

National Transportation Safety Board
Office of Research and Engineering
Washington, D.C. 20594

Airplane Performance Study

Specialist Report Timothy Burtch

A. ACCIDENT

Location: Billings, Montana
Date: October 30, 2020
Time: 0105 GMT (1905 MDT)
Airplane: Cessna 172M Skyhawk, N124TW
NTSB Number: WPR21LA032

B. GROUP

No vehicle performance group was formed.

C. SUMMARY

On October 30, 2020 about 1905 mountain daylight time (MDT), a Cessna 172M Skyhawk, N124TW, was substantially damaged when it was involved in an accident near Billings, Montana. The pilot was fatally injured. The airplane was operated as a Title 14 Code of Federal Regulations (CFR) Part 91 cross-country flight.

According to air traffic control (ATC), the pilot reported wind shear and turbulence and had difficulties in continuing the flight at night with strong headwinds. The pilot also reported that he was unable to climb to an altitude to safely navigate mountainous terrain and needed to divert to Billings Logan International airport (BIL), Billings, Montana. The pilot turned right and continued his flight to BIL where he was instructed to land on runway 28R. As the pilot was approaching BIL, the tower controller asked if he would like runway 25 because it was more aligned with the winds, and the pilot agreed. As the pilot was approaching the airport, he advised, "I'm having trouble making out the airport from the rest of the flashing lights." The pilot then reported that he needed to maneuver to lineup with the runway. The controller issued the winds and cleared the pilot to land on runway 25, with additional instructions not to descend below 4,000 ft mean sea level (msl). With the airplane lined up for runway 25, the controller advised the pilot that the runway elevation was at 3,600 ft msl and that he could descend at any time. The controller also advised the pilot that the runway had Precision Approach Path Indicator (PAPI) lights, to which the pilot reported that he had them in sight. The controller lost sight of the airplane and lost all communication with the pilot shortly after.

The airplane impacted trees and level terrain east of the airport, about 3/4-mile from the threshold for runway 25 and on the extended runway centerline. All major structural components of the airplane were located within the debris field.

Airplane Performance Study

WPR21LA032, N124TW, Cessna 172M Skyhawk, October 30, 2020

The flight originated in Dallas, Texas, with multiple intermediate stops along the way. The accident-leg initiated from Sheridan County airport (SHR) in Sheridan, Wyoming, which has an airport elevation of 4,021 feet (ft) msl, and the pilot's planned destination was Three Forks airport (9S5) in Three Forks, Montana. (See Figure 1.)

Times in the study are quoted in MDT. Greenwich Mean Time (GMT) = MDT + 6 hr.

D. THE AIRPLANE

A picture of the accident airplane, a Cessna 172M Skyhawk, is shown in Figure 2. The airplane was manufactured by Cessna in 1975 and registered to the accident pilot.

E. WEATHER SUMMARY

Billings Logan International airport had the closest official weather station to the accident site. BIL had an Automated Surface Observing System (ASOS). The BIL ASOS site is located within a mile of the accident site and reported the following approximately 12 minutes before the accident:

METAR KBIL 310053Z 25012KT 10SM FEW090 FEW130 SCT200 14/M02 A2960

The automated surface weather observation at Billings Logan International on October 30 at 1853 MDT was wind from 250° at 12 knots (kt); 10 statute miles visibility; few clouds at 9,000 ft above the ground (agl), a few clouds at 13,000 ft agl, and scattered clouds at 20,000 ft agl; temperature 14° Celsius (C); dew point -02°C; altimeter 29.60" mercury.

The winds aloft were stronger than those observed at the surface. The 1900 MDT High-Resolution Rapid Refresh (HRRR) sounding wind profile indicated a wind from 280° at 10 kt at the station elevation of 3,415 ft msl¹. The wind speed increased to 25 knots by 4,300 ft msl (~900 ft agl) and to 35 knots by 4,800 ft msl (~1,400 ft agl). The wind direction shifted to the northwest by 5,500 ft msl, and the wind speed increased to 45 knots by 6,000 ft above msl.

See the NTSB Meteorology Specialist's Factual Report for additional weather information.

F. PERFORMANCE STUDY

The airplane performance study is largely based on Automatic Dependent Surveillance-Broadcast (ADS-B) data provided by the Federal Aviation Administration (FAA). ADS-B is a primary technology supporting the FAA's Next Generation Air Traffic Control System, or NextGen, which is shifting airplane separation and air traffic control from ground-based radar to satellite-derived positions. ADS-B broadcasts an airplane's Global Positioning System (GPS) position to the ground where it is displayed to Air Traffic Control. The GPS position is

¹ The accident was located at 45.8124° N latitude, 108.5200° W longitude, and at an approximate elevation of 3,320 ft msl.

Airplane Performance Study

WPR21LA032, N124TW, Cessna 172M Skyhawk, October 30, 2020

also transmitted to other airplanes with ADS-B receivers, either directly or relayed through ground stations, to allow self-separation and to increase situational awareness.

GPS has an accuracy of approximately 20 meters (m) in both the horizontal and vertical dimensions. GPS augmented with the Wide Area Augmentation System (WAAS)² is accurate to approximately 1.5 – 2 meters.

