

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

May 6, 2014

Engine Data Monitor (EDM) and GPS

Specialist's Factual Report
By George Haralampopoulos

1. EVENT SUMMARY

Location: Middle Grove, New York
Date: August 27, 2013
Aircraft: Lake Model 250
Registration: N522WB
Operator: Private
NTSB Number: ERA13LA382

On August 27, 2013, about 1520 eastern daylight time, a Revo, Incorporated Lake Model 250, N522WB, registered to Terell Enterprises LLC, operated by a private individual, landed hard during a forced landing in a field near Middle Grove, New York. Visual meteorological conditions prevailed at the time and no flight plan was filed for the 14 Code of Federal Regulations (CFR) Part 91 personal flight from Saratoga County Airport (5B2), Saratoga Springs, New York, to a body of water called Blue Mountain Lake, located in Indian Lake, New York. The airplane sustained substantial damage and the private pilot, the sole occupant sustained minor injuries. The flight originated about 3 minutes earlier from 5B2.

2. DETAILS OF ENGINE DATA MONITOR INVESTIGATION

The Safety Board's Vehicle Recorder Division received the following devices:

Recorder Manufacturer/Model: **JPI EDM-700**
Recorder Serial Number: **23627**

Recorder Manufacturer/Model: **Garmin GPSMAP 696**
Recorder Serial Number: **1H6004944**

2.1. Garmin GPSMAP 696 Device Description

The Garmin GPSMAP 696 is a battery-powered portable multi-function display and GPS receiver with a 7-inch diagonal high resolution LCD display screen. 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.

The unit stores date, route-of-flight, and flight-time information for up to 50 flights. A flight record is triggered when groundspeed exceeds 30 knots and altitude exceeds 250 feet, and ends when groundspeed drops below 30 knots for 10 minutes or more. A detailed track log – 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 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 and 15 saved track logs can be maintained in addition to the current track log. Track log storage may be activated or de-activated at user discretion. All recorded data is stored in non-volatile memory. 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.

2.1.1.1. Garmin GPSMAP 696 Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior inspection revealed that the Garmin 696 unit had sustained negligible damage (figure 1). The unit was powered on normally and the data was extracted using the manufacturer's recommended procedures.

Figure 1. Garmin 696 unit as received.



2.1.2. Garmin GPSMAP 696 Data Description

The data extracted included 98 total logs from May 5, 2013¹ through September 5, 2013. The accident flight was identified by the recorded date and time starting at 19:04:10 UTC and ending at 19:19:19 UTC on August 27, 2013.

2.2. EDM 700/800 Device Description

The J. P. Instruments EDM-700/800 is a panel mounted gauge that the operator can monitor and record up to 24 parameters related to engine operations. Depending on the installation, engine parameters that are monitored include:

- Exhaust Gas Temperature (EGT)
- Cylinder Head Temperature (CHT)
- Oil Pressure and Temperature
- Manifold Pressure
- Outside Air Temperature
- Turbine inlet Temperature
- Engine Revolutions per Minute
- Compressor Discharge Temperature
- Fuel Flow
- Carburetor Temperature
- Battery Voltage

The unit can also calculate, in real-time, horsepower, fuel used, shock cooling rate and EGT differentials between the highest and lowest cylinder temperatures. The calculations are also based on the aircraft installation.

The unit contains non-volatile memory for data storage of the parameters recorded and calculated. The rate at which the data is stored is selectable by the operator from 2 to 500 seconds per sample. The memory can store up to 20 hours of data at a 6 second sample rate. The data can then be downloaded by the operator using the J.P. Instruments software.

2.2.1. EDM Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior inspection revealed that the JPI-700 unit had sustained negligible damage (figure 2). The unit was powered on normally and the data was extracted using the manufacturer's recommended procedures.

¹ The GPS records data in Coordinated Universal Time (UTC).

Figure 2. EDM 700 unit as received.



