

NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, D.C. 20594

December 1, 2020

Electronic Devices – Recorded Flight Data

Specialist's Factual Report
By W. Deven Chen

1. EVENT SUMMARY

Location: Lancaster, California
Date: August 25, 2019
Aircraft: Scoda Aeronautica LTDA Super Petrel LS
Registration: N632MM
Operator: Worldwide Missions Inc
NTSB Number: WPR19LA240

On August 25, 2019, about 1405 Pacific daylight time, a Scoda Aeronautica LTDA Super Petrel LS airplane, N632MM, sustained substantial damage during an off-field landing after experiencing a loss of engine power, while flying near General WM J Fox Airfield, (WJF) Lancaster, California. The private pilot and passenger were not injured. The airplane was registered to Worldwide Missions Inc., and operated by the pilot as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

2. RECORDED FLIGHT DATA GROUP

A recorded flight data group was not convened.

3. DETAILS OF INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received, on August 5, 2020, the following electronic devices:

Device 1 Manufacturer/Model: **Garmin Aera 796**
Serial Number: **2CY012961**

Device 2 Manufacturer/Model: **Dynon SV-D1000**
Serial Number: **8810**

Device 3 Manufacturer/Model: **Dynon SV-D1000**
Serial Number: **7957**

3.1. Garmin Aera 796 Description

The Garmin aera 796 is a battery-powered, portable, multi-function display and GPS receiver with a 7-inch diagonal, high-resolution, LCD touch screen display. The unit includes a built-in Jeppesen database and is capable of receiving XM satellite radio for flight

information including NEXRAD Radar, lightning, METARs, TAFs, and TFRs. The unit can also perform and store weight and balance calculations. A built-in AOPA Airport Directory and SafeTaxi airport diagrams are included for selected airfields. With appropriate subscriptions, the unit is capable of storing and displaying geo-referenced VFR and IFR navigation charts, including IFR approach charts. The unit also has a “scratch pad” feature, allowing the user to hand write electronic notes.

The unit stores date, route-of-flight, and flight-time information for up to 50 flights. A detailed track log – including latitude, longitude, date, time, and GPS altitude information– is stored within the unit whenever the receiver has a lock on the GPS navigation signal. Position is updated within the track log as a function of time or distance moved, depending on how the unit has been configured. Once the current track log memory becomes full, new information either overwrites the oldest information or recording stops, depending on how the unit is configured. The current track log can be saved to long-term memory. Track log storage may be activated or de-activated at user discretion. All recorded data is stored in non-volatile memory¹.

The unit contains hardware and software permitting the download of recorded waypoint, route, and track log information to a PC via a built-in USB port. 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.

3.1.1. Garmin Aera 796 Data Recovery

The device was undamaged upon arrival at the Vehicle Recorder Division, as shown in Figure 1. The device powered up normally and the data were extracted using manufacturer’s software.



Figure 1: Front and back view of Garmin Aera 796 as received.

¹ Non-volatile memory is semiconductor memory that does not require external power for data retention.

3.1.2. Garmin Aera 796 Data Description

The recovered data contained 3 sessions recorded on August 23, 2019, August 25, 2019 and July 20, 2020. The session recorded on August 25, 2019 was determined to be the accident flight.

3.1.3. Garmin Aera 796 Parameters Provided

Table 1: Garmin Aera 796 Data Parameters.

Parameter Name	Parameter Description
Date	Date for recorded data point (MM/DD/YYYY)
Time	Coordinated Universal Time for recorded data point (HH:MM:SS)
Latitude (Deg)	Recorded Latitude (degrees)
Longitude (Deg)	Recorded Longitude (degrees)
GPS Alt (Ft)	GPS Altitude (feet)
Groundspeed (Kt)	Average groundspeed between current and previous data point (knots)
Track (Deg)	Path on the surface of the Earth directly below an aircraft (degrees)

3.2. Dynon SV-D1000 Description

The Dynon SV-D1000 has an 11" screen with both a touchscreen and softkey interface. The device can serve as either a Primary Flight Display (PFD) or a Multifunction Display (MFD) depending on installation. The unit has a solid-state Air Data and Attitude Heading Reference System (ADAHRS) and displays aircraft parameter data including altitude, airspeed, attitude, vertical speed, and heading. The unit also has external pitot/static inputs for altitude, airspeed, and vertical speed information. The device contains an internal flash memory device. The flash memory stores information sampled every 60 milliseconds for the last two hours of flight in a file called a "Black_Box_Log," detailed alert logs that show both caution, warning and aural alerts generated by the display in a file called "Alert_Data," as well as a flight history log which is sampled at a lower rate that can record many more hours of operation. The flight history is recorded as a file called "User_Log" and is sampled about every 250 milliseconds.

3.2.1. Dynon SV-D1000 Data Recovery

Both Dynon SV-D1000 units were in good condition upon arrival at the Vehicle Recorder Division. Figure 2 is a picture of the "left" display, functioning as the aircraft's PFD, and the "right" display, functioning as the aircraft's MFD. The data were downloaded using the manufacturer's procedure.