Figures 3 and 4 show the ADS-B ground track in the vicinity of the airport. The pilot reported to ATC that he was having difficulty making out the airport with other flashing lights in the area but, after some maneuvering, indicated that he had the airport in sight. The maneuvering is highlighted in Figure 3. The airplane was aligned with the runway for approximately the last nautical mile as shown in Figure 4.

Figure 5 shows the ADS-B altitude and airspeed recorded on the two hour and six-minute flight from SHR. In addition, smoothed ADS-B data from the point the piloted diverted to BIL and that were used to estimate airplane attitude is highlighted in red. The time that elapsed from diverting until the accident was approximately 27 min.

The ground speed (Vg) and calibrated airspeed (Vc) estimated from ADS-B and sounding data after the flight diverted to BIL are shown in Figure 6. The figure highlights an approximate 15 kt headwind right before diverting that transitioned to about a 30 kt tailwind after.

Figure 7 shows the estimated airspeed and altitude for the final three minutes of the accident flight. There does not appear to be any abrupt changes in altitude, and the airspeed was never slower than the flaps up, power-off, 1g stall speed³ of 49 kt. The airplane was in a slight descent when it impacted trees and level terrain east of the airport.

The estimated airplane attitude for the final minutes is shown in Figure 8. There were no abrupt changes in pitch attitude, and the bank angle in the final seconds was less than +/- 10°. The heading remained largely aligned with the runway 25 centerline until impact.

Figure 9 shows the airplane in its final position.

G. SUMMARY AND CONCLUSIONS

The pilot of N124TW encountered strong headwinds on the final leg of a multi-leg flight from Dallas, Texas, to Three Forks, Montana. With darkness and mountainous terrain ahead, the pilot elected to divert to Billings, Montana.

According to ATC communications, the pilot was having difficulties locating BIL because of flashing lights in the vicinity of the airport. However, the airplane did track the final approach

² WAAS collects, processes, and corrects GPS information to ensure that the data the pilot receives can be trusted: https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=14974&omniRss=fact_sheetsAoc&cid=103_F_S

³ The 1975 Cessna 172 Skyhawk Owner's Manual only publishes stall speeds with power off and at maximum gross weight with an aft center of gravity. The stall speed would be lower with power and at weights less than maximum. The stall speed would typically be slightly higher with a forward center of gravity.

Airplane Performance Study
WPR21LA032, N124TW, Cessna 172M Skyhawk, October 30, 2020

course to runway 25 once the pilot found the airport and maneuvered into position. The airplane impacted trees and terrain while flying the final approach course to the runway.

Airspeed and airplane attitude information estimated from ADS-B and winds aloft data indicate that the airplane impacted a tree and terrain while in a controlled descent and that an aerodynamic stall was not likely a factor.

The airplane was operating at altitudes between 7,000 and 11,000 ft msl for most of the two hour and six-minute flight accident flight, and it was night⁴ for the last half hour with the airplane largely operating between 4,000 and 9,000 ft msl.

It is not known whether the pilot was using supplemental oxygen; however, ATC communications indicate that he was having difficulty finding the airport at night. The FAA Airplane Flying Handbook, FAA-H-8083-3B, 2016, recommends using oxygen at night due to a “significant deterioration in night vision” at cabin altitudes as low as 5,000 ft.

The handbook goes on to say that “flying over terrain with only a few lights makes the runway recede or appear farther away. With this situation, the tendency is to fly a lower-than-normal approach. If the runway has a city in the distance on higher terrain, the tendency is to fly a lower-than-normal approach.” Figure 11 shows the ADS-B ground track for N124TW and the surrounding terrain on final approach into Billings.

Timothy Burtch
Specialist – Airplane Performance
National Transportation Safety Board

⁴ Title 14 CFR Section 1 defines night as the time between the end of evening civil twilight and the beginning of morning civil twilight. The end of evening civil twilight in Billings, Montana, was at 6:33 pm MDT on the day of the accident. See Figure 10.