2.2.2. EDM Data Description

The EDM recorded approximately 8,977 points of data over 19 power cycles. The event flight was located by the unit's recorded date and time stamp of August 27, 2013 and contained approximately 306 valid points of data over a span of about 5 minutes.

2.2.3. Engineering Units Conversions

The engineering units conversions used for the data contained in this report are based on documentation from the manufacturer of the EDM.

Appendix A lists the EDM parameters verified and provided in this report.

2.3. Time Correlation

The EDM records time from the first data sample based on the unit's internal clock. The internal clock is set and updated by the operator and displayed upon power up. The JPI was powered on and the internal time was recorded as two minutes behind UTC.

Correlation of the EDM data to UTC, was established by taking the unit's internal time and applying a two minute offset.

The GPS records time in UTC and no offset was necessary. All times are referenced as UTC for the rest of this report.

3. GPS PARAMETERS PROVIDED

Table 1 describes data parameters provided by the GPS device. Date, Time, Latitude, Longitude, and GPS Altitude are recorded by the device. Groundspeed and Track are derived from the recorded parameters.

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 (feet, MSL ²)
Groundspeed	Average groundspeed between current and previous data point (knots)
Track	Average true course between current and previous data point (degrees)

4. PLOTS AND CORRESPONDING TABULAR DATA

The following figure contains EDM and GPS data recorded during the August 27, 2013 event flight and the flight prior.

Figure 3 is a Google Earth overlay of the entire event flight which shows the aircraft takeoff originating from Saratoga County Airport. The first and last recorded data points are shown at 19:04:10 to 19:19:19 UTC, respectively. Figure 4 is an overlay that highlights the points leading up to the last recorded data point.

Figure 5 is a Google Earth overlay of the preceding flight on August 27, 2013 which originated from Blue Mountain Lake. The first and last recorded data points are shown at 17:23:03 and 17:59:31 UTC.

Figure 6 is a plot from the event flight that contains engine and GPS parameters. The EDM begins recording data at 19:14:02 UTC denoted by the dashed line. The Engine Exhaust Gas (EGT) parameters begin to drop at 19:17:08 UTC with an associated drop in RPM. Just prior to the drop in EGT at 19:16:44 UTC, the Oil Temperature begins to rise from 88 degrees Fahrenheit (degF) to the max recorded Oil Temperature at 19:17:32 UTC.

Figure 7 is a plot of engine and GPS parameters from the flight preceding the event. The last recorded data point is 17:58:50 UTC.

The values of CHT-3 were observed to be fluctuate intermittantly during both recordings. The values recorded may not accurately represent the actual CHT due to a faulty sensor or installation error.

The corresponding tabular data from the GPS and EDM used to create the overlays and plots from the event flight and previous flight are provided in electronic (*.csv³) format as Attachments 1 and 2, respectively, to this report.

² MSL means altitude above mean sea level

³ Comma Separated Value format.

Figure 3. Overlay of aircraft track during event flight.

