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

July 12, 2017

Electronic Devices

Specialist's Factual Report
by Christopher Babcock

1. EVENT

Location:	Lake Berryessa, California
Date:	May 8, 2017
Aircraft:	Icon A5
Registration:	N184BA
Operator:	Icon Aircraft Inc.
NTSB Number:	WPR17FA101

On May 8, 2017, about 0908 Pacific Daylight Time (PDT), an amphibious light sport Icon Aircraft Inc. A5, registration N184BA, impacted terrain while maneuvering near Lake Berryessa, California. The commercial pilot and passenger were fatally injured, and the airplane sustained substantial damage. The airplane was registered to a private individual and operated by Icon Aircraft Inc., Vacaville, California, as a 14 *Code of Federal Regulations* Part 91 business flight. Visual meteorological conditions prevailed near the accident site about the time of the accident and no flight plan was filed. The local flight originated from the Nut Tree Airport (VCB), Vacaville, California, at 0852.

2. DETAILS OF INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following devices:

Device 1:	Data Files
Device 1 Serial Number:	N/A
Device 2:	Rotax Engine Control Unit (ECU)
Device 2 Serial Number:	12.0400

2.1. Flight Data Monitoring (FDM) Device Data File Description

Although not required by regulation, the Icon A5 was equipped with a flight data monitoring device (FDM) (Figure 1).

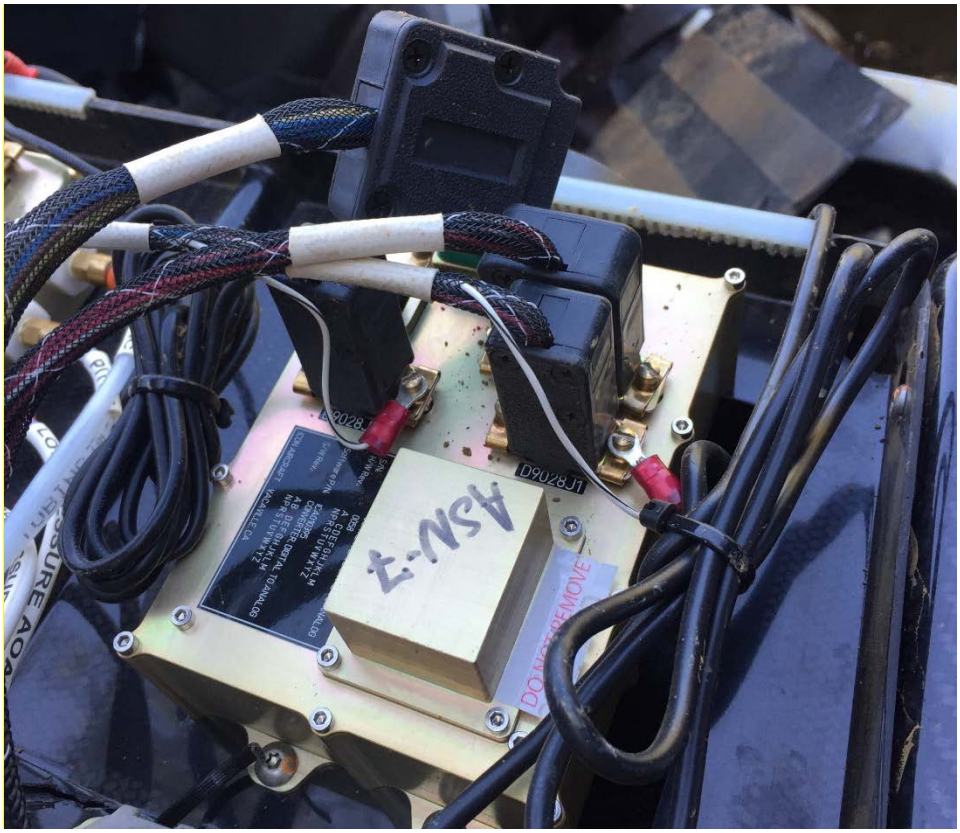


Figure 1. FDM device.