H. FIGURES

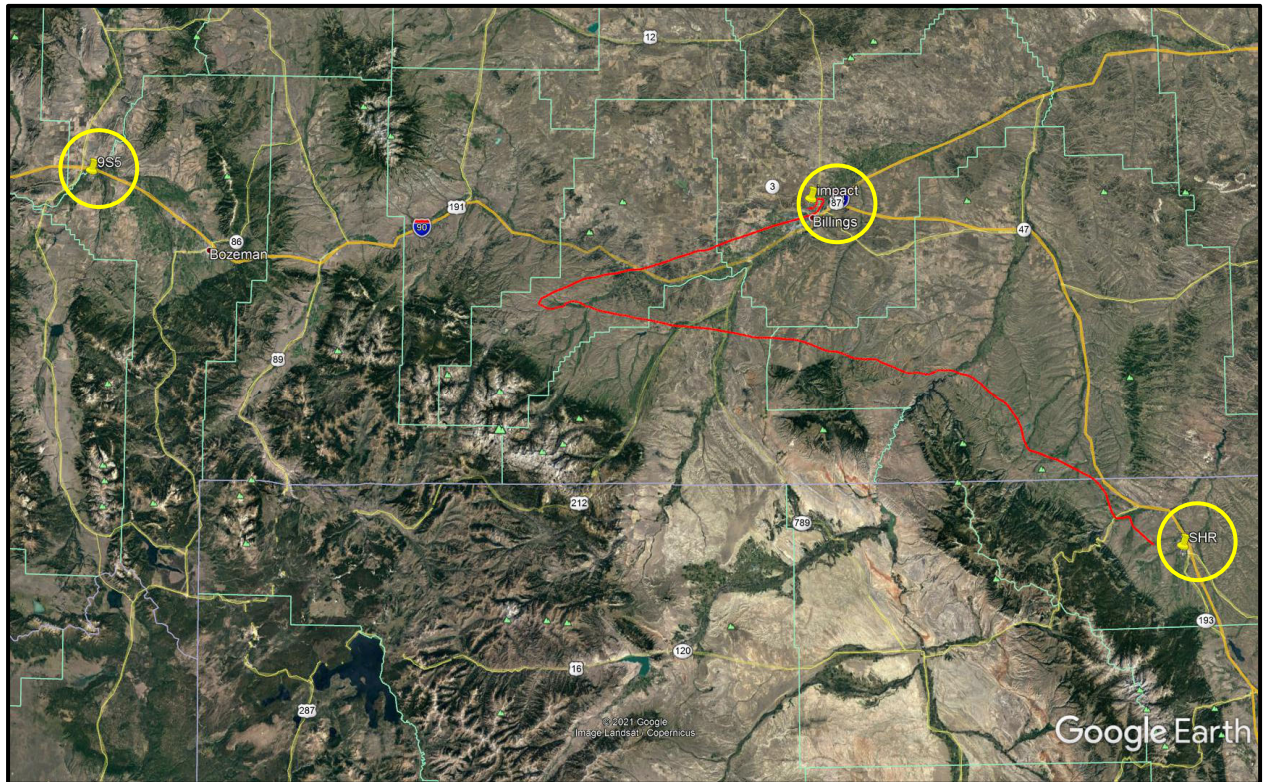


Figure 1: Accident-leg Intended from Sheridan County airport (SHR), Sheridan, WY, to Three Forks airport (9S5), Three Forks, MT, but Diverted to Billings, MT