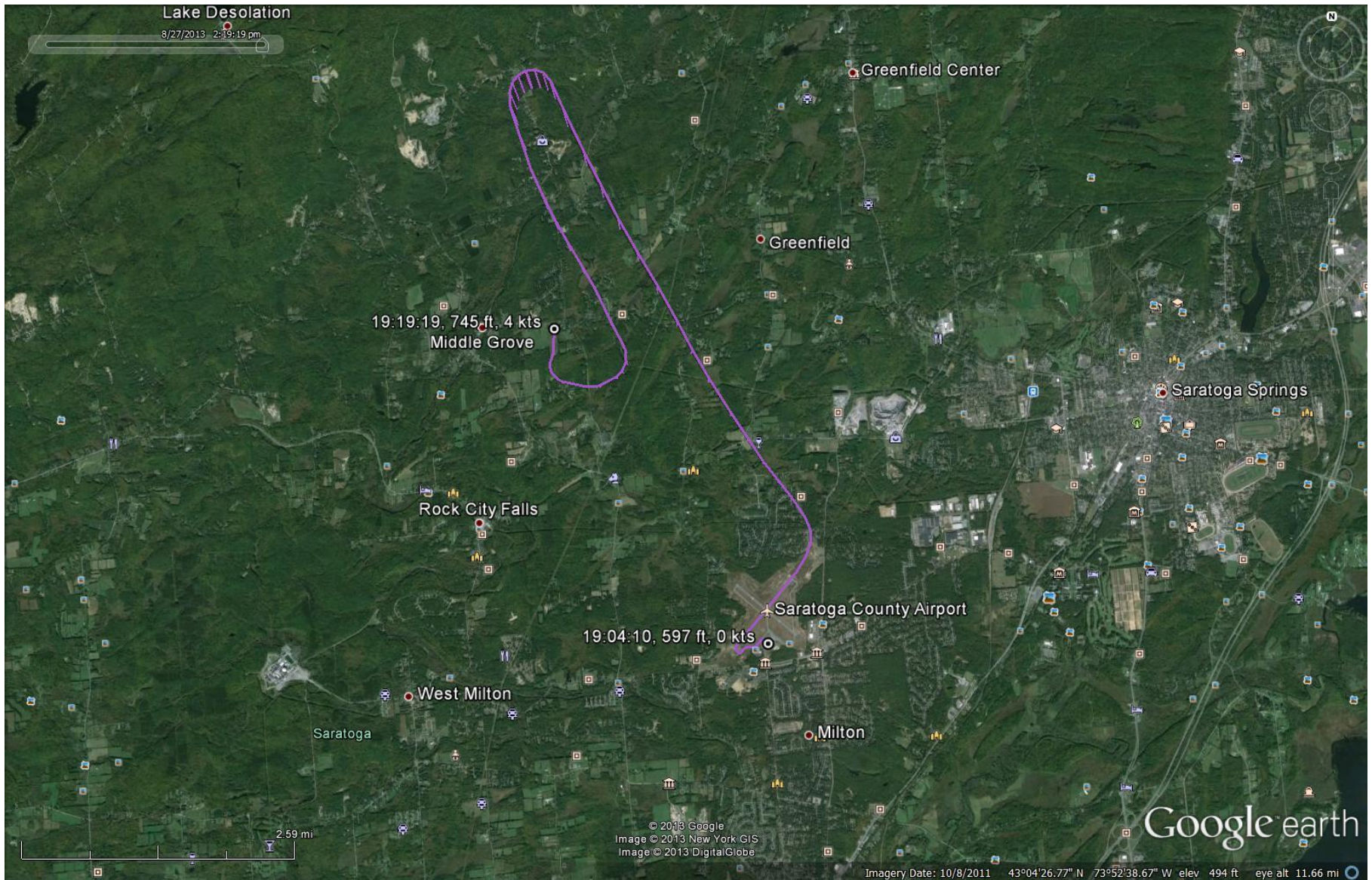


Figure 4. Overlay of aircraft track highlighting last recorded points.