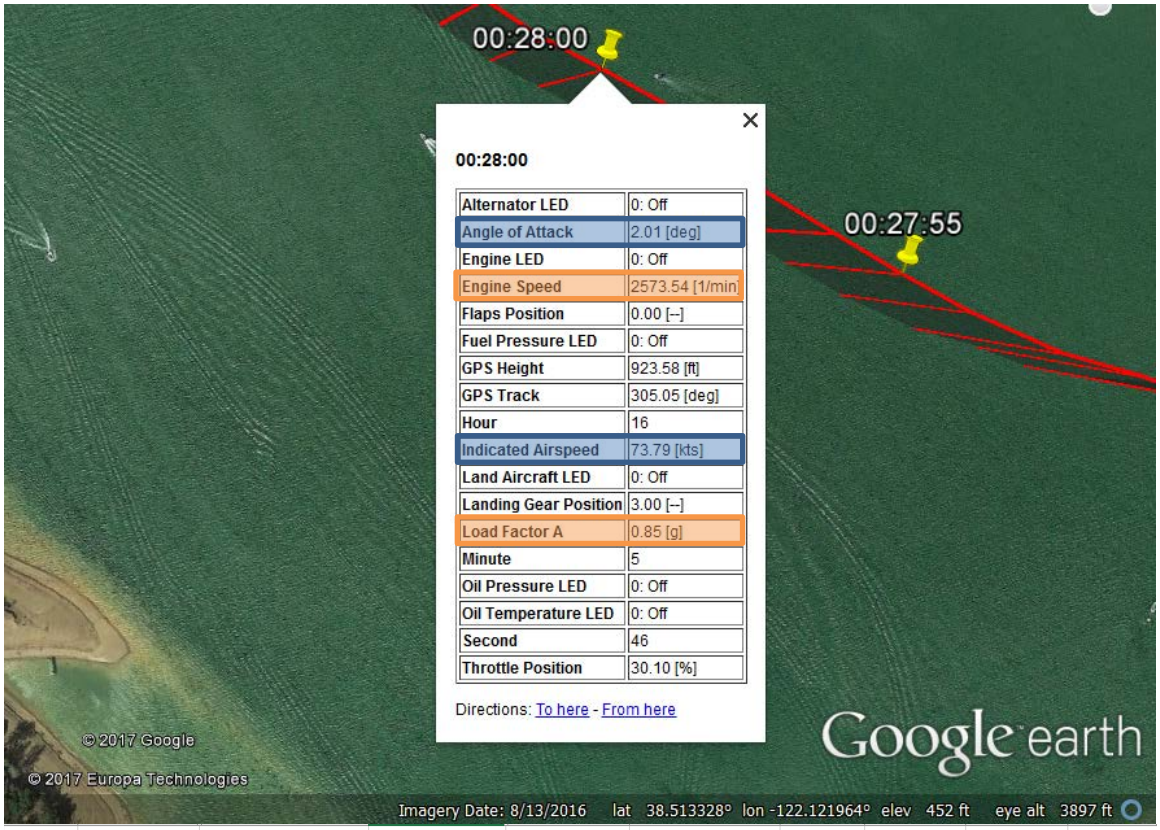
2.1.1. Data Recovery

Six files corresponding to the accident flight containing raw, binary data were recovered. Selected parameters from these files were converted to engineering units by Icon Aircraft under supervision of an NTSB investigator.

2.1.2. Data File Data Description

The conversion software produced a Keyhole Markup Language (kml) file and a comma separated value (csv) text file containing the recorded data sampled at 10 Hz. Examination of the kml file and the text file revealed that the kml file contained additional precision in the latitude and longitude values. Additionally, the placemarks included in the kml file contained snapshots of the parametric data. These snapshots contained data from two adjacent samples (see example in Figure 2).

The csv file contained GPS hours, minutes, and seconds parameters but, according to the manufacturer, the GPS second parameter may not be reliable. In order to apply a proper local time stamp to the data, the elapsed time of the data record for which the GPS second parameter first incremented on the accident flight was adjusted to match the recorded GPS time, 15:37:53, with subsequent records occurring at 0.1 second intervals and then converted to local PDT by subtracting 7 hours.



Time	Load Factor A	Indicated Airspeed	Angle of Attack	Engine Speed	Throttle Position	Latitude	Longitude	GPS Height	GPS Track
28:04.1	0.9	74.09	1.75	2609.19	30.11	3830.83	-12207.14	930.8	305.16
28:04.2	0.79	74.42	1.76	2606.47	30.11	3830.83	-12207.14	930.8	305.16
28:04.3	1.05	74.49	1.93	2608.52	30.1	3830.83	-12207.14	930.8	305.13
28:04.4	1.02	74.32	2.01	2608.71	30.09	3830.83	-12207.15	928.51	305.13
28:04.5	0.87	74.29	2.1	2603.75	30.1	3830.83	-12207.15	928.51	305.13
28:04.6	0.92	74.16	2.12	2598.71	30.12	3830.83	-12207.15	926.21	305.08
28:04.7	0.87	73.98	2.06	2594.06	30.09	3830.83	-12207.15	926.21	305.08
28:04.8	0.96	73.87	1.99	2589.04	30.09	3830.83	-12207.15	926.21	305.05
28:04.9	1.06	73.79	2.01	2582.23	30.1	3830.84	-12207.15	923.58	305.05
28:05.0	0.85	73.67	2.03	2573.54	30.1	3830.84	-12207.17	923.58	305.05
28:05.1	0.81	73.67	1.97	2569.42	30.11	3830.84	-12207.17	923.58	305.02
28:05.2	0.79	73.55	1.92	2570.33	30.11	3830.84	-12207.17	923.58	305.02
28:05.3	0.8	73.59	1.82	2563.23	30.09	3830.84	-12207.17	923.58	304.98

Figure 2. Example of data snapshots containing data from adjacent samples.

2.2. Rotax Engine Control Unit Device Description

The Rotax ECU's primary purpose is to control engine functions to reduce pilot workload such as automatically adjusting air/fuel mixture. The ECU has two channels, also known as lanes, which are used for engine feedback and monitoring; the primary lane "A," and a secondary lane "B." The ECU will automatically detect failures and switch to the secondary lane seamlessly when necessary.

In addition to its primary function, the ECU contains a data logging feature that captures the last hour of data from engine parameters. Data is recorded at 10 times a second and once a second, depending on the parameter. Additionally, the ECU captures fault codes at the time of occurrence. The data is time stamped based on device operating time and elapsed time from the beginning of the log file.

2.2.1. Rotax Engine Control Unit Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the unit had not sustained any damage and information was extracted using the manufacturer's software normally, without difficulty (Figure 3).

Figure 3. Rotax ECU, as received.

2.2.2. Rotax Engine Control Unit Data Description

The ECU data were used to identify any recorded engine faults and to corroborate data recovered from the FDM device discussed in section 2.1. The accident flight was identified as logs 1226, 1227, and 1228 on lane A and logs 770 and 771 on lane B by comparing the recorded engine speed from the ECU and the recorded engine speed on the FDM device. Table 1 shows the time added to the elapsed time from each log file to correct to local PDT. According to the ECU manufacturer, the fuel flow parameter likely measures fuel flowing from the tank, including the fuel returned to the tank not used by the engine.

Table 1. ECU log file offset.

ECU Lane	Log Number	Seconds Added
A	1426	31158.9
A	1427	31810.4
A	1428	31818.3
B	770	31150.7
B	771	31814.5

3. Plots and Tabular Data

The ECU data indicate that the engine was started at 8:39:34 PDT. At 8:50:05 PDT, new ECU logs for both lanes A and B were created, consistent with the pre-takeoff lane check. At 8:52:00 PDT, the aircraft departed runway 2 at the Nut Tree Airport, Vacaville, CA, and proceeded north. The aircraft reached a maximum GPS altitude of about 3700 feet at about 9:00:00 PDT and began to descend shortly thereafter. At 9:05:25 PDT, the aircraft turned to the west, crossed the shore of Lake Berryessa near the Monticello Dam, and continued to descend. By 9:06:44 PDT, the aircraft descended to about 450 feet GPS altitude and turned to the north, staying over the water between the shorelines. At 9:07:30 PDT, the aircraft entered Little Portuguese Canyon at about 450 feet GPS altitude and 54 knots indicated airspeed. At 9:07:50 PDT, the aircraft increased power and began to climb. The aircraft turned slightly to the east before turning back to the west. The aircraft reached a maximum altitude of 506 feet GPS altitude at 9:08:03 PDT before beginning to descend. The aircraft struck terrain at about 9:08:06 PDT at 470 feet GPS altitude and 66 knots indicated airspeed.