Figure 2: Accident Airplane, N124TW, a Cessna 172M Skyhawk

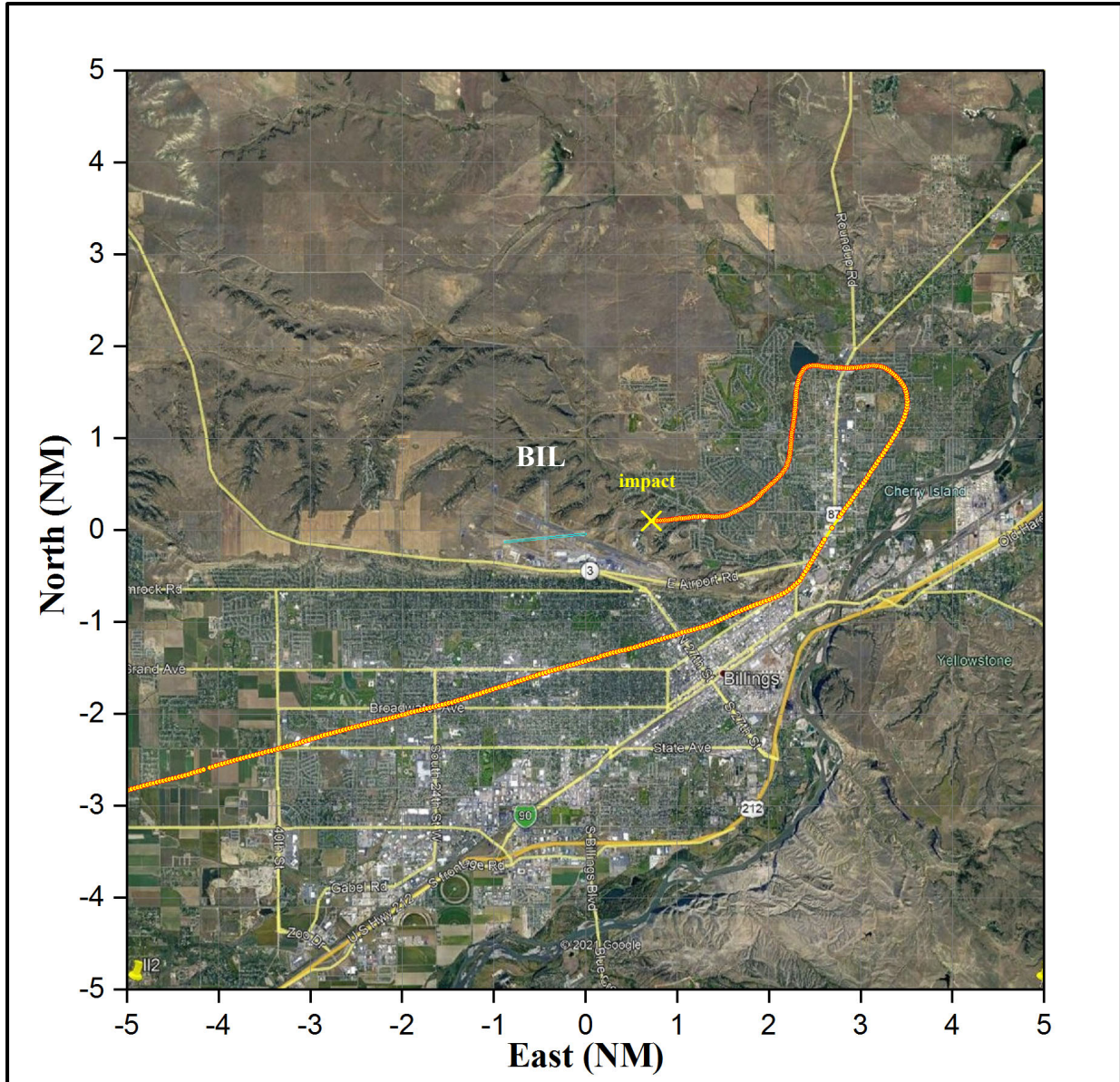


Figure 3: ADS-B Ground Track (○○○) with Runway 25 (—) and Impact Site (X) Denoted