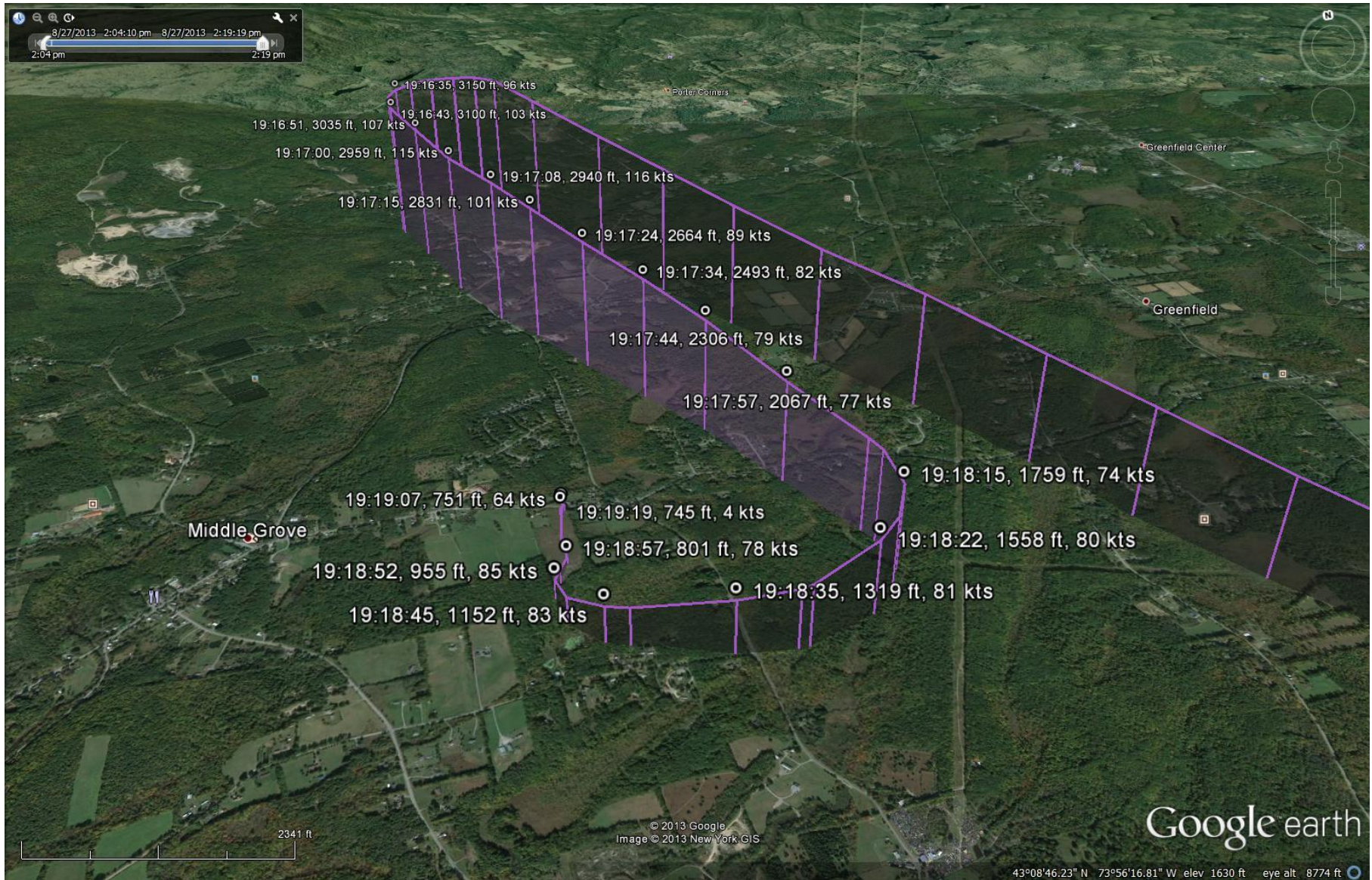


Figure 5. Overlay of aircraft track for flight preceding event.