Figure 4 shows basic flight data for the entire accident flight. Figure 5 shows engine data recorded during the entire accident flight. Figure 6 shows basic flight data recorded during the last 3 minutes of the accident flight. Figure 7 shows engine data recorded during the last 3 minutes of the accident flight. Figure 8 shows basic flight data recorded during the last 27 seconds of the accident flight. Figure 9 shows engine data recorded during the last 27 seconds of the accident flight.

Figures 10-14 show the aircraft's flight path overlaid on satellite imagery using Google Earth. At times between 9:06:40 and 9:07:50, the recorded GPS altitude was below the Google Earth terrain elevation model and the aircraft's trackline disappeared.

The corresponding tabular data used to create Figures 4-14 are provided in electronic csv format as Attachment 1 to this report.

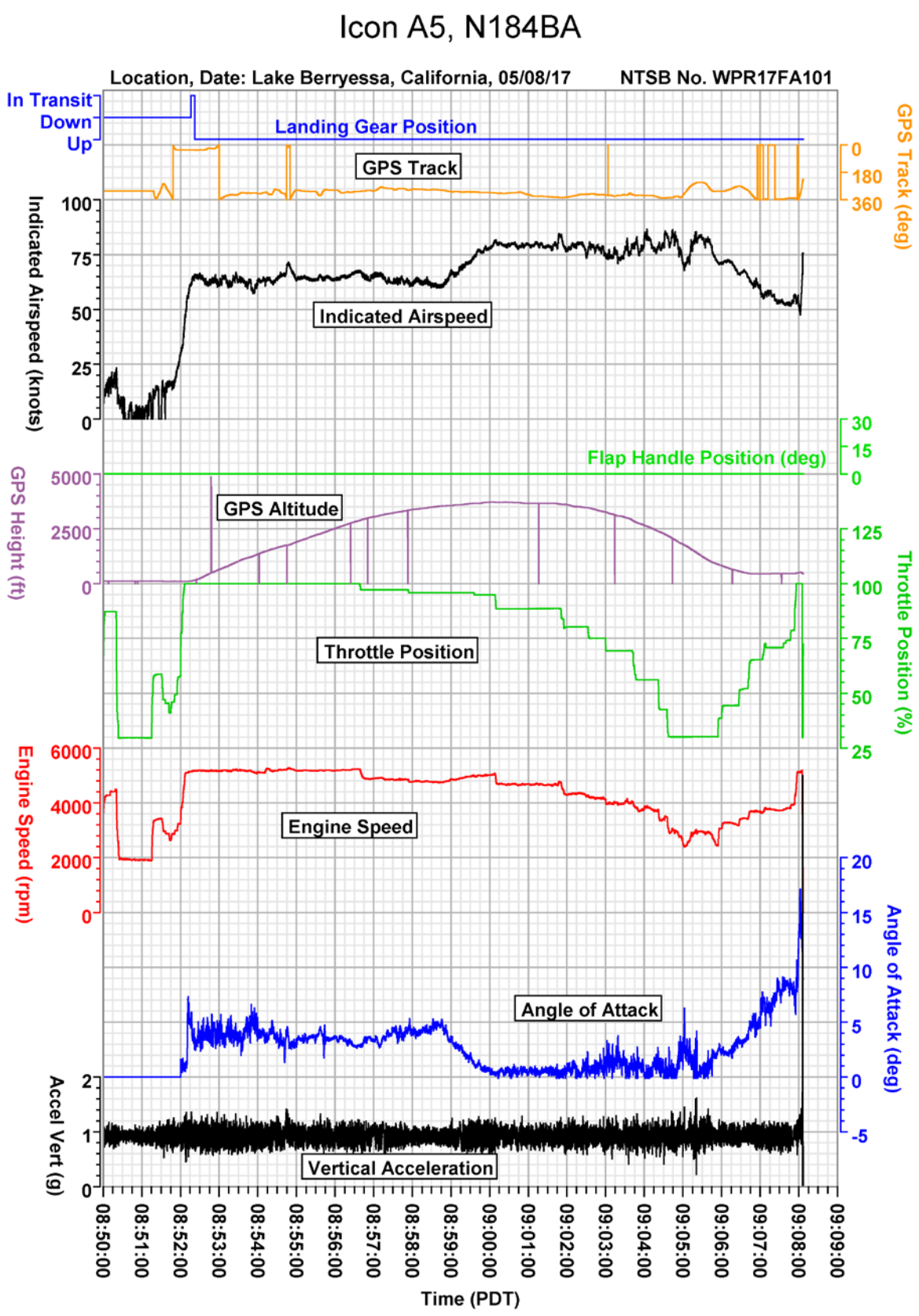


Figure 4. Flight data recorded over entire accident flight.