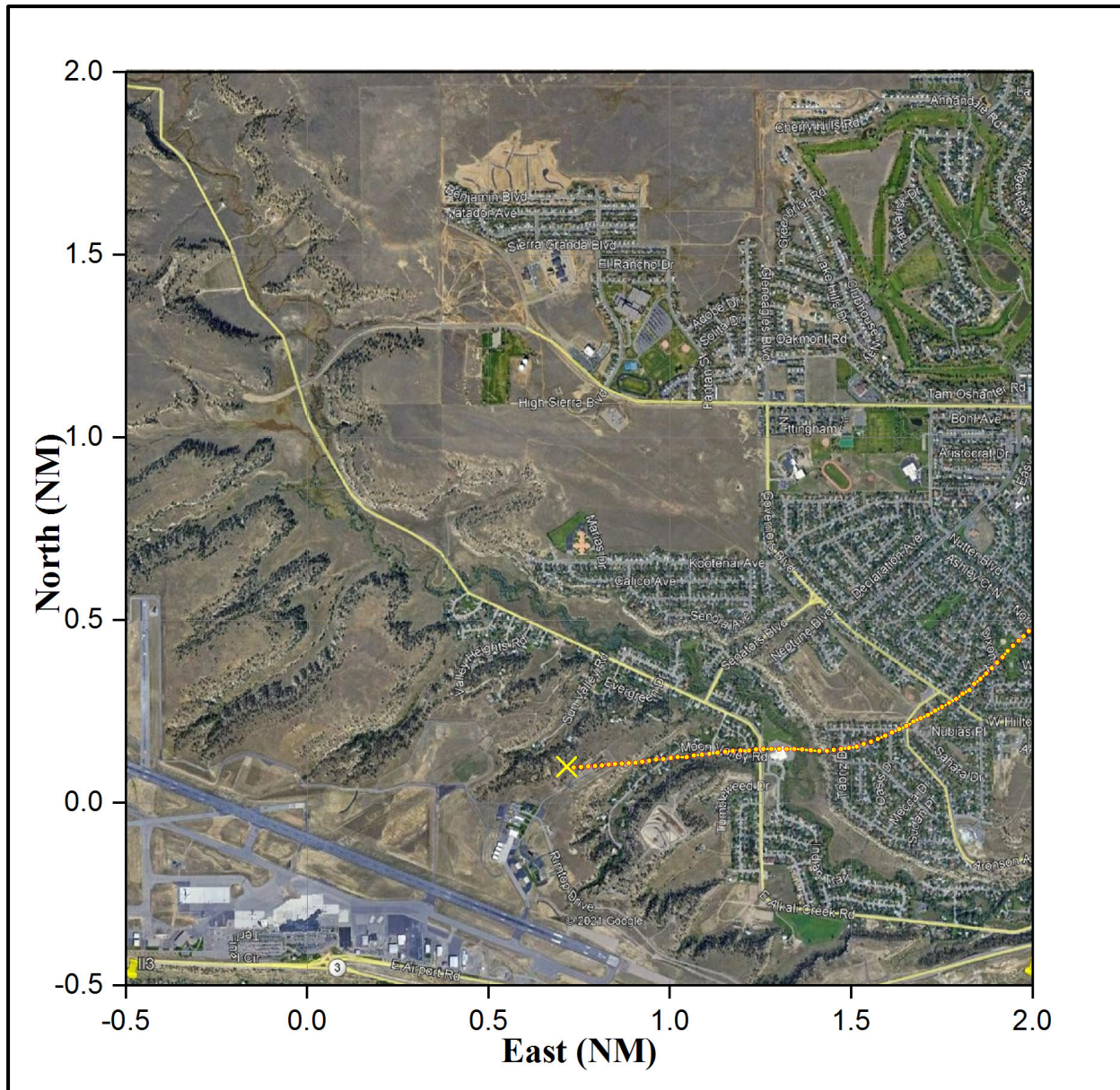


Figure 4: ADS-B Ground Track (●●●) and Impact Site (X) Closer to Airport

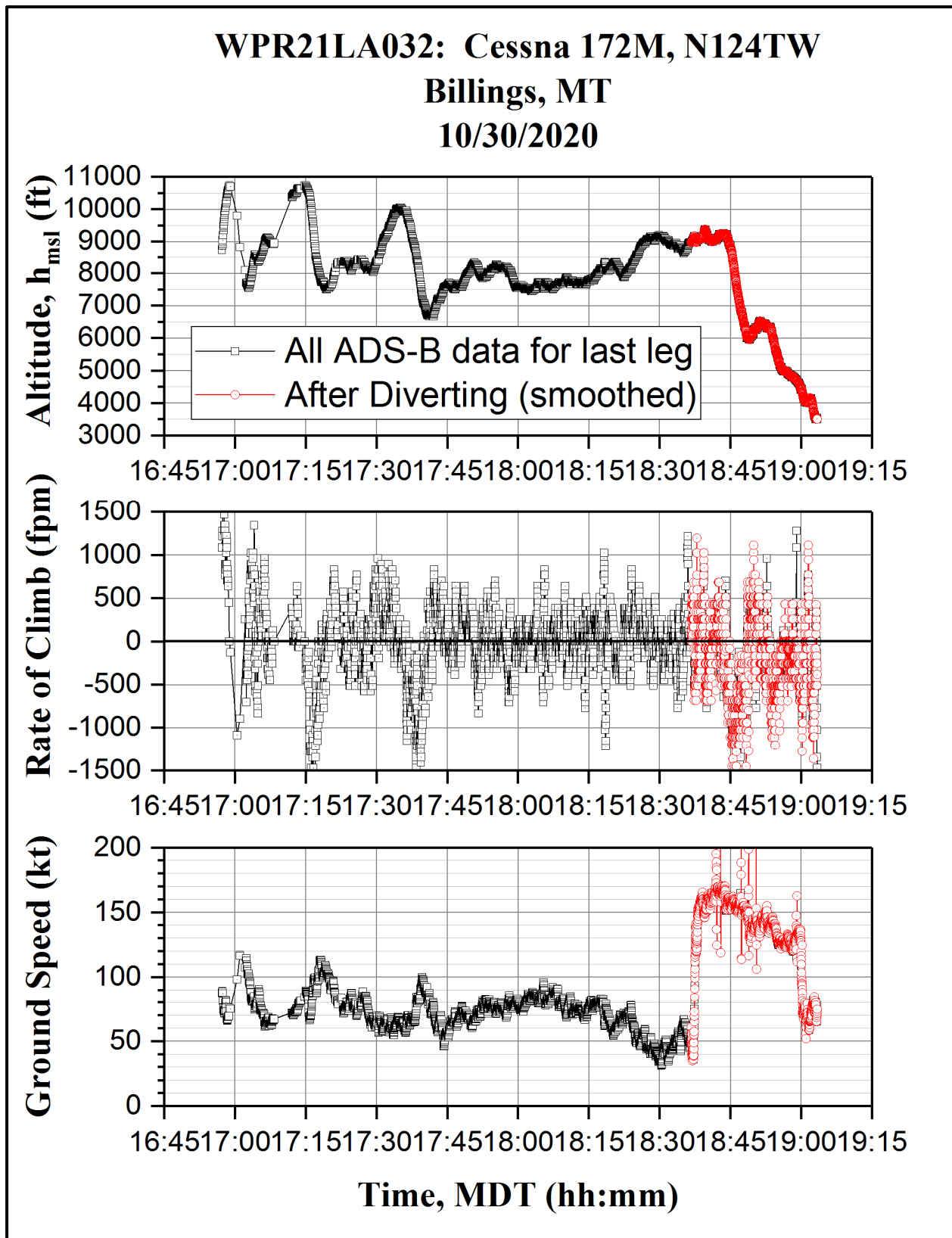


Figure 5: All ADS-B Altitude and Ground Speed for Last Leg

