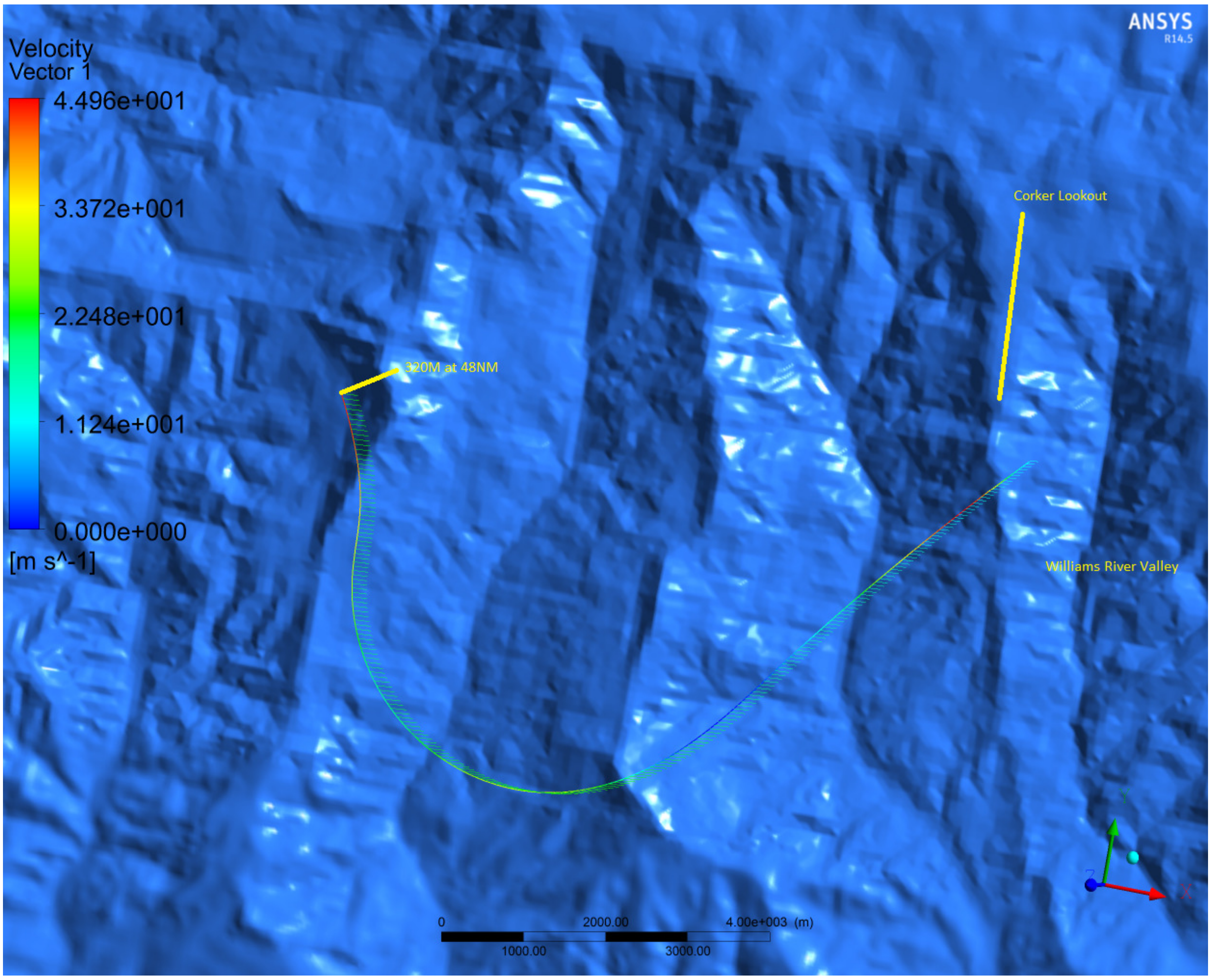


**Figure 7 - Wind velocity vectors along the predicted VH-MDX flight path.**

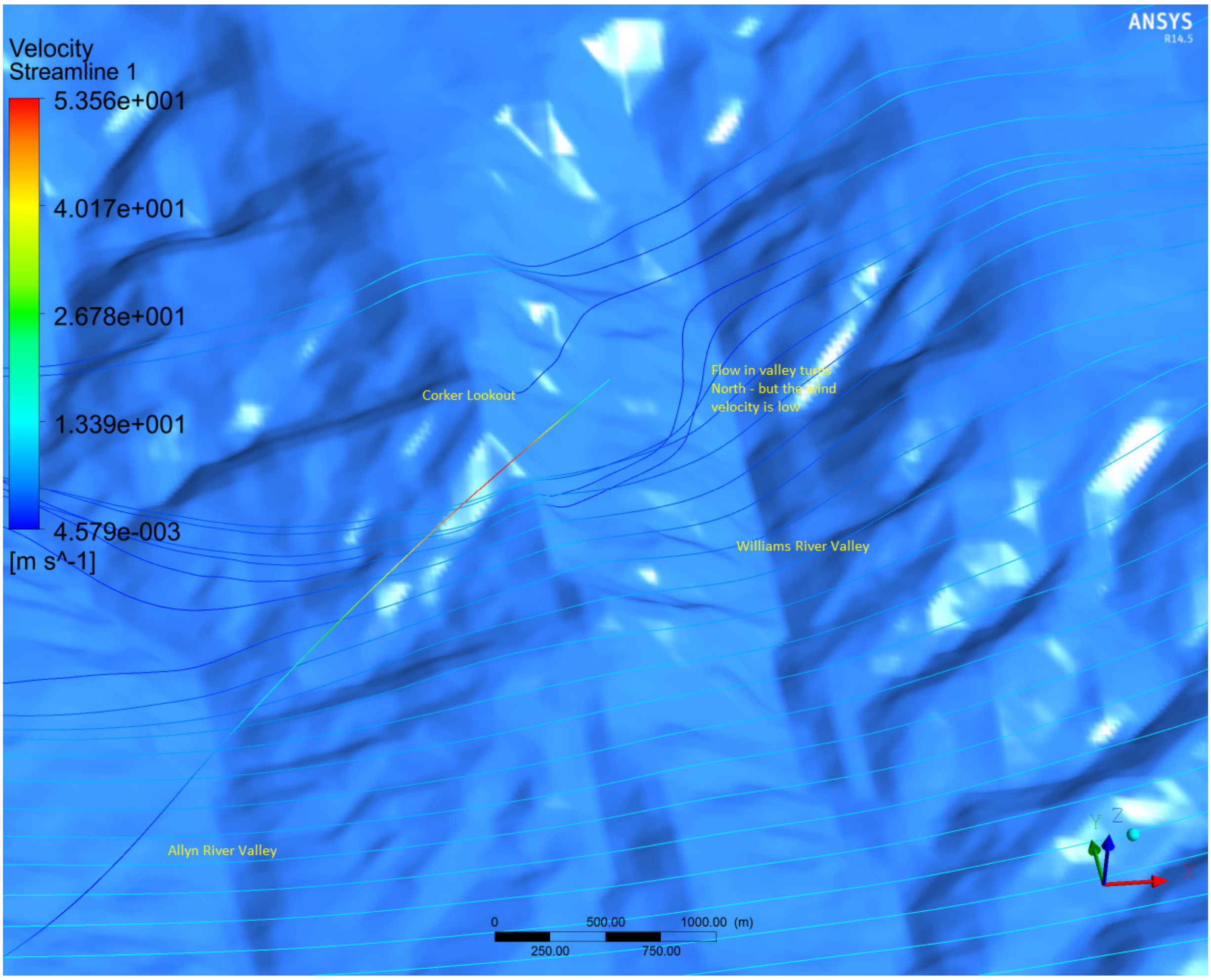


**Figure 8 - Wind streamlines starting from 5000 feet altitude. You can see the wind turns north in the bottom of the valley, but the strength of this wind is low.**

## Detailed Results - Wind Sink Velocity

The maximum up and down draft experienced by the aircraft on the predicted flight path according to this simulation is +/-250 feet per minute. While that is a big rollercoaster ride it is much smaller than the 1000 (or more) feet per minute descent rate MDX reports in the control tower transcripts. This means that it is the icing which is the most important factor causing VH-MDX to loose altitude by far, the mountain waves are small in comparison. This confirms that the wind sink velocity on the lee side of the Careys Peak Ridge is not likely to bring VH-MDX down rapidly, so it is likely VH-MDX would have made it to the middle of the valley or the other side (eastern side ) of the Upper Williams River valley.

The predicted wind rise/sink as felt by VH-MDX on the predicted flight path is shown in Figure 9. It shows that the aircraft experiences a rollercoaster ride of rising and sinking air as it travels along its predicted flight path. However, the aircraft was loosing altitude at around 1700 feet per minute in the final minutes of the flight, so this shows the wind is only a small contributor to that descent.

