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

Performance Study

Specialist Report
Marie Moler

A. ACCIDENT

Location:	Marco Island, Florida
Date:	March 1, 2015
Time:	1615 EST
Airplane:	Bombardier Challenger CL-600-2A12, N600NP
NTSB Number:	ERA15LA140

B. GROUP

No vehicle performance group was formed.

C. SUMMARY

On March 1, 2015, about 1615 Eastern Standard Time (EST), a Bombardier Challenger CL-600-2A12, N600NP, registered to and operated by Six Hundred NP, LLC, experienced a landing overrun and subsequent collapse of the nose gear at the Marco Island Airport (MKY), Marco Island, Florida. Visual flight rule conditions prevailed at the time of the accident and an IFR flight plan was filed for the 14 Code of Federal Regulations (CFR) Part 91 personal flight from the Florida Keys Marathon Airport (MTH), Marathon, Florida. The airplane sustained substantial damage. The airline transport rated pilot, the co-pilot, the flight attendant and four passengers were not injured, while one passenger sustained serious injuries, and one passenger sustained minor injuries. The flight originated from MTH about 1554.

RADAR STUDY

Two sets of radar data were used in this study to describe the accident airplane's ground track, altitude, and speed. Pressure altitude was provided with both sets of radar data and was corrected using the barometric pressure provided in the weather observation below.

The first set of radar data used in this study is from the Southwest Florida International Airport in Fort Meyers, Florida, coded as RSW. The ASR-11 (airport surveillance radar) is sampled at a frequency of once every 4.5 seconds. The radar was approximately 33 nautical miles (NM) from the aircraft's final location. These radar have approximately a 60 NM range and an inherent uncertainty of ±2 Azimuth Change Pulses (ACP) = ± (2 ACP) x (360º/4096 ACP) = ±0.176° in azimuth, ±50 ft in altitude, and ±1/16 NM in range.

Radar data was also collected from the tethered aerostat radar station (TARS) B94, about 80 NM from the accident in the Florida Keys. The aircraft location and altitude were recorded every 12 seconds. A tethered aerostat is a blimp that carries surveillance radar and because of its high altitude (up to 15,000 ft) the TARS system is able to monitor very low level aircraft. The uncertainty of the TARS system was not available.

Times in the study are reported in EST.

Weather Observation

The weather conditions reported at MKY at 1615 (at the time of the accident) were winds from 250° at 8 knots, 10 miles prevailing visibility with few clouds at 9,000 feet. The temperature was 27°F, the dew point was 20°F, and the pressure was 30.22 inHg.

Aircraft Flight Path, Altitude, and Groundspeed

The radar data for the aircraft is shown in Figure 1. The aircraft passed east of Marco Island at about 1612 before turning west and heading south for runway 17 at Marco Island Executive Airport. The radar data from Fort Meyers, Florida (labelled RSW) is shown in Figure 1 in green and the TARS radar data (labelled B94) in blue.

Figure 1. Aircraft flight path from RSW and B94 radar. Select altitudes and times are marked on the RSW track.

The RSW radar path in green had location accuracy of approximately ±560 ft in the east-west direction and ±380 ft in the north-south direction, but due to altitude and line of sight limitations, the last recorded radar location was about 1 NM from the runway threshold. Since the B94 radar data was from a TARS, it recorded the aircraft for longer at lower altitudes, but the location data was much less accurate.

Altitude was reported by the aircraft transponder. The altitude was corrected for both sets of radar data using an altimeter setting of 30.22 inHg and is shown in Figure 2. The data was

aligned using altitude and time. The last radar return from B94 was at 0 ft of corrected altitude. MKY is at 1ft of elevation and the altitude uncertainty was ± 50 ft.