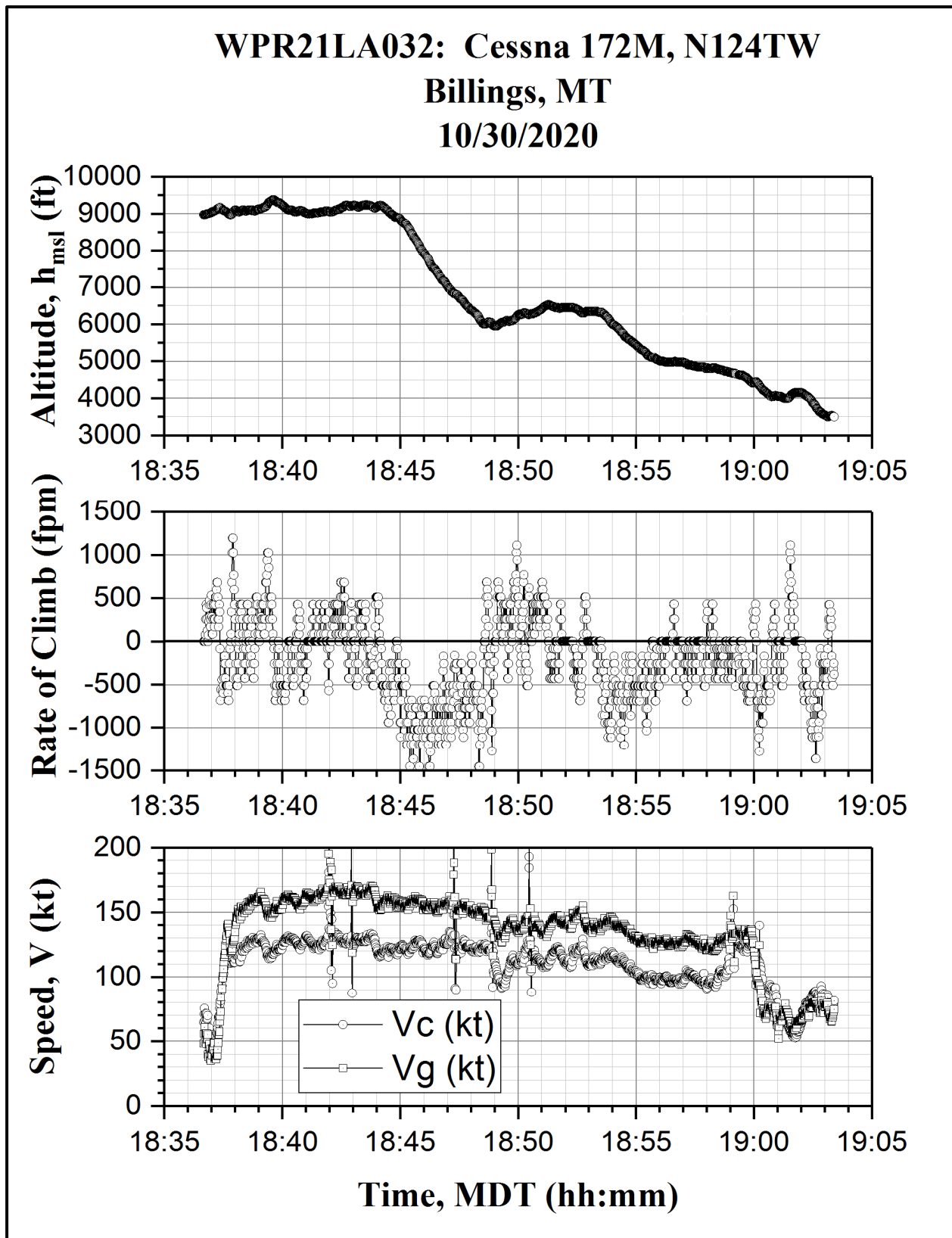


Figure 6: Estimated Groundspeed (V_g) and Calibrated Airspeed (V_c) After Diverting

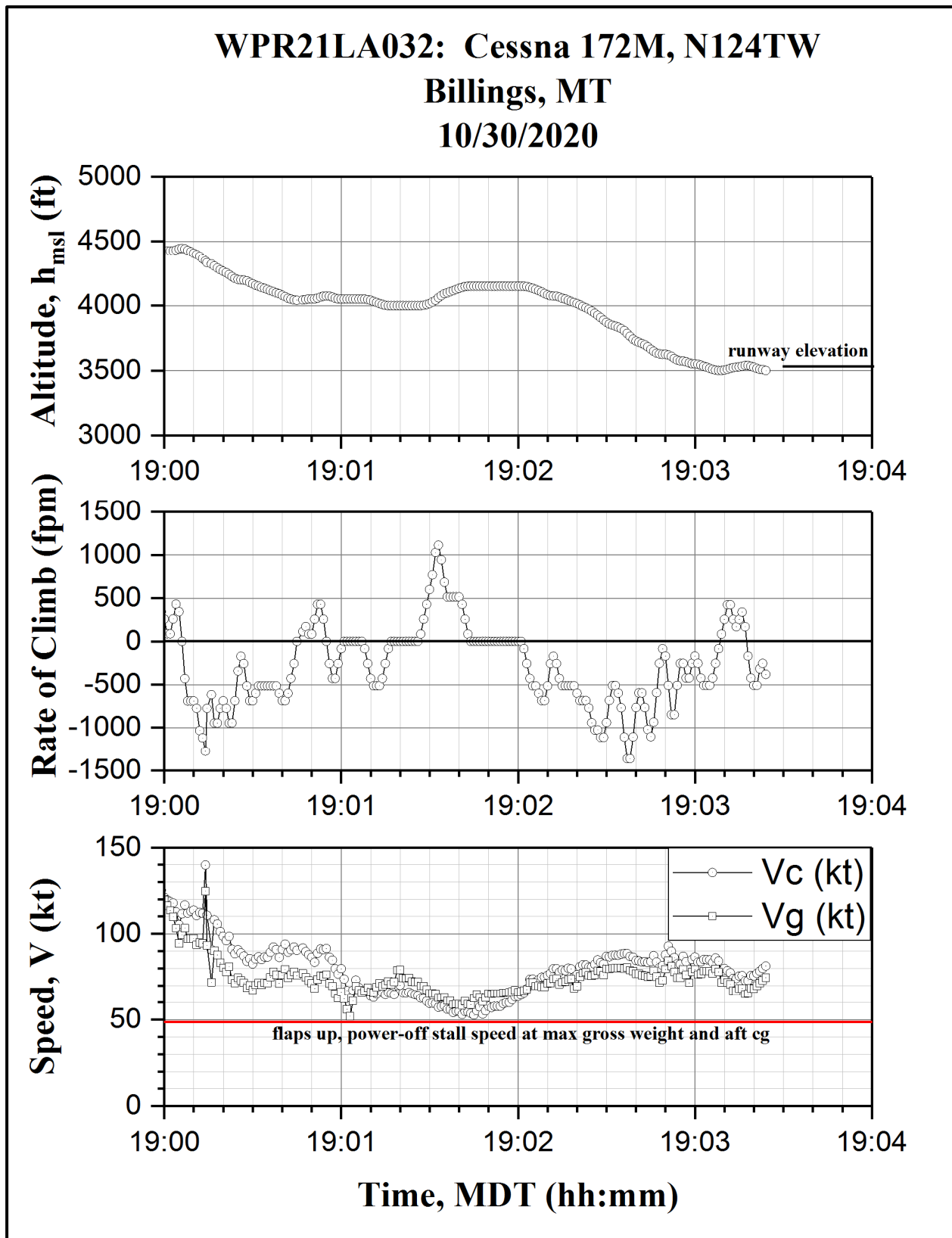


Figure 7: Estimated Groundspeed (V_g) and Calibrated Airspeed (V_c) for Final Minutes