Figure 2: Dynon SV-D1000 units as received, the PFD (left) and the MFD (right).

3.2.2. Dynon SV-D1000 Data Description

The downloaded data from the PFD contained 3 data files: User_Log, Alert_Data and Black_Box_Log. Each data file had the first session of recording at different time, but all had last session recorded on July 20, 2020. The User_Log file contained data at a sampling frequency of approximately 4 data points per second, while the Black_Box_Log file contained data at a sampling frequency of approximately 16 data points per second. The Alert_Data file only contained data recorded whenever an event occurred. Those 3 data files all contained the accident flight recorded on August 25, 2019. The duration of the accident recording was approximately 12 minutes and 40 seconds. Table 2 is a summary of the data downloaded from the PFD. Data downloaded from the MFD were identical as compared to the PFD.

Table 2: Summary of data downloaded from the PFD.

Data File	First Session	Last Session	Sample Frequency	Contained Accident flight (Y/N)
User_Log	June 15, 2019	July 20, 2020	~ 4	Y
Alert_Data	March 7, 2018	July 20, 2020	Whenever events occurred	Y
Black_Box_Log	August 23, 2019	July 20, 2020	~16	Y

3.2.3. Dynon SV-D1000 Time Correlation

Data was recorded in Universal Coordinated Time (UTC). The plotted information was left in UTC and was not converted to local time of the accident.

3.2.4. Dynon SV-D1000 Parameters Provided

Table 3 shows the data parameters downloaded from the Dynon SV-D1000. In a discussion with the IIC (investigator in charge), it was determined that the EGT 1 & 2 and CHT 1 & 2 were measuring exhaust gas temperatures and cylinder head temperatures at two selected physical locations (there were four cylinders within the engine) within the engine, where the measurements were representative of the whole engine. Data from Garmin Aera 796 were reviewed and matched those of Dynon SV-D1000, thus not provided in this report.

Table 3: Dynon SV-D1000 Data Parameters.

Parameter Name	Parameter Description
Date	Date for recorded data point (MM/DD/YYYY)
Time	UTC for recorded data point (HH:MM:SS)
EGT 1/2 (degF)	Exhaust Gas Temperature Location # (degrees Fahrenheit)
CHT 1/2 (degF)	Cylinder Head Temperature Location # (degrees Fahrenheit)
OAT (degF)	Outside Air Temperature (degrees Fahrenheit)
MAP (inHg)	Manifold Pressure (inches of mercury)
FUEL P (PSI)	Fuel Pressure (pounds per square inch)
FUEL R (gal)	Fuel Remaining (gallons)
RPM (rpm)	Engine Rotational Speed (revolutions per minute)
OIL T (F)	Oil Temperature (degrees Fahrenheit)
OIL P (PSI)	Oil Pressure (pounds per square inch)
Volts (V)	Bus Voltage (voltage)
Amps(A)	Bus Load Current (amperes)
Lateral Accel (g)	Lateral Acceleration (g)
Vertical Accel (g)	Vertical Acceleration (g)
AP Roll Position (steps)	Auto Pilot Roll Position (steps)
AP Pitch Position (steps)	Auto Pilot Pitch Position (steps)
Pitch (deg)	Pitch (degrees)
Roll (deg)	Roll (degrees)
Ground Speed (kt)	Average groundspeed between current and previous data point (knots)
Indicated Airspeed (kt)	Airspeed read from airspeed indicator onboard (knots)
True Airspeed (kt)	Airspeed corrected for temperature and pressure altitude (knots)
Vertical Speed (ft/min)	Aircraft vertical speed (feet per minute)
Ground Track (deg)	Path on the surface of the Earth directly below aircraft (degrees)
Magnetic Heading (deg)	Direction relative to magnetic north (degrees)
GPS Altitude (ft)	Geometric altitude above Mean Sea Level (feet)
Pressure Altitude (ft)	Altitude recorded at a 29.92 inHg pressure setting (feet)

3.3. Plots and Corresponding Tabular Data

The following nine figures contain data recorded on Dynon SV-D1000 on August 25, 2019. Figures 3 through 6 show parameters plots and figures 7 through 11 show Google Earth overlays of the accident flight.

Figure 3 is a plot of the engine parameters for the entire accident flight recorded on August 25, 2019. The time interval displayed is 18:20:00 to 18:34:00 UTC. Alert data from the Alert_Data file are overlaid on the plot. At 18:32:14.18, the Dynon SV-D1000 system was displaying “TACH LOW” in text and playing “EMS_RPM” in audio. At 18:32:23.37, the Dynon SV-D1000 system was displaying “OIL PRES LOW” in text and playing “EMS_OIL_PRES” in audio.