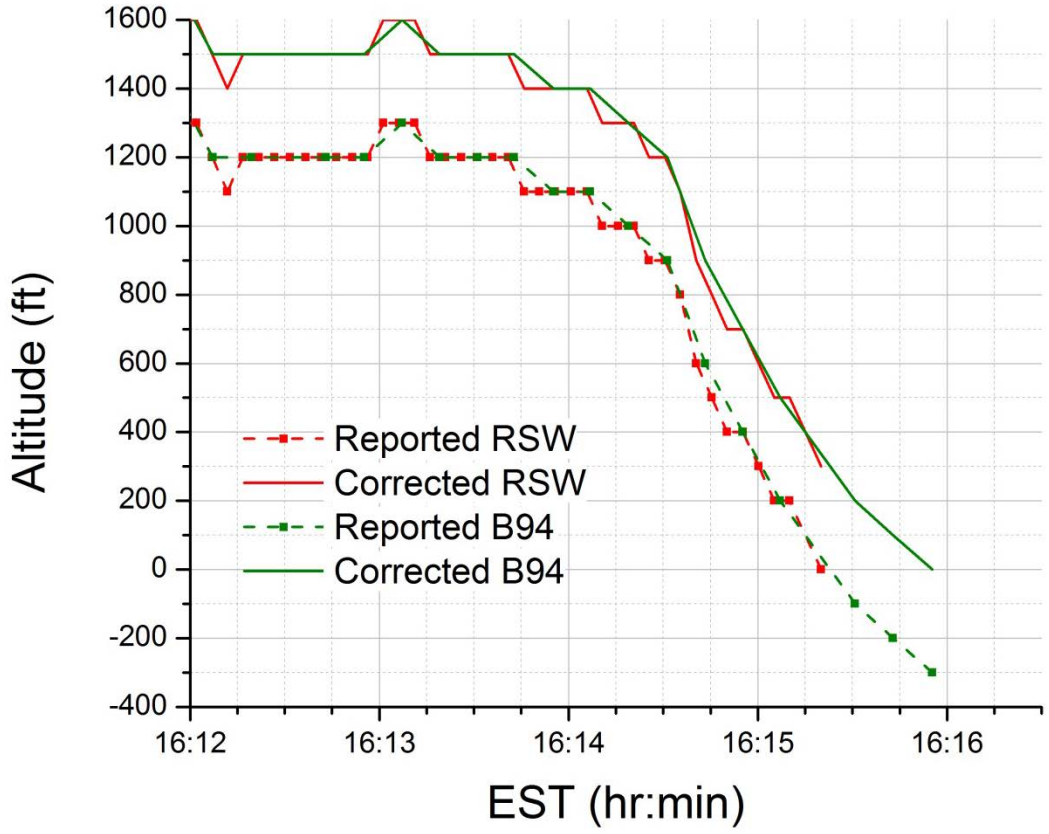

Figure 2. Aircraft pressure and corrected altitude from RSW (red) and B94 (green) radar.

The aircraft was equipped with an enhanced ground proximity warning system (EGPWS). While the terrain inhibit was not active during this flight, the device did record the aircraft's take-off and landing [1]. The landing record reported that the aircraft was at a GPS height of 68 ft (geometric height 58 ft) at a point 800 ft before the runway threshold. The reported uncertainty of the GPS location from the EGPWS was 0.0032 NM, or ± 20 ft. The GPS location was along the runway centerline and is shown in Figure 3.

The last four B94 radar returns were shifted to align with the runway centerline, the RSW radar data, and the EGPWS altitude and location. The track between the two points farther from the runway was parallel to the runway, as was the track between the two points closer to the runway. The two points farther from the runway were shifted together so their locations relative to each other were maintained. The two points closer to the runway were moved in a similar manner. These two segments of B94 data were shifted such that the aircraft's track and altitude were consistent with the other data. Figure 3 and Figure 4, below, show how the B94 data was shifted. Shifting the data adds additional uncertainty.

Figure 3. Aircraft radar paths from RSW (green) and B94 (blue) with the final points of B94 shifted (red) to align with RSW and EGPWS point.