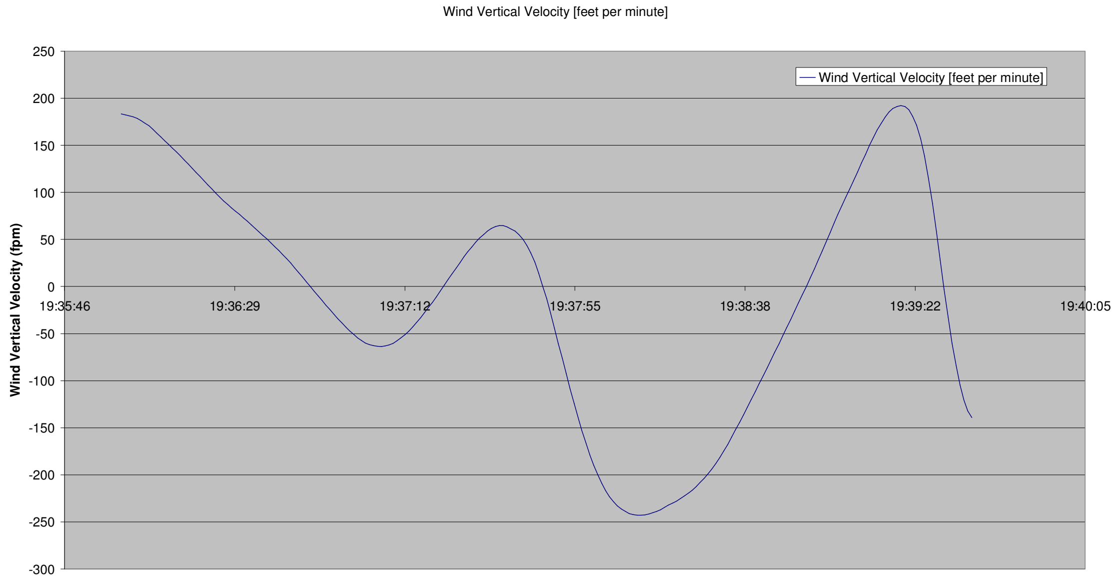


**Figure 9 - The wind rise/sink velocity as observed by the aircraft on its predicted flight path.**

## Detailed Results - Wind Speed Profile

The wind speed around the 5000 feet altitude is only about half that at 8000 feet. Other reports (eg John Watson's analysis, and the Area Forecast for that night) suggest the wind speed at 5000 feet was about 75% that at 8000 feet. This is showing that the atmospheric boundary layer over this mountainous region is slowing the wind down more than the flatter plains around it. This is not unexpected as the rough mountainous terrain is expected to increase the thickness of the atmospheric boundary layer.

The predicted wind velocity and direction is shown in Figure 10, together with the wind velocity predicted in the Area Forecast report.