Figure 4 is a plot of the engine parameters for the final portion of the accident flight recorded on August 25, 2019. The time interval displayed is 18:28:00 to 18:34:00 UTC.

Figure 5 is a plot of the operational parameters for the entire accident flight recorded on August 25, 2019. The time interval displayed is 18:20:00 to 18:34:00 UTC.

Figure 6 is a plot of the operational parameters for the final portion of the accident flight recorded on August 25, 2019. The time interval displayed is 18:20:00 to 18:34:00 UTC.

Figure 7 is a Google Earth overlay of the entire accident flight recorded on August 25, 2019. The weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording.

Figure 8 is a Google Earth overlay of the beginning of the accident flight. It shows the aircraft took off at Agua Dulce Airpark (L7O) at around 18:20:00 UTC.

Figure 9 is a Google Earth overlay of the final portion of the accident flight. It shows the aircraft landed on a field near William J Fox Airport (WJF) at around 18:33:00 UTC.

Figures 10 and 11 are Google Earth overlays of the final portion of the accident flight viewed at different angles.

The corresponding tabular data used to create figures 3 through 11 are provided in electronic comma-delimited (.csv) format as Attachment 1 to this report. The Alert_Data file is provided in (.csv) format as Attachment 2 to this report. Not every additional parameter in the attachments have been validated by the specialist.

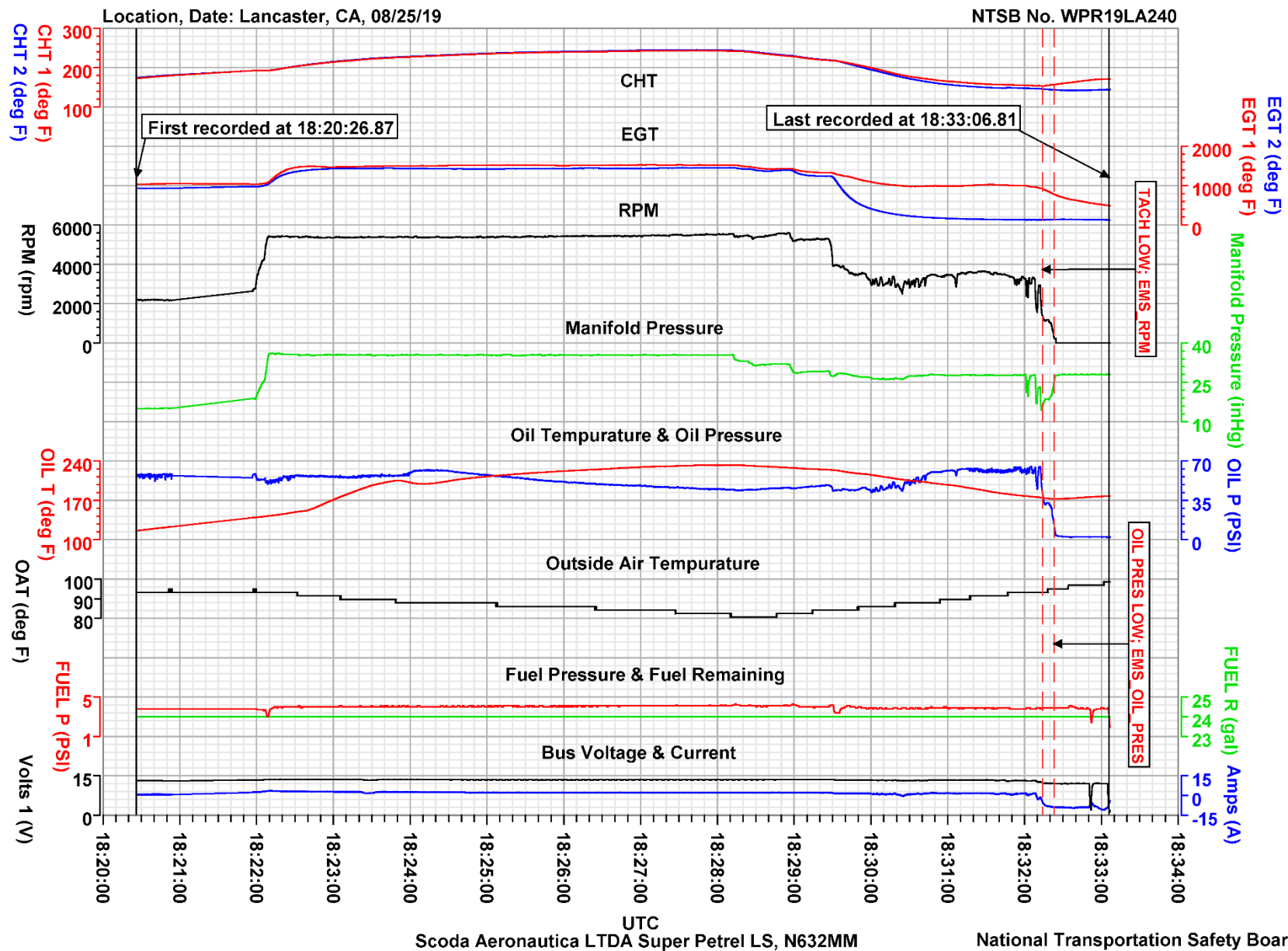


Figure 3: Plot of Dynon SV-D1000 engine parameters for the entire accident flight recorded on August 25, 2019.