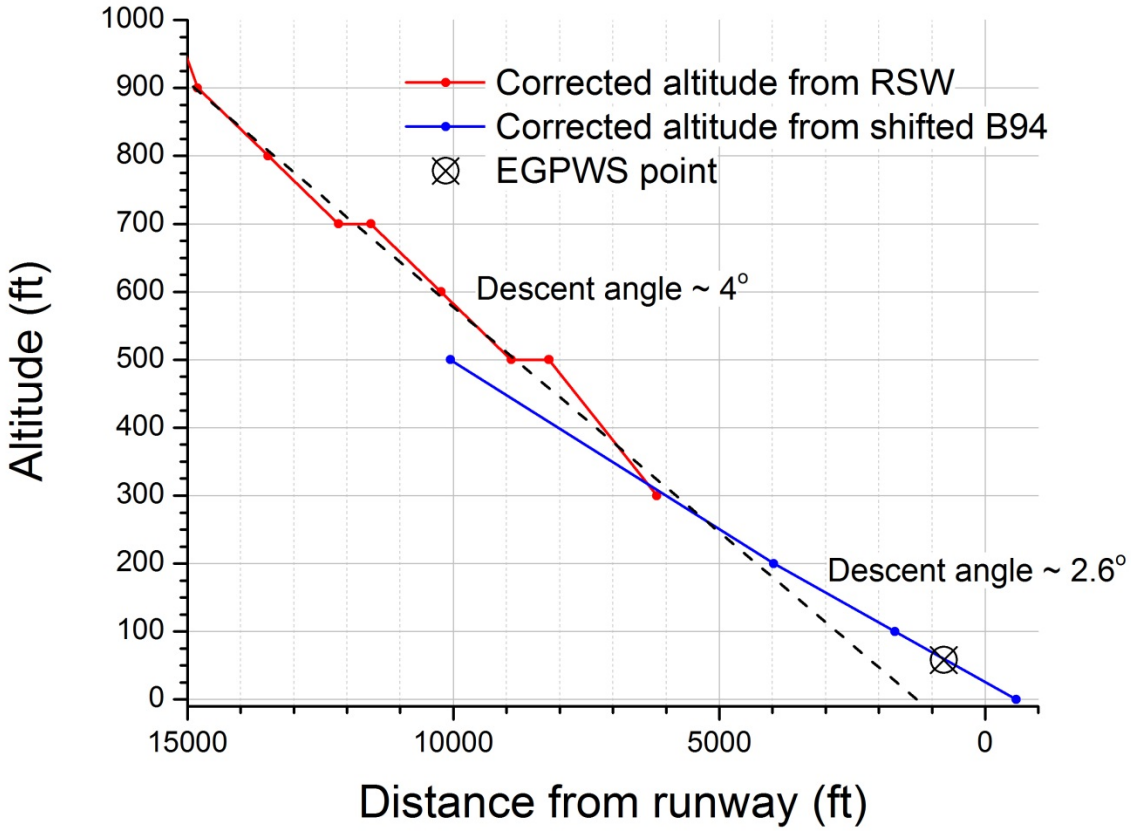

Figure 4. Descent angles for final RSW radar returns and shifted B94 radar data. The shifted B94 data was matched to the altitude of the final RSW data point and to the EGPWS point.

Figure 4 shows the aircraft's descent angle from 2.5 NM to 1 NM out from the threshold to be about 4°. The EGPWS and shifted B94 data show a final descent angle of 2.6°. MKY runway 17 has a four light precision approach path indicator (PAPI) set for a glide slope of 3.00° [2].

The shifted B94 data has the aircraft touching down 600 ft past the threshold. However, since the altitude uncertainty is ± 50 ft, the aircraft at this point could have been 50 ft above the runway. If the aircraft was at + 50 ft and the same angle of descent was assumed, the aircraft would have touched down 1700 ft past the threshold. Using these two points as boundaries, the B94 radar indicated the aircraft touched down between 600 and 1700 ft past the threshold of runway 17. Security camera video showed the aircraft touching down just past the 1,000 ft mark (see Figure 5) which agreed with pilot and passenger interviews [3].

Figure 5. Security camera still from MKY of the accident aircraft on runway. The white mark to the extreme left behind the aircraft is the 1,000 ft mark (yellow arrow). The small cloud of smoke behind the aircraft (white arrow) visible in this frame was indicative of touchdown.

Video was collected from 10 different security cameras that captured the aircraft flight or landing. Due to either the angle of the image, a lack of necessary background reference points, or the frame rate of the video (nine of the cameras, including the one in Figure 5 sampled at 1 frame per second) a reliable groundspeed was unable to be calculated. It was also not possible to conclusively determine the configuration of the aircraft from the images.

The calculated groundspeed from radar is shown in Figure 6, below. The aircraft began its final approach on the heading for runway 17 at 16:14:40. The final calculated groundspeed was just below 110 kts. This number has a large amount of uncertainty from the B94 radar position and the shifting of the points, but earlier points tracked the RSW calculated groundspeed well.