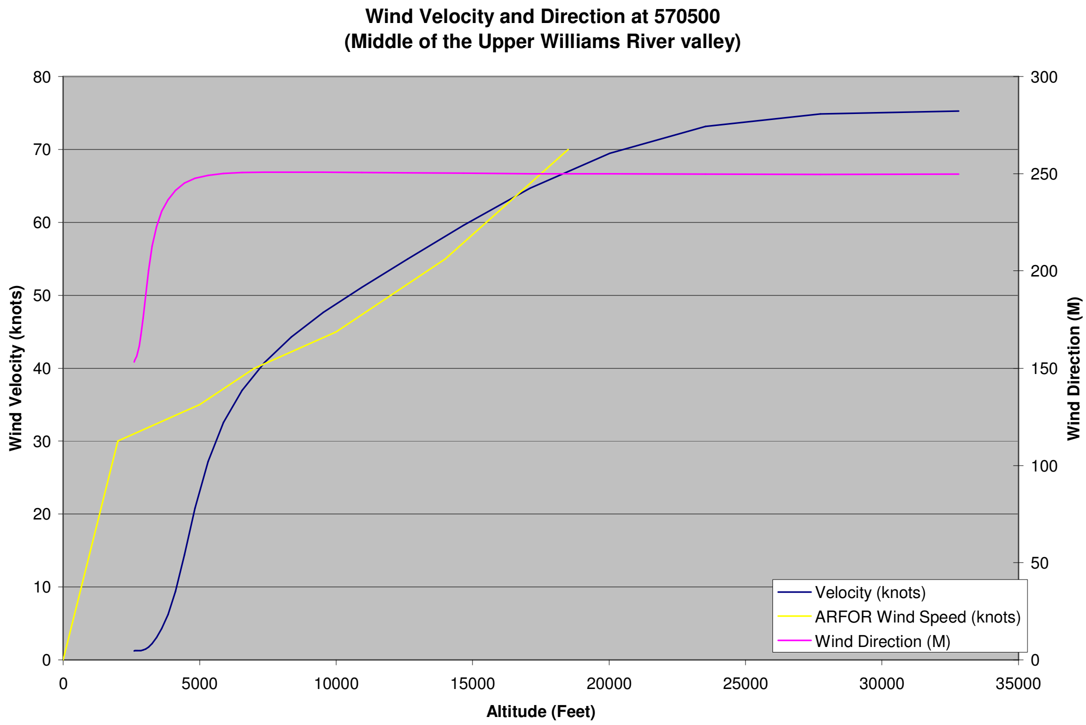


**Figure 10 - Wind velocity and direction profiles**

In Figure 11 we can see the wind rise/fall rate - and with a maximum value of 1.5 feet per second it can be seen that the wind rise/fall rate is small in this area. Also shown is the turbulence intensity, which shows the air at the lower altitudes is highly turbulent, so the aircraft can expect heavy buffeting which will get worse rapidly as aircrafts altitude decreases.

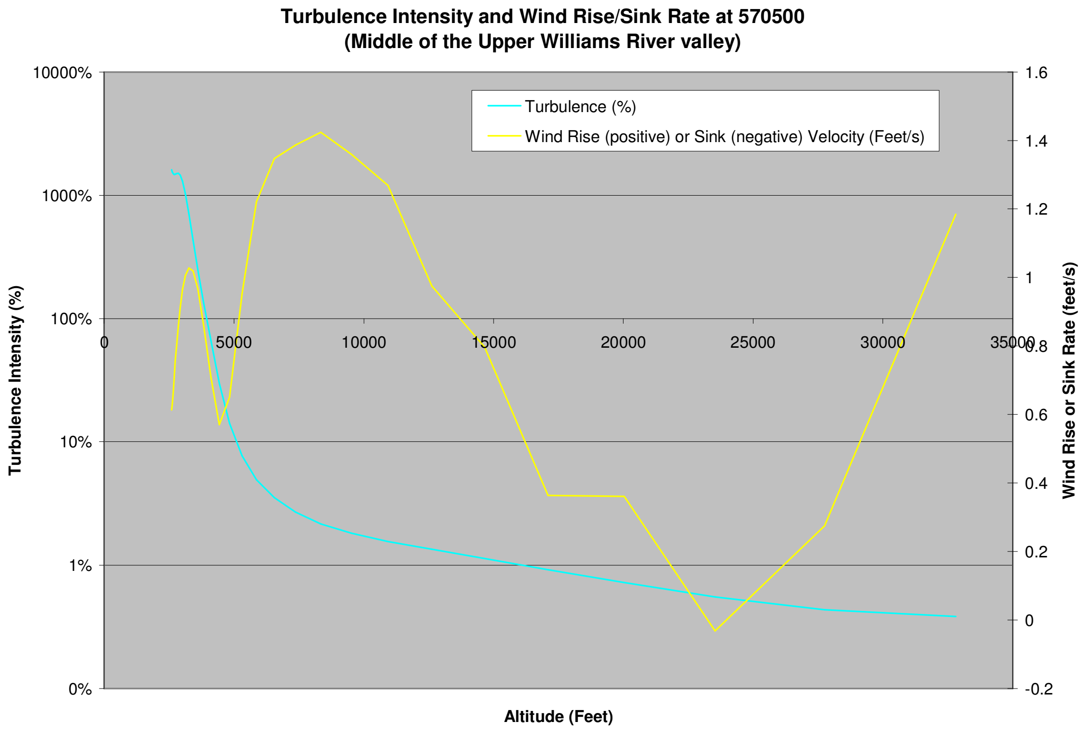


**Figure 11 - Turbulence Intensity and wind rise/sink profiles.**

## *Conclusion*

The prevailing wind on 9 August 1981 caused a flow separation on the eastern side of Carey's Peak Ridge. The predicted flight path of VH-MDX passed into this area at a low altitude, but as a separation existed there was no huge down draft of wind. This means VH-MDX is likely to have continued flying further into the valley. The work here also shows that as the aircraft goes lower in altitude the turbulence experienced increases dramatically.

## *Acknowledgements*

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