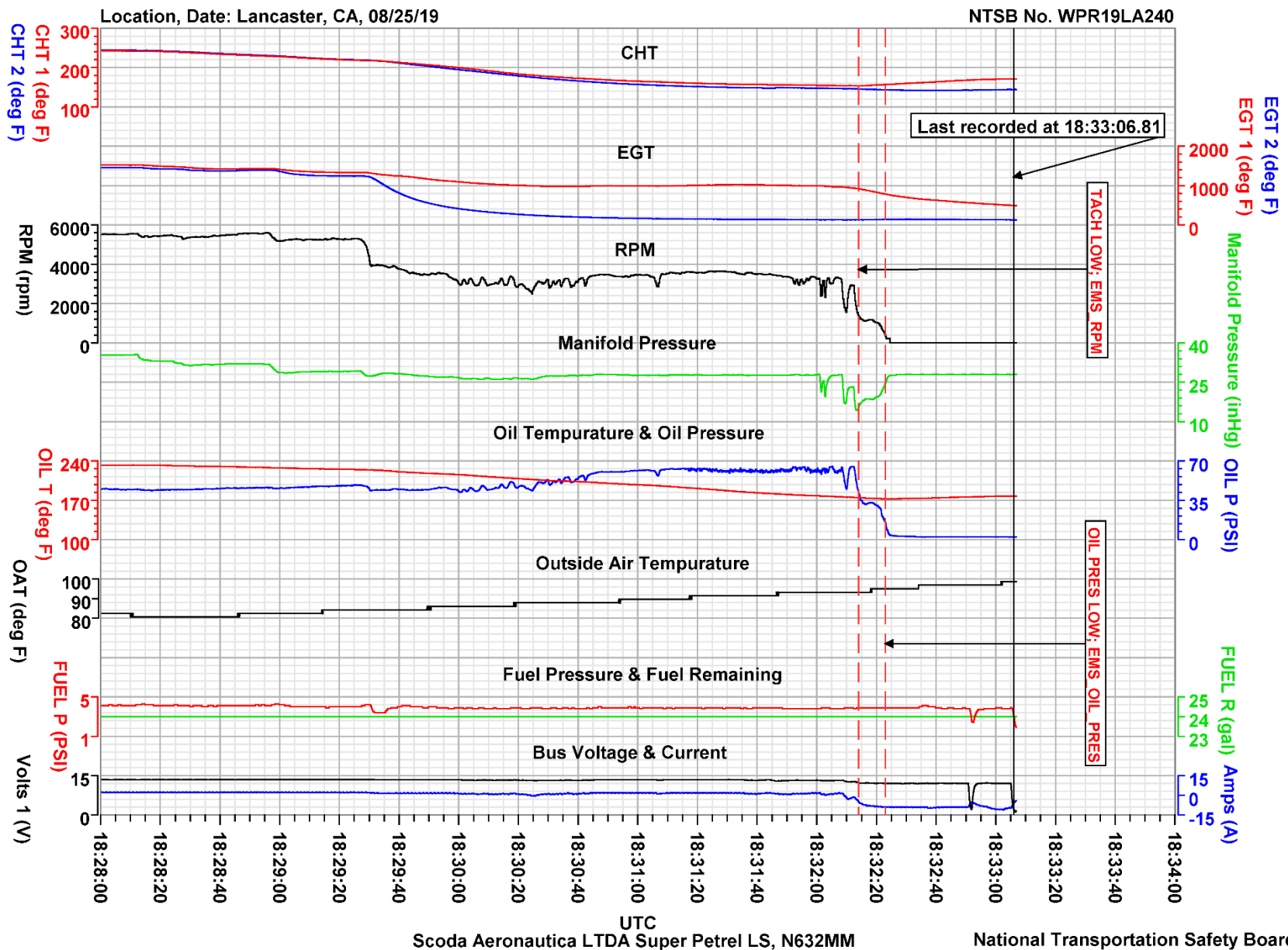


Figure 4: Plot of Dynon SV-D1000 engine parameters for the final portion of the accident flight.