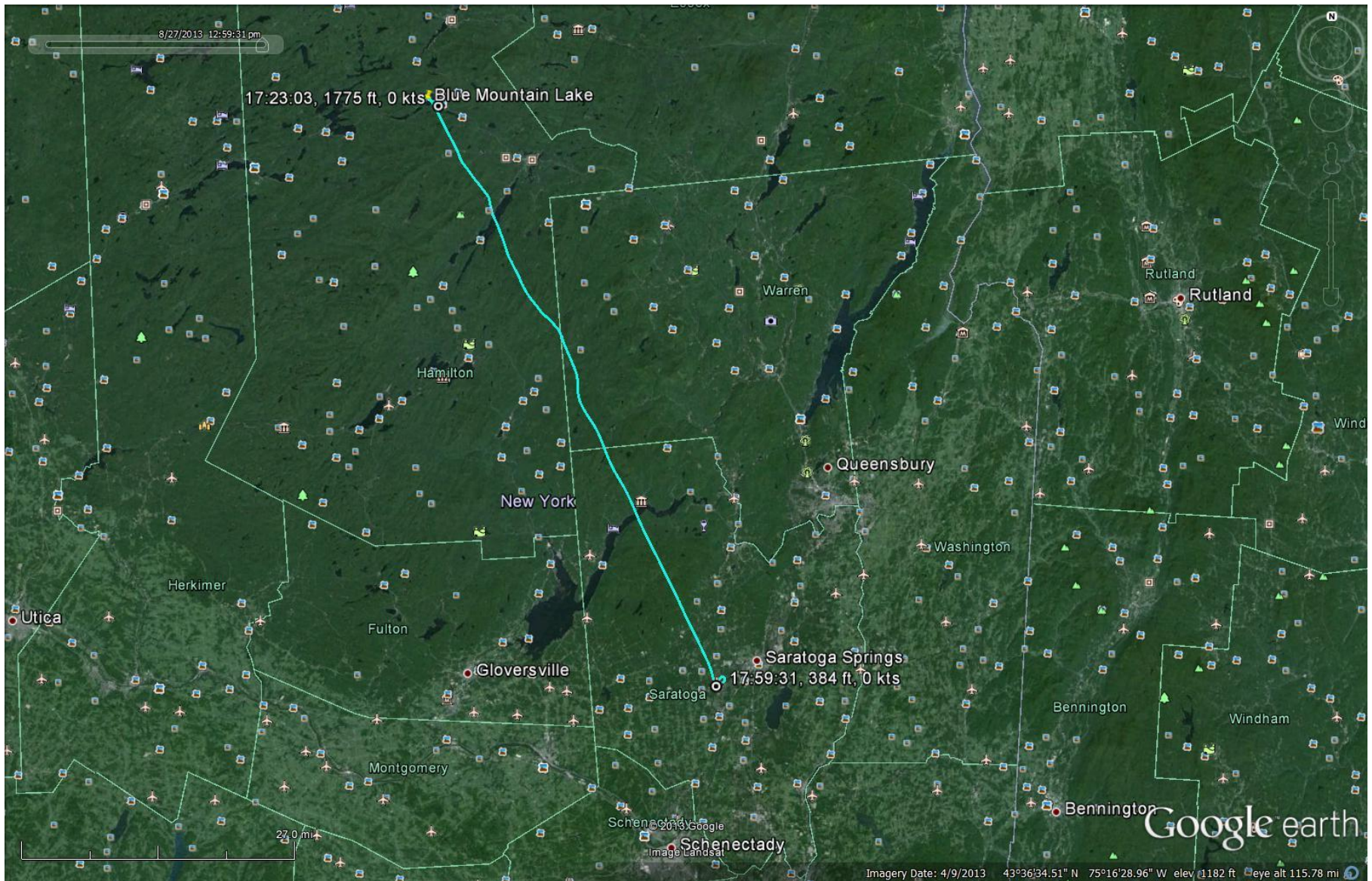