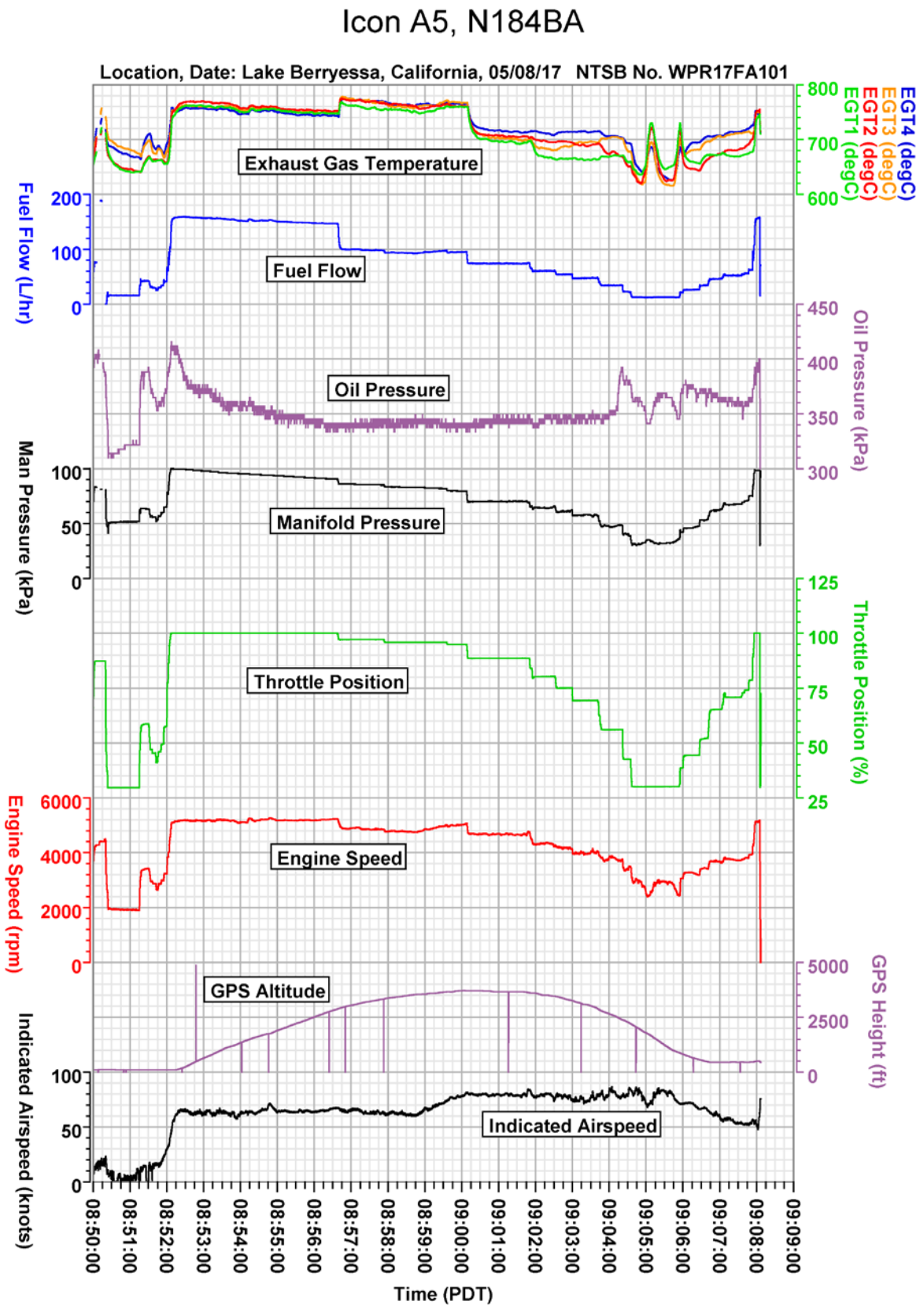


Figure 5. Engine data recorded over entire accident flight.

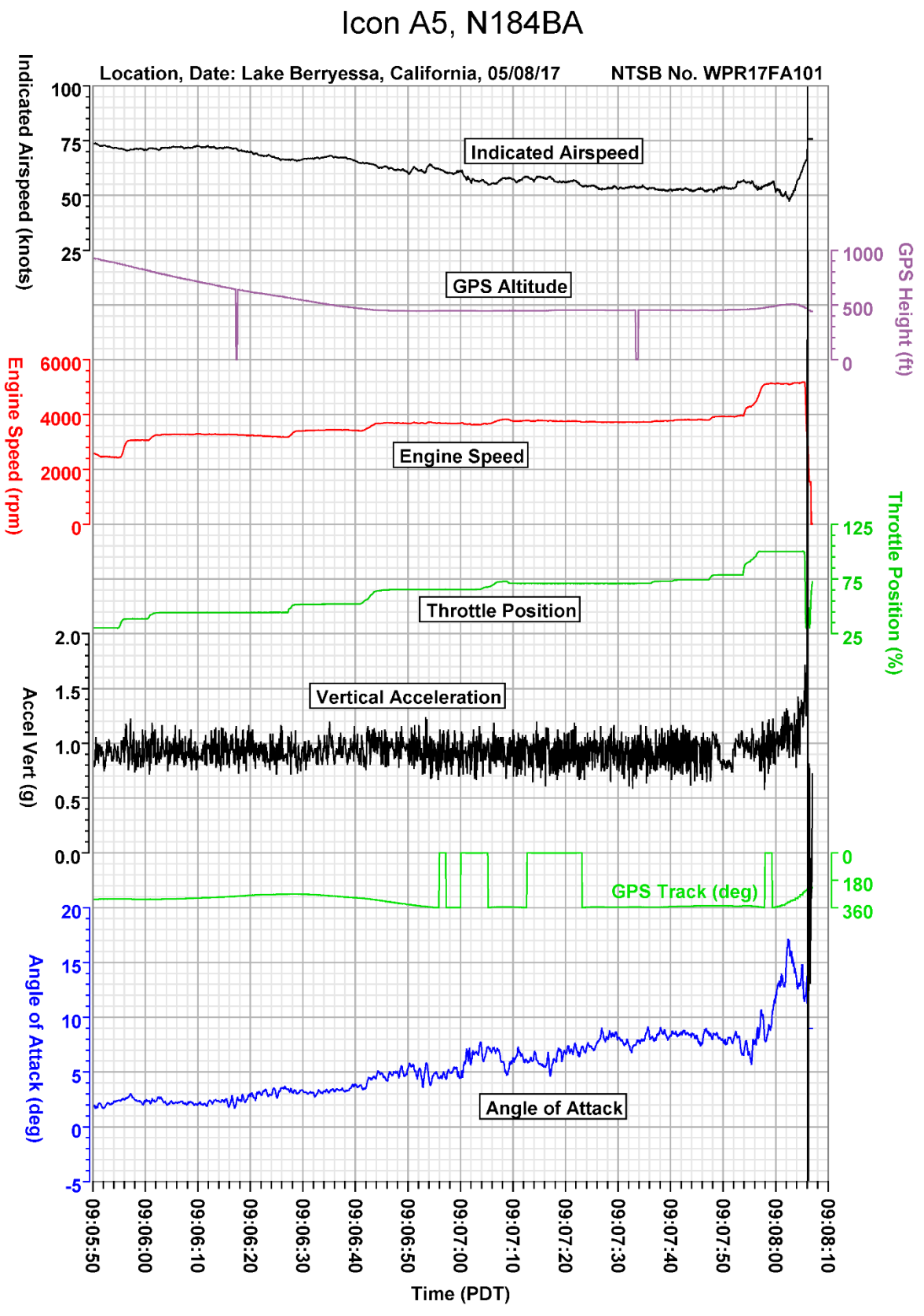


Figure 6. Flight data recorded during last 3 minutes of accident flight.