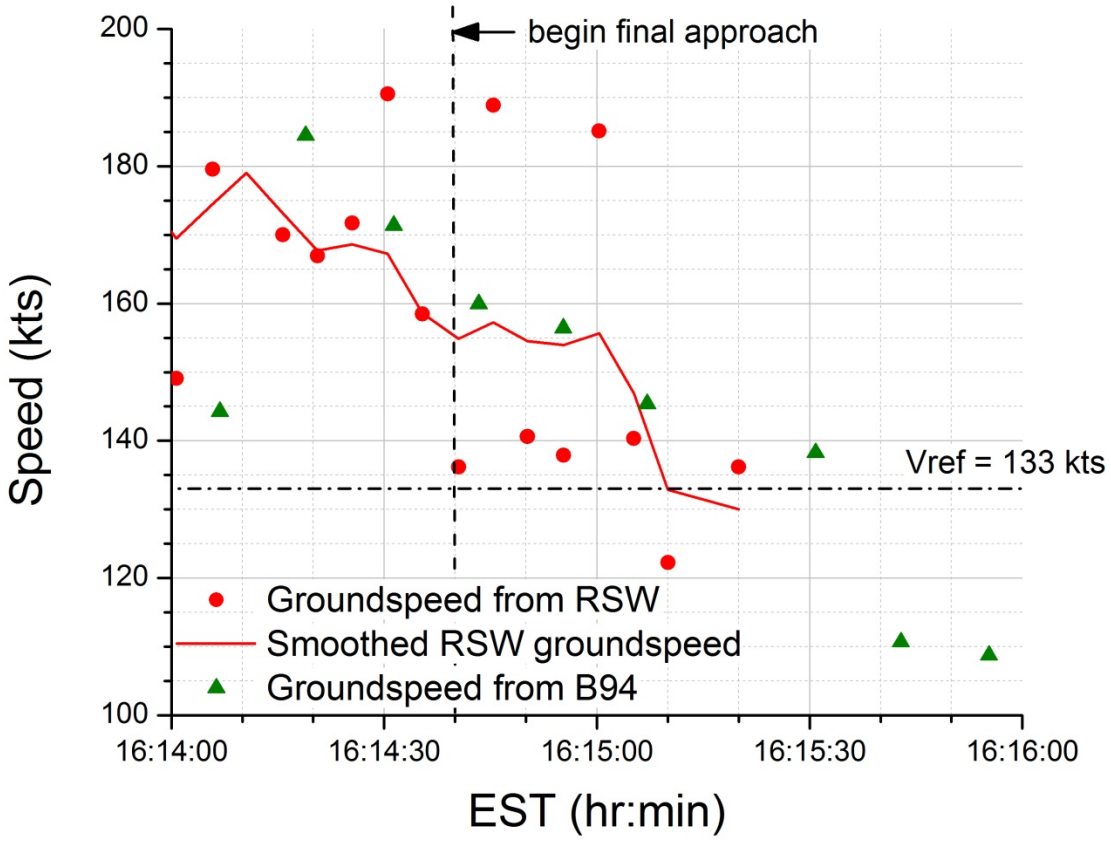

Figure 6. Calculated groundspeed from RSW and B94 radar.

The pilot and copilot reported the aircraft was at or a few knots above the V_{ref} speed of 133 kts as they crossed the runway threshold. The final RSW groundspeed calculations, approximately 1 NM from the threshold, were in agreement with the V_{ref} speed. The final calculated groundspeed from the shifted B94 was more than 20 kts slower than V_{ref}. The wind, from between 250º and 280º was mostly a crosswind and would have had little effect on the aircraft's airspeed. Despite this disagreement in calculations, the pilot reports and the RSW and B94 groundspeeds indicate that the aircraft did not touchdown faster than recommended.

D. CONCLUSIONS

The radar data from RSW and B94 indicate that the aircraft's approach into Marco Island Airport was consistent in speed, glide slope, and heading with aircraft and airport recommendations. While the B94 data had to be shifted to align with the runway, it produced a calculated groundspeed below the aircraft's V_{ref} value.

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E. REFERENCES

1. Enhanced Ground Proximity Warning System Factual Report, Accident number ERA15LA140. National Transportation Safety Board, 2015.
2. http://www.airnav.com/airport/kmky
3. Pilot interviews, Accident number ERA15LA140. National Transportation Safety Board, 2015.