

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division

Washington, D.C. 20594

April 26, 2019

Global Positioning System

Specialist's Factual Report by Alice Park

1. EVENT

Location: Louisa, Virginia
Date: November 4, 2018
Aircraft: Titan Tornado 1
Registration: N38FD
Operator: Private
NTSB Number: ERA19FA036

On November 4, 2018, about 1258 eastern standard time, an experimental amateur-built Titan Tornado 1, N38FD, was substantially damaged when it impacted a field during initial climb from Louisa County Airport (LKU), Louisa, Virginia. The sport pilot was fatally injured. The personal flight was conducted under the provisions of Title 14 *Code of Federal Regulations* Part 91. Visual meteorological conditions prevailed, and no flight plan was filed for the local flight that departed LKU about 1255.

2. DETAILS OF DEVICE INVESTIGATION

The National Transportation Safety Board Vehicle Recorder Division received the following Global Positioning System (GPS) device:

Device: Garmin GPSMAP 295
Device S/N: 98806849

2.1. Garmin GPSMAP 295 Device Description

The Garmin GPSMAP 295 is a hand-portable GPS unit equipped with a detachable antenna, a 256 color TFT LCD display, built in base map and an internal Jeppesen aviation database. The unit employs a parallel 12 channel receiver and can be operated using external power, or alternatively by using an internal Li-Ion rechargeable battery. The GPSMAP 295 can store date, route of flight, and flight time information for up to 50 individual flights in the form of a flight log. Flight logging begins when the GPS unit senses

a speed increase to greater than 30 knots together with an altitude gain of greater than 500 feet. The record is saved when the speed is sensed to decrease to below 30 knots, and a new log will be started if more than 10 minutes passes from this time. A detailed tracklog – including latitude, longitude, date, time, and GPS altitude information for an unspecified number of points – is stored within the unit whenever the receiver has a lock on the GPS navigation signal. Position is updated within the tracklog as a function of time or distance moved, depending on how the unit has been configured.¹

Once the current tracklog memory becomes full, new information either overwrites the oldest information or recording stops, depending on how the unit is configured. The current tracklog can be saved to long-term memory and 15 saved tracklogs can be maintained in addition to the current tracklog. Tracklog storage may be activated or deactivated at user discretion. All recorded data is stored in *non-volatile*² memory (NVM). The unit contains hardware and software permitting the download of recorded waypoint, route, and tracklog information to a PC via a built-in serial port using the NMEA 0183 version 2.0 protocol. An internal button-battery is used to back-up power to the internal memory and real-time clock during those periods when main power is removed.

2.1.1. Garmin GPSMAP 295 Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed that the unit had sustained impact damage during the accident and would not power on (Figures 1 and 2). It was disassembled for further examination.

The GPSMAP 295 stores recorded data in *non-volatile* memory (FLASH).³ The integrated circuit that was removed and read out was an AMD AM29DL323GB-90E1 NOR FLASH chip. It was read out using an NFI MTK II FLASH memory chip reader and the data converted using our in-house software program, SuperScrap (2.21.9.0).

¹ A third “Resolution setting” is available which records a new track point only when the direction and speed have changed significantly. In this mode the unit examines current 2-D position, velocity and ground track once per-second, and calculates a project position. If the unit’s actual position 1-second later differs from the projected position by a set value (25 meters or 82 feet by default).

² Non-volatile memory is semiconductor memory that does not require external power for data retention.

³ FLASH memory is a form of re-writable, non-volatile memory that can retain data without external power.

Figure 1. External view of the Garmin GPSMAP 295 - front (s/n 98806849).



Figure 2. External view of the Garmin GPSMAP 295 - back (s/n 98806849).



2.1.2. Garmin GPSMAP 296 Data Description

Track log data dated October 7, 2018, and November 4, 2018, were recovered directly from FLASH memory chip. And the track log of the accident flight, which was November 4, 2018, was identified with the date of the accident.

3. GPS PARAMETERS PROVIDED

Table 1 describes the data parameters provided. Date, Time, Longitude, Latitude, and GPS Altitude are recorded by the device. Groundspeed and Track are derived by the download software using recorded information. Data from the accident flight recorded is provided in tabular format as Attachment 1 to this report.

Table 1. GPS Data Parameters.