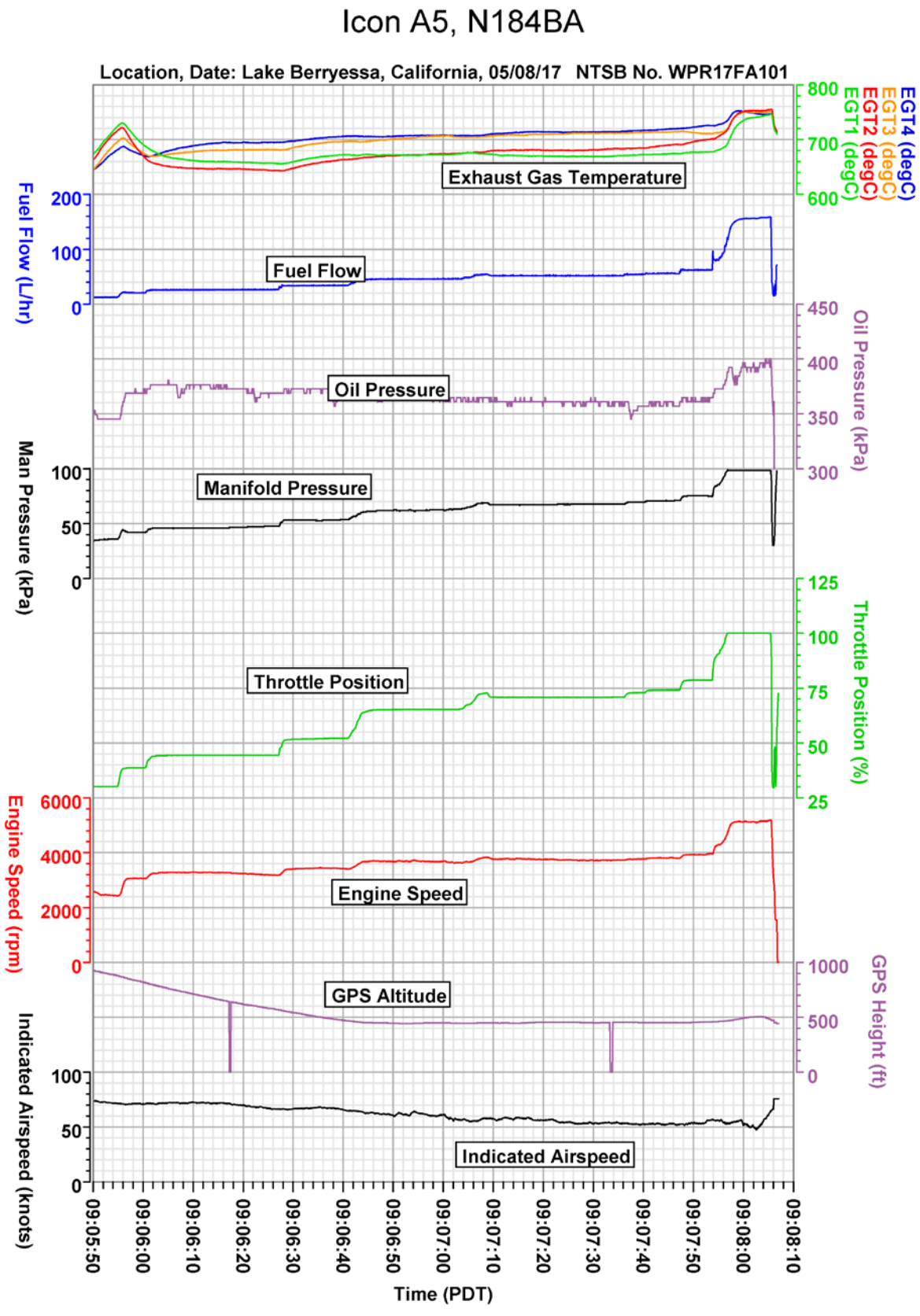


Figure 7. Engine data recorded during last 3 minutes of accident flight.