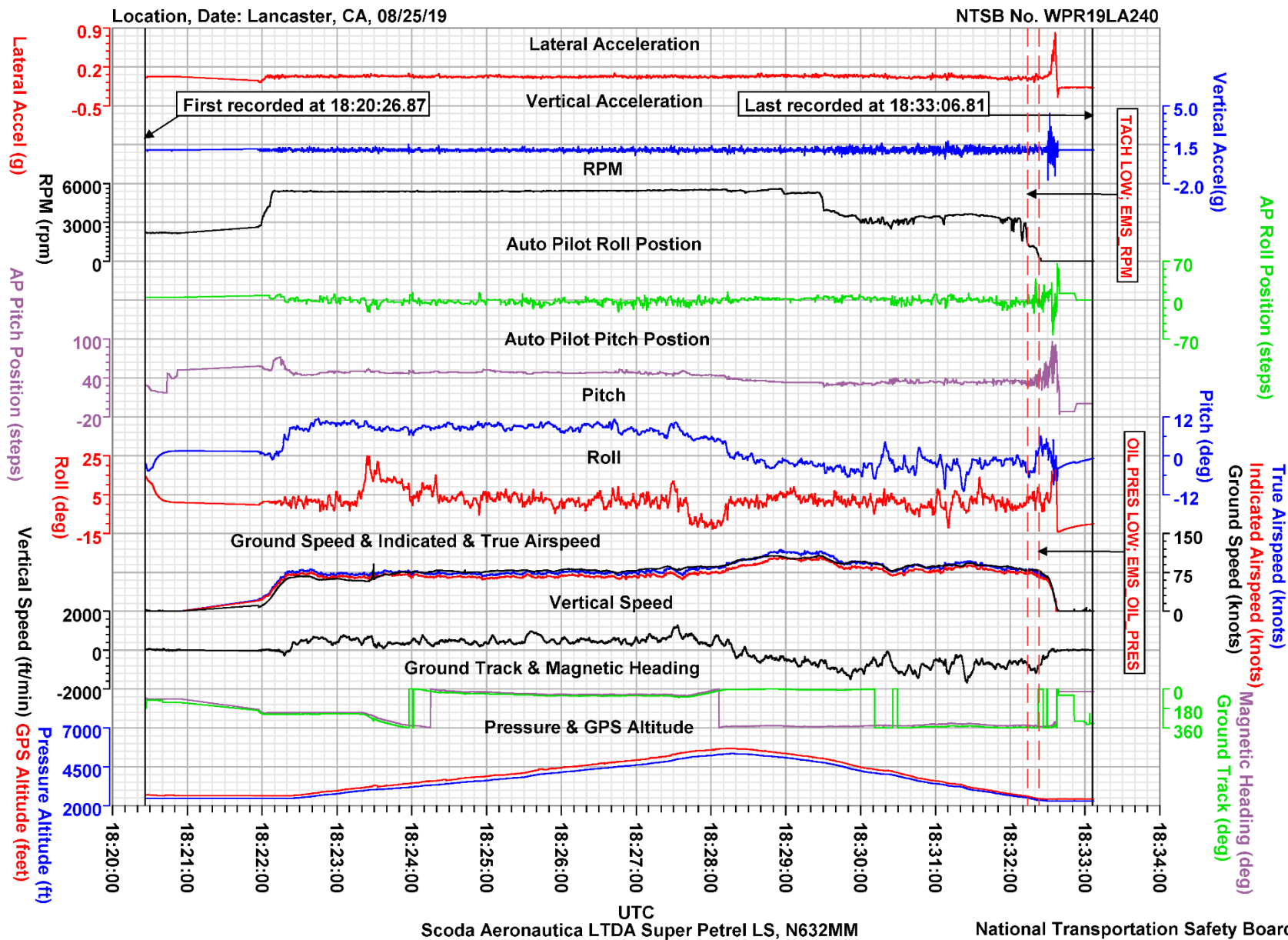


Figure 5: Plot of Dynon SV-D1000 operational parameters for the entire accident flight recorded on August 25, 2019.