Parameter Name	Parameter Description
Date	Date for recorded data point (MM/DD/YYYY)
Time	Time (UTC) for recorded data point (HH:MM:SS)
Latitude	Recorded Latitude (degrees)
Longitude	Recorded Longitude (degrees)
GPS Alt	Recorded GPS Altitude (ft)
Groundspeed	Average groundspeed between current and following data point (knots)
Track	Average true course between current and following data point (degrees)

4. OVERLAYS AND TABULAR DATA

Graphical overlays in this report were generated using Google Earth Pro. Note that the weather and lighting conditions depicted in Google Earth imagery do not necessarily reflect the conditions present during the accident flight.

The most recently recorded track log began at 1749:20 Universal Time Coordinated (UTC) on November 4, 2018, departing at Louisa County Airport (LKU), Louisa, Virginia. The accident flight turned north after takeoff and flew about a mile from the airport before the recording ended. The final position was recorded at 1758:02 UTC with an altitude about 570 feet. The computed average ground speed between the two recorded latitude and longitude points was 34 knots. Figure 3 and 4 show overhead view of the entire flight. Figure 5 displays close view of the accident location.

Figure 3 Overhead view of the entire flight

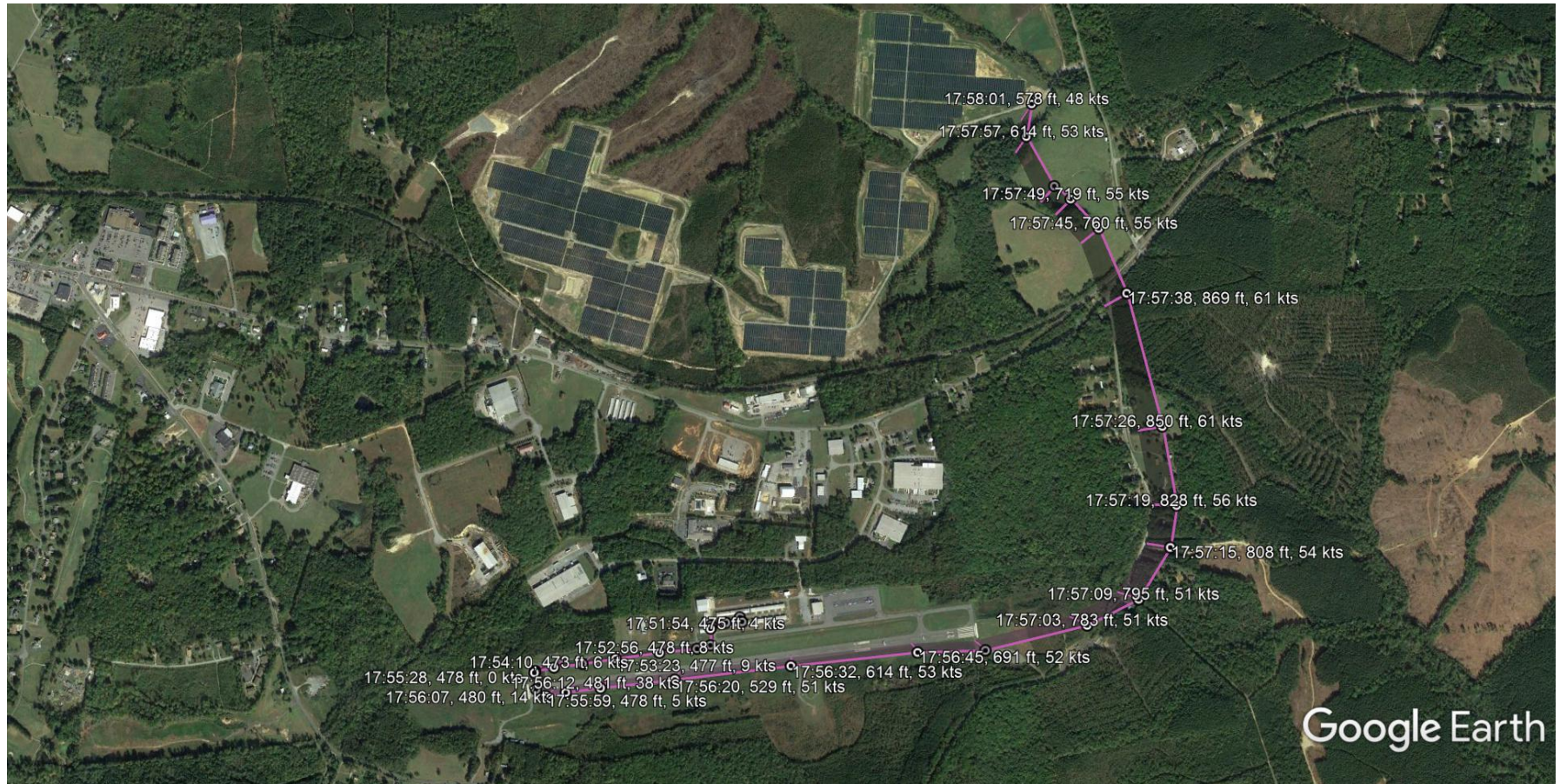


Figure 4 Oblique overhead view of the entire flight

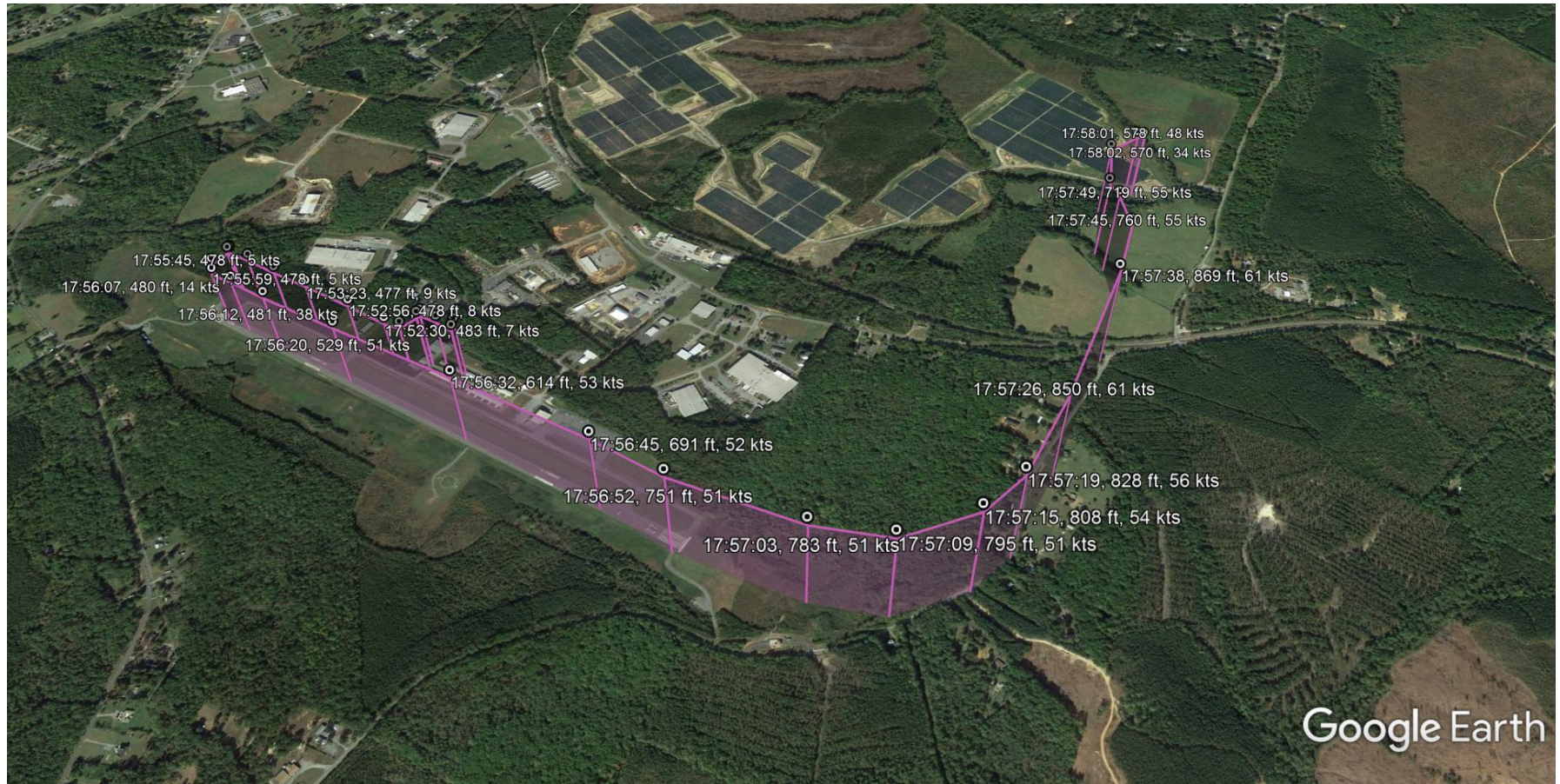


Figure 5 Close view of the impact location