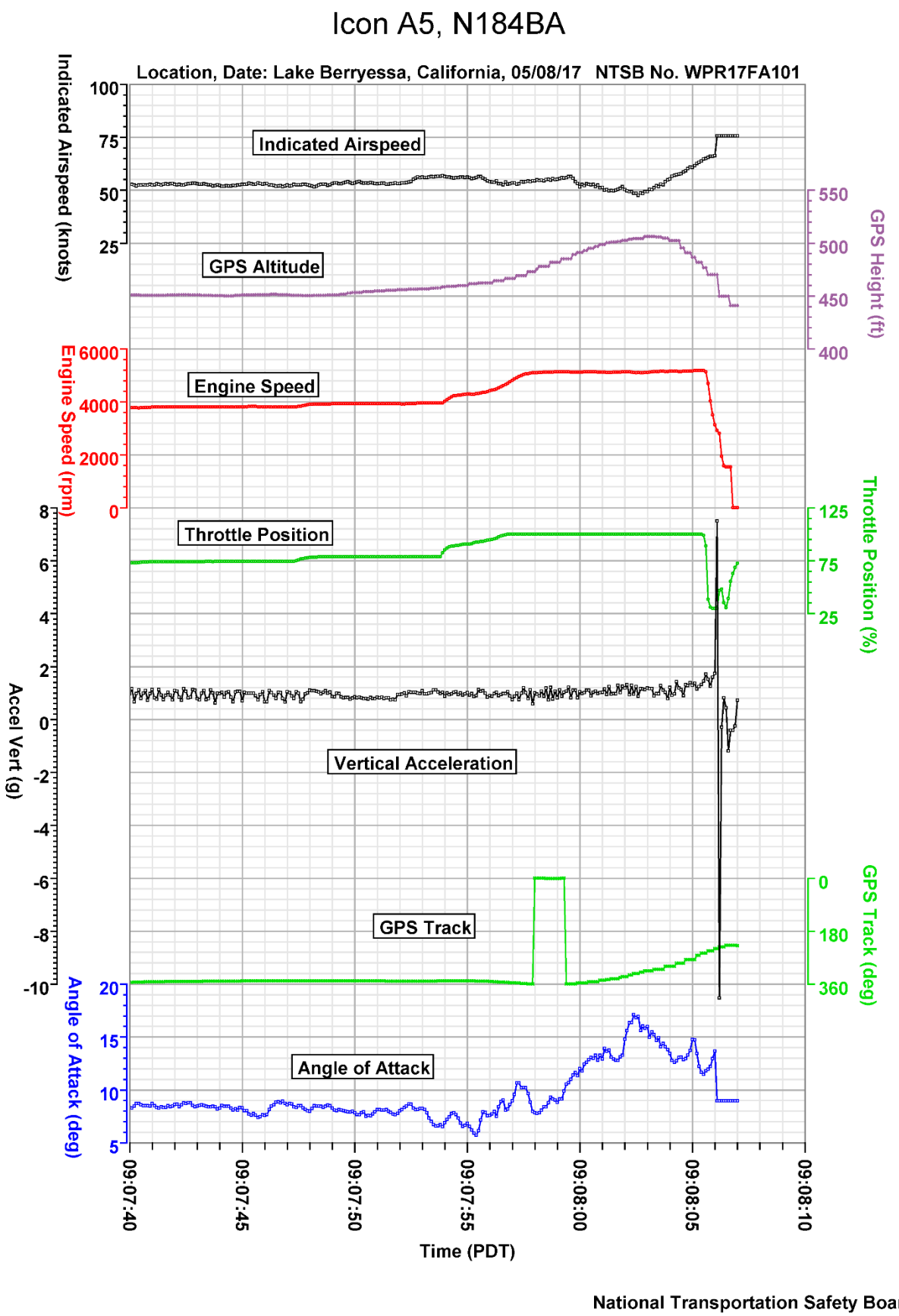


Figure 8. Flight data recorded during last 27 seconds of accident flight.

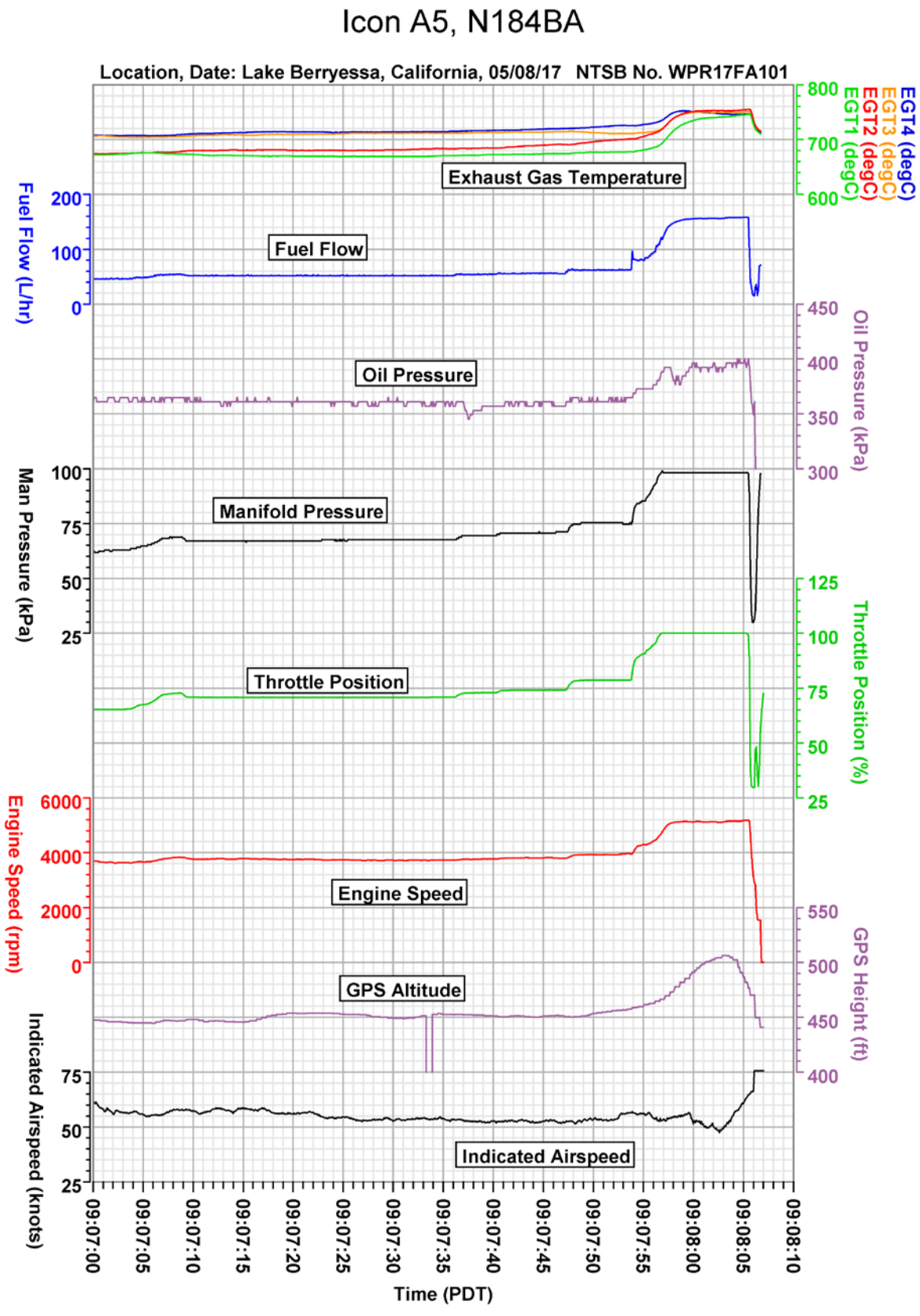


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Figure 9. Engine data recorded during last 27 seconds of accident flight.