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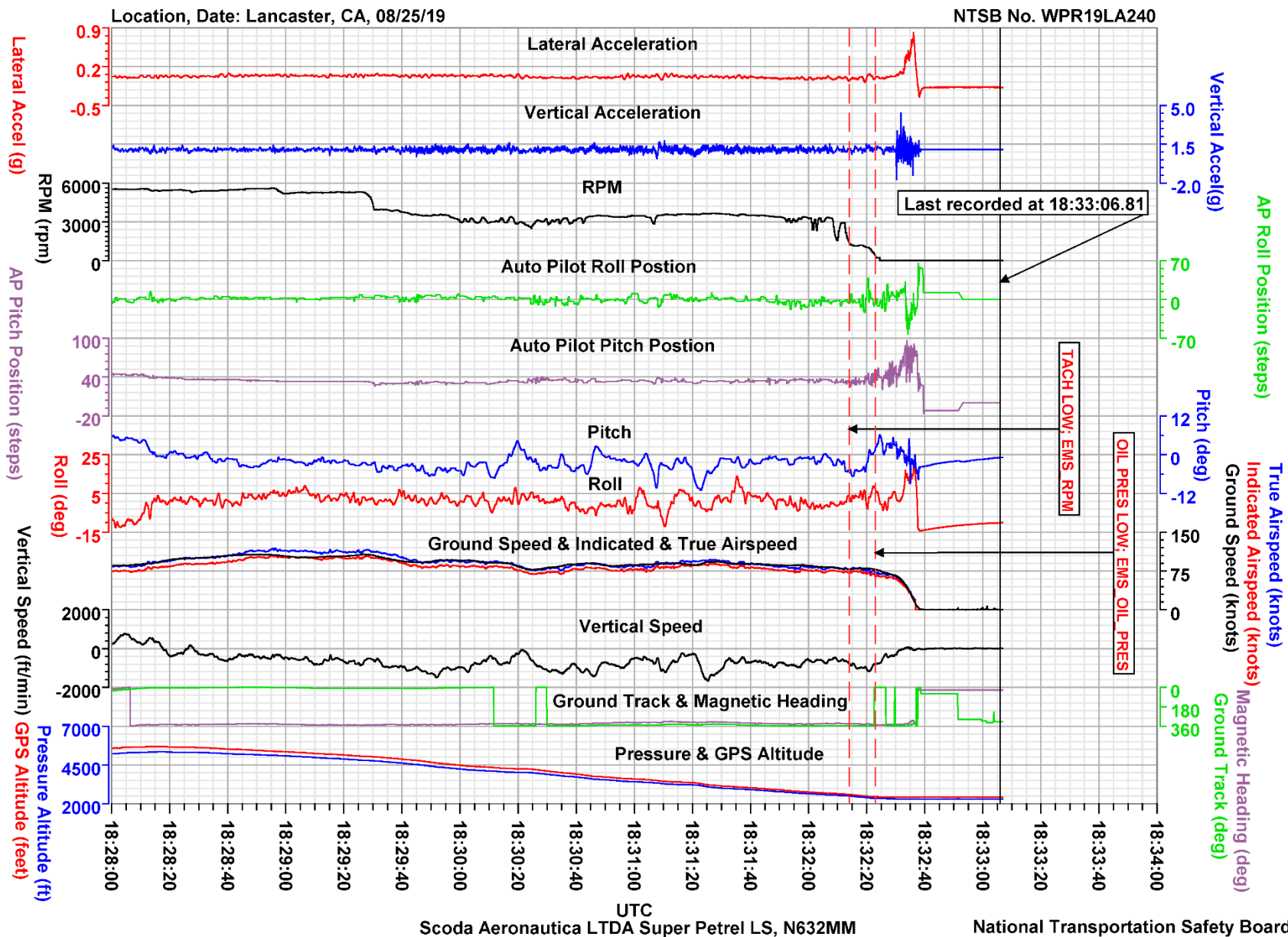


Figure 6: Plot of Dynon SV-D1000 operational parameters for the final portion of the accident flight.