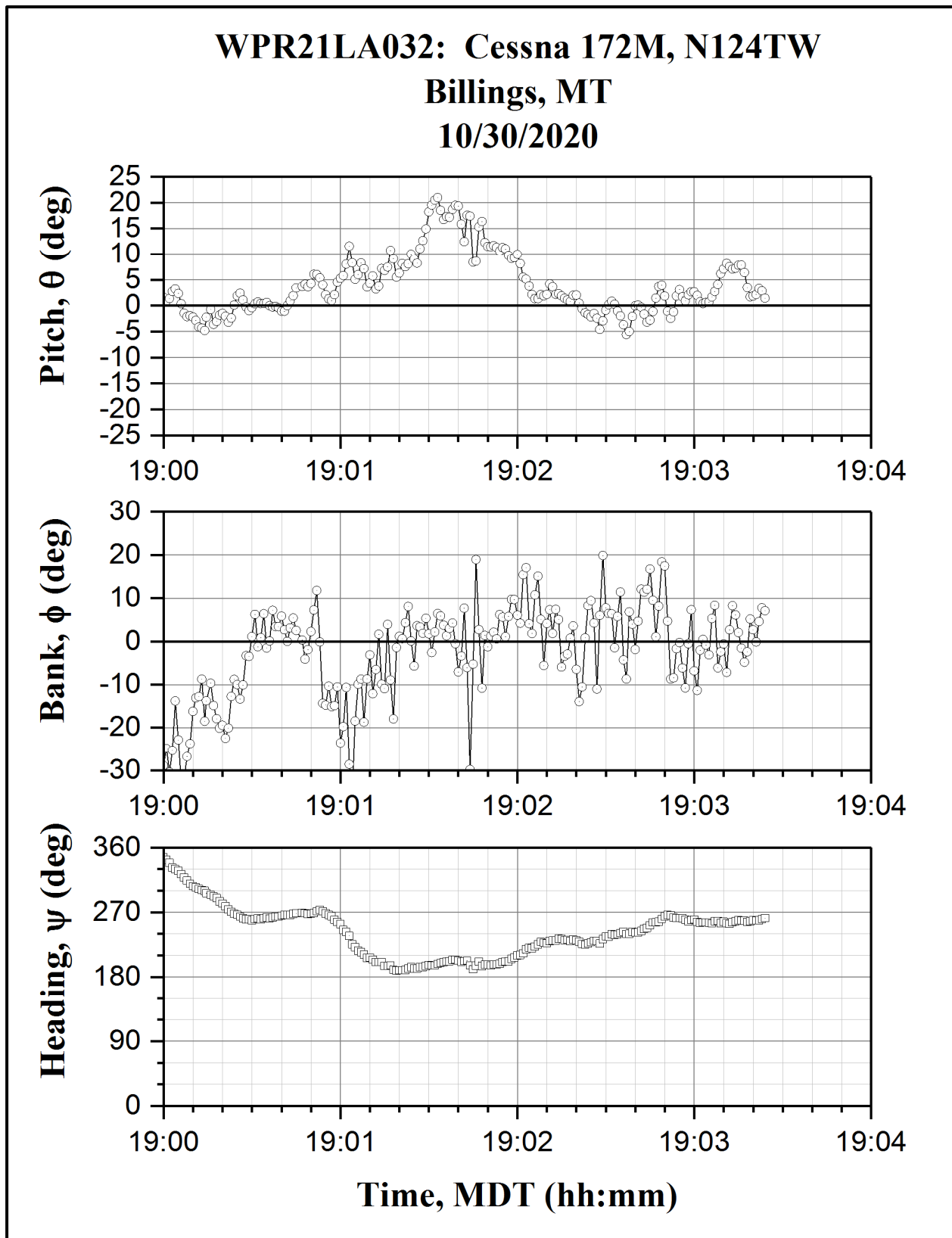


Figure 8: Estimated Pitch, Bank, and Heading for Final Minutes of Flight

Airplane Performance Study
WPR21LA032, N124TW, Cessna 172M Skyhawk, October 30, 2020