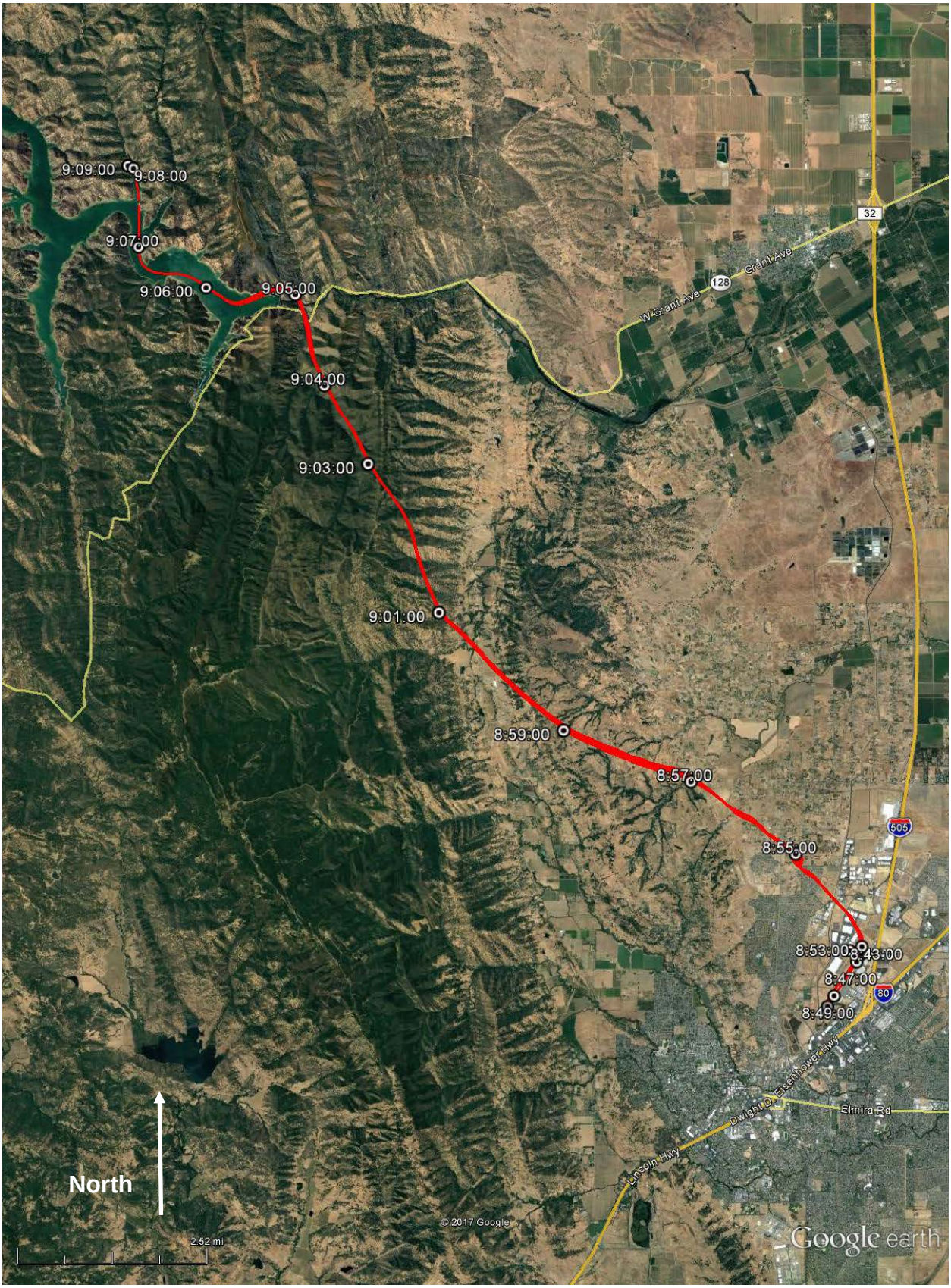

Figure 10. Overview of accident flight.

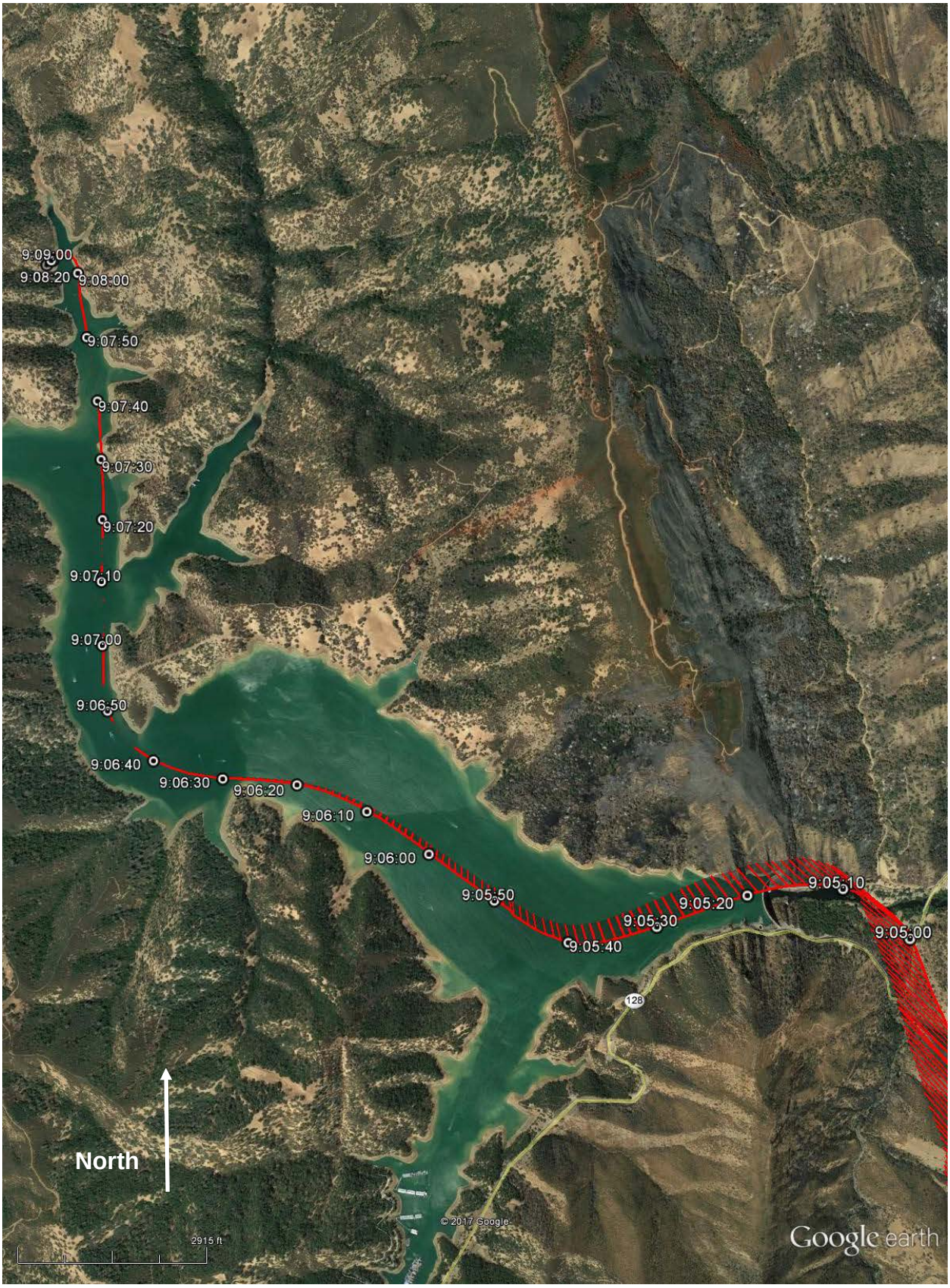

Figure 11. Overview of over lake portion of accident flight.