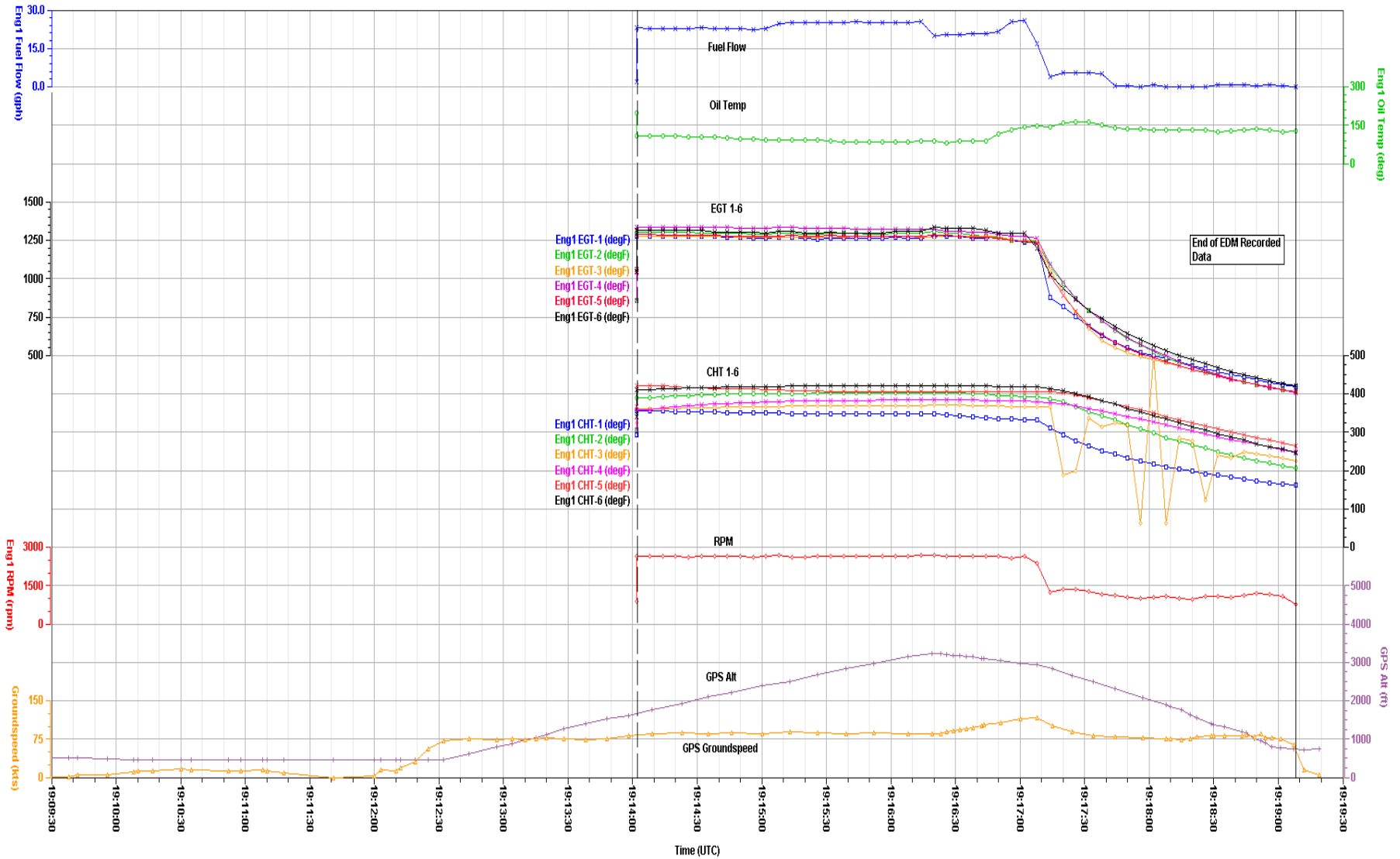