Figure 9: Picture of Wreckage

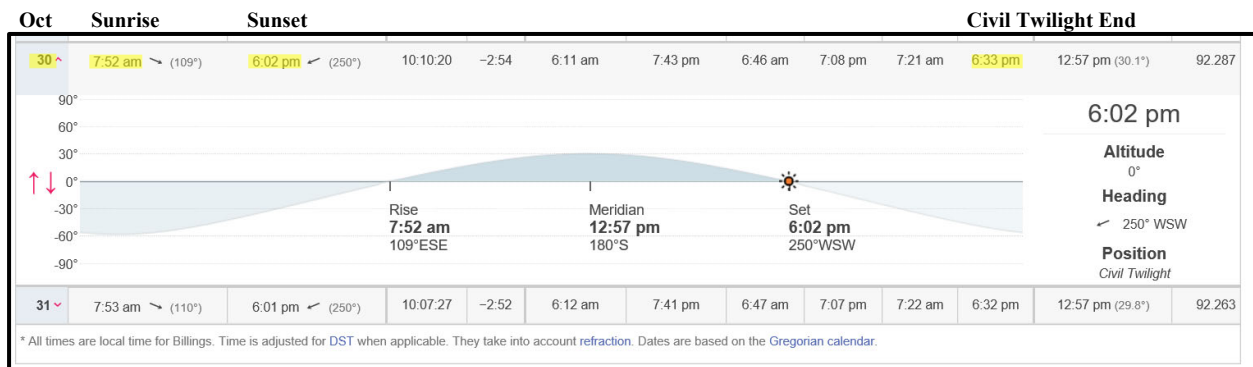


Figure 10: Sunrise and Sunset Times in Billings, MT, on the Day of the Accident

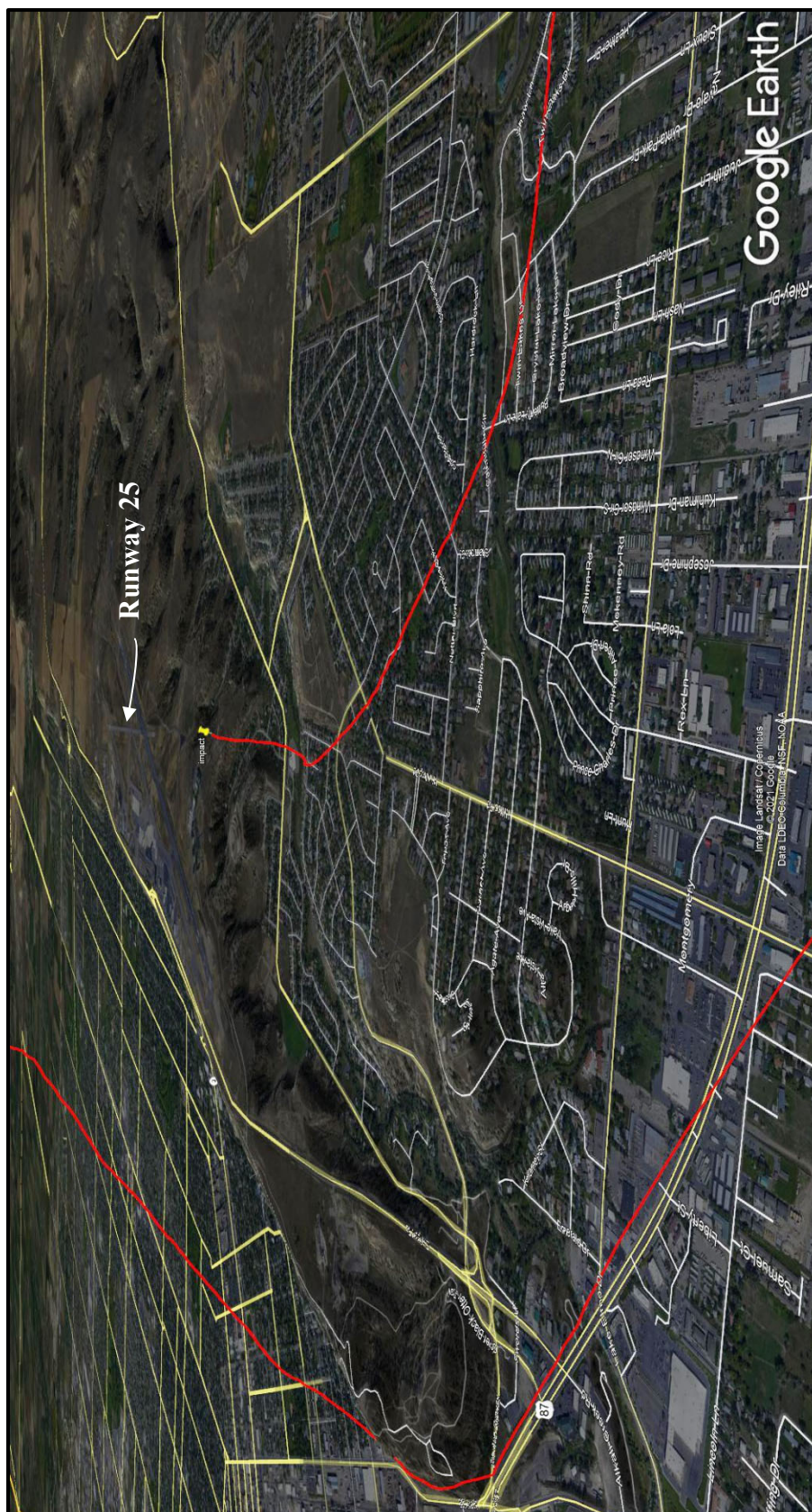


Figure 11: ADS-B Ground Track and Surrounding Terrain on Final Approach into BIL