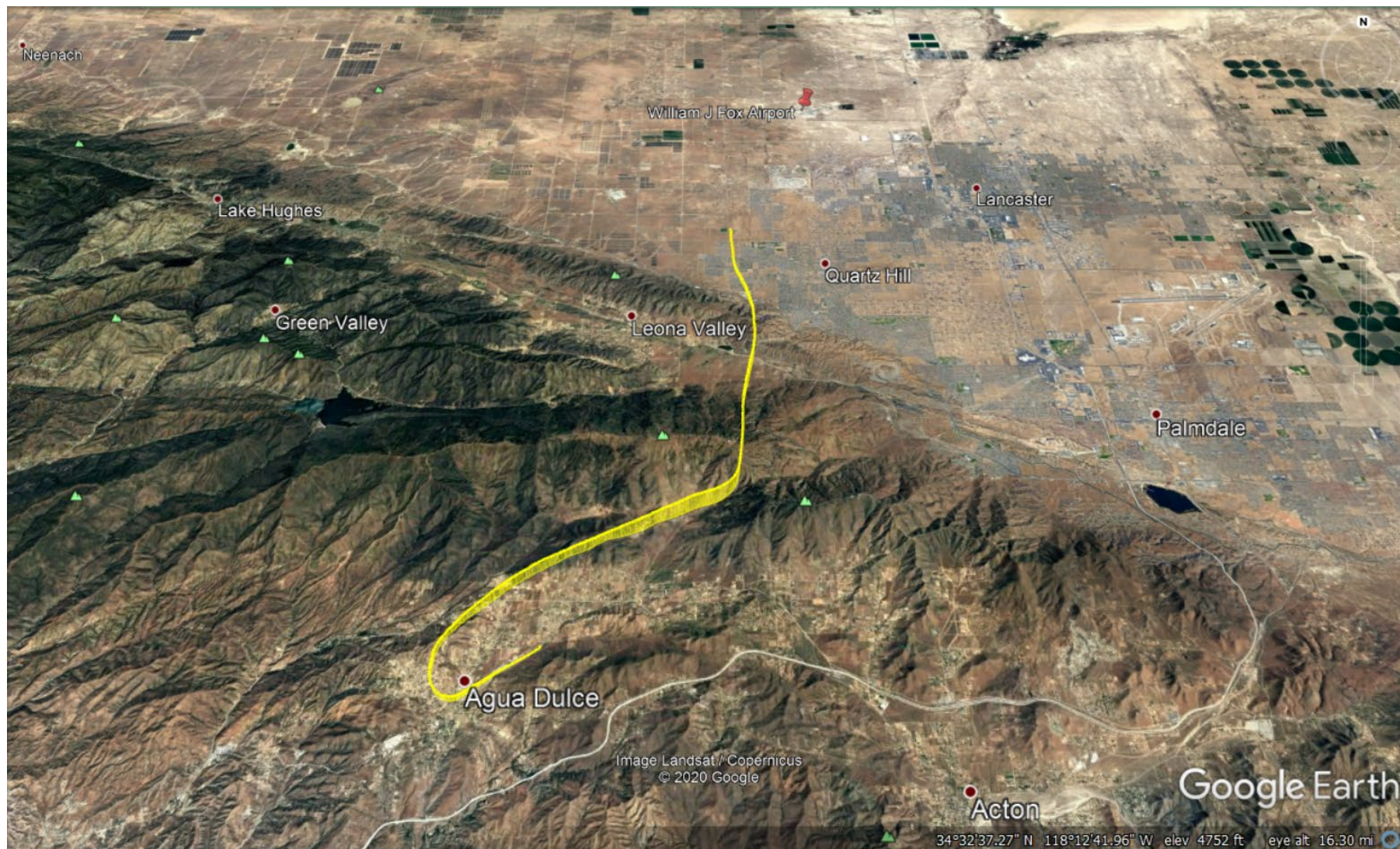


Figure 7: Google Earth overlay of the entire accident flight.