Figure 6. Plot of Engine parameters from EDM during event flight.

Private, Lake Model 250, N522WB

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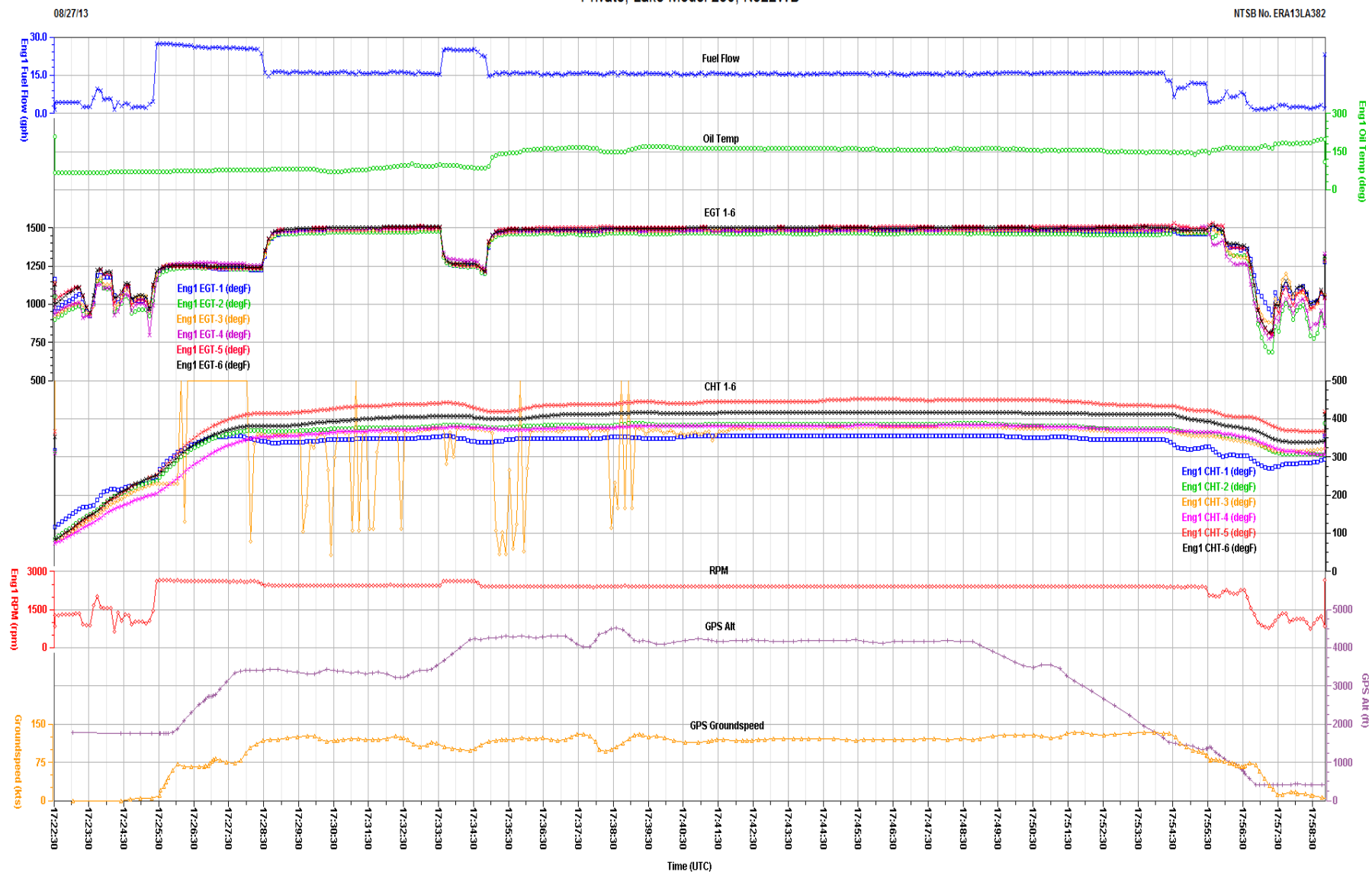
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Figure 7. Plot of Engine parameters from EDM for flight preceding event.

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APPENDIX A

This appendix describes the parameters provided and verified in this report. Table A-1 lists the parameters and table A-2 describes the unit abbreviations used in this report.

Table A-1. Verified and provided parameters.

Parameter Name	Parameter Description
1. Eng1 CHT-# (degF)	Engine Cylinder Head Temperature Cylinder #
2. Eng1 EGT-# (degF)	Engine Exhaust Gas Temperature Cylinder #
3. Fuel Flow (gph)	Fuel Flow
4. Eng1 Oil Temp (degF)	Engine Oil Temperature
5. Eng1 RPM (rpm)	Engine Rotations per Minute
6. GPS Alt ^a (ft)	GPS altitude
7. Groundspeed ^a (kts)	Groundspeed

^a Source of parameter is from GPS

Table A-2. Unit abbreviations.

Units Abbreviation	Description
degF	Degrees Fahrenheit
gph	Gallons per Hour
rpm	Rotations per Minute
ft	feet
kts	knots