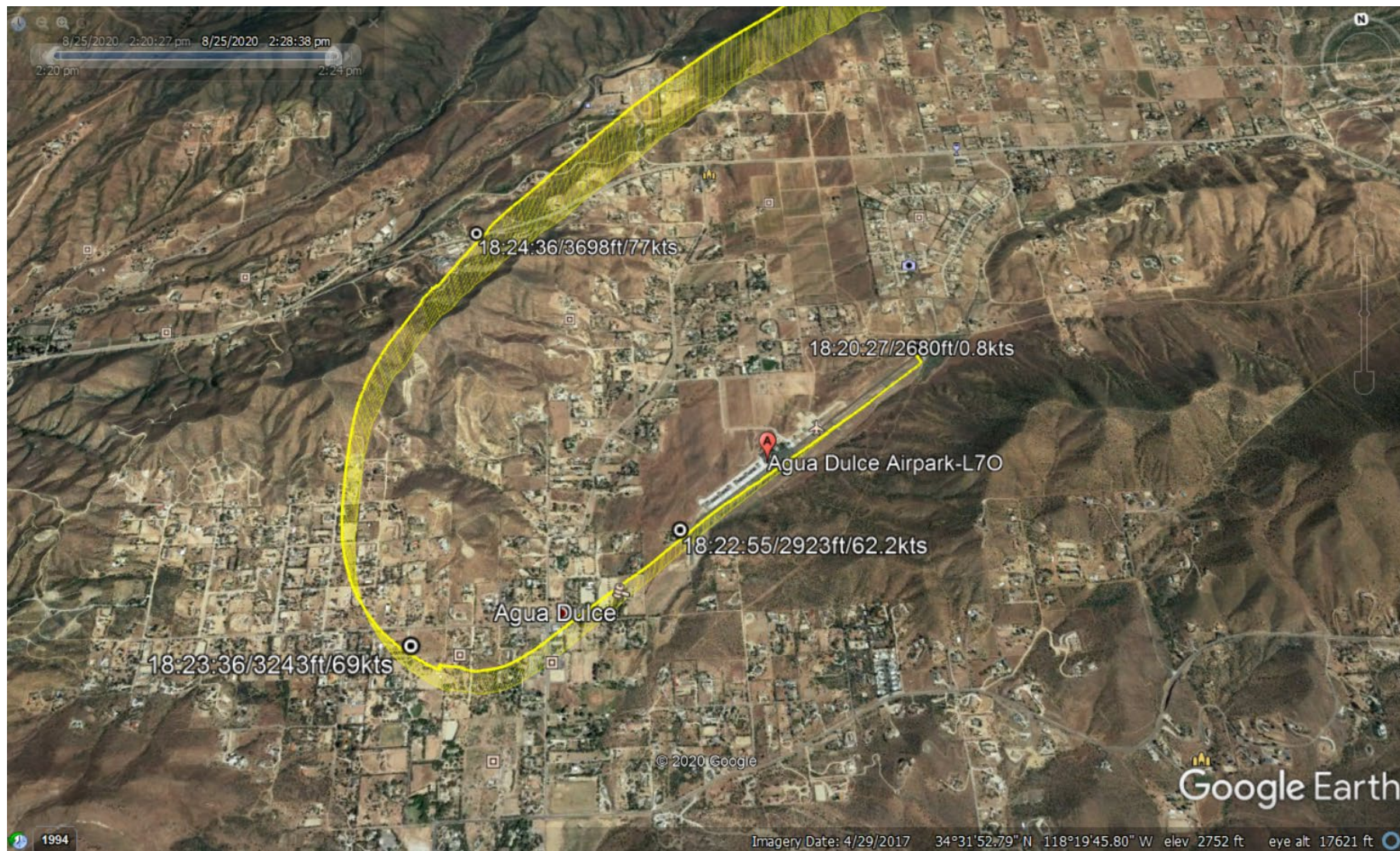


Figure 8: Google Earth overlay of the beginning of the accident flight.



Figure 9: Google Earth overlay of the final portion of the accident flight.



Figure 10: Google Earth overlay of the final portion of the accident flight.

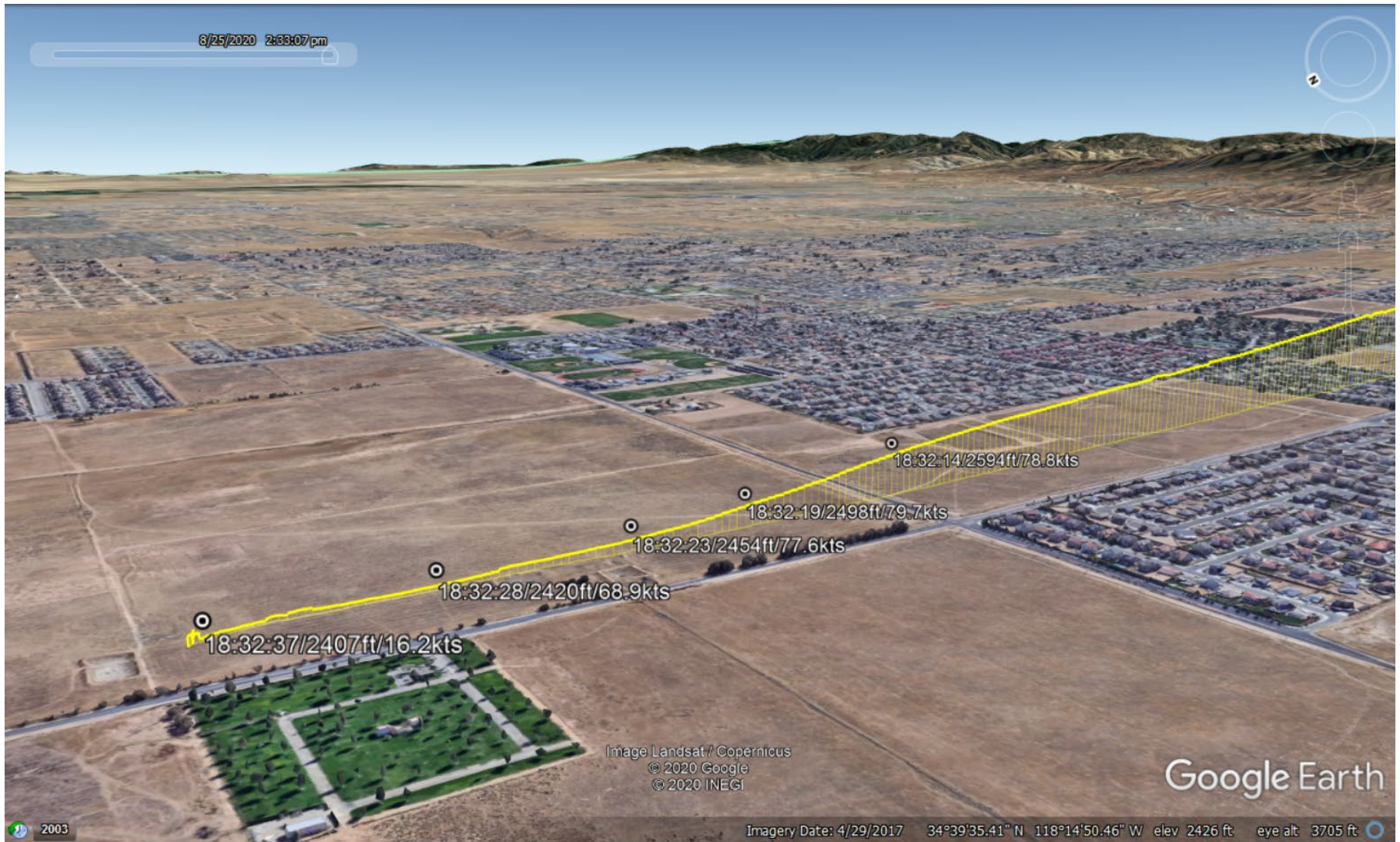


Figure 11: Google Earth overlay of the final portion of the accident flight.