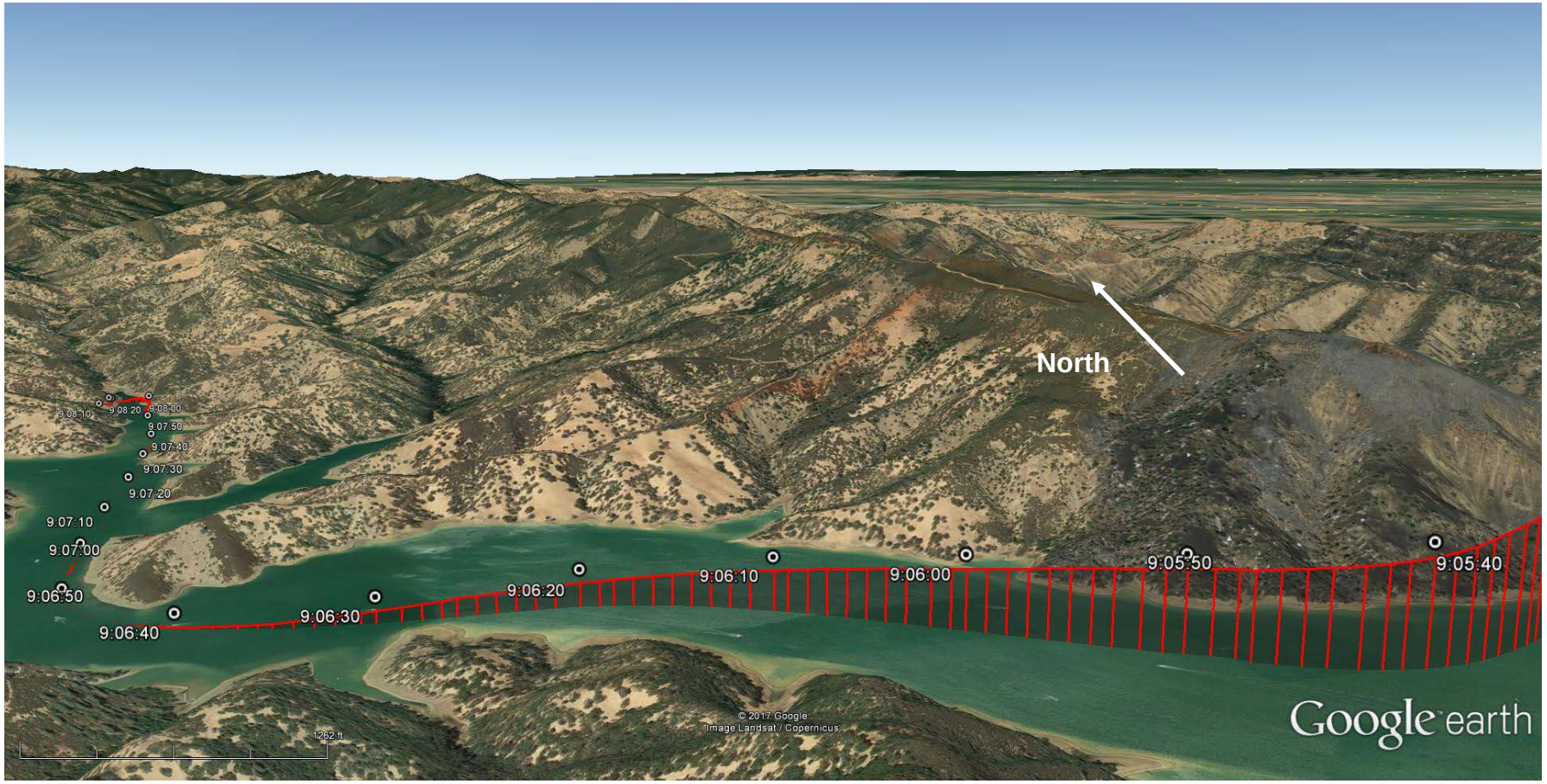

Figure 12. Oblique view of over lake portion of accident flight.

Figure 13. Overview of last 4 minutes of accident flight.

Figure 14. Last 90 seconds of accident flight.

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.

Tabular Data Label	Parameter Description	Source
Accel Vert	Vertical Acceleration	FDM
Angle of Attack	Angle of Attack	FDM
EGTTemp1_1426 (degC)	Exhaust Gas Temperature Cylinder 1	ECU Lane A Log 1426
EGTTemp1_1427 (degC)	Exhaust Gas Temperature Cylinder 1	ECU Lane A Log 1427
EGTTemp1_1428 (degC)	Exhaust Gas Temperature Cylinder 1	ECU Lane A Log 1428
EGTTemp2_1426 (degC)	Exhaust Gas Temperature Cylinder 2	ECU Lane A Log 1426
EGTTemp2_1427 (degC)	Exhaust Gas Temperature Cylinder 2	ECU Lane A Log 1427
EGTTemp2_1428 (degC)	Exhaust Gas Temperature Cylinder 2	ECU Lane A Log 1428
EGTTemp3_1426 (degC)	Exhaust Gas Temperature Cylinder 3	ECU Lane A Log 1426
EGTTemp3_1427 (degC)	Exhaust Gas Temperature Cylinder 3	ECU Lane A Log 1427
EGTTemp3_1428 (degC)	Exhaust Gas Temperature Cylinder 3	ECU Lane A Log 1428
EGTTemp4_1426 (degC)	Exhaust Gas Temperature Cylinder 4	ECU Lane A Log 1426
EGTTemp4_1427 (degC)	Exhaust Gas Temperature Cylinder 4	ECU Lane A Log 1427
EGTTemp4_1428 (degC)	Exhaust Gas Temperature Cylinder 4	ECU Lane A Log 1428
Engine Speed (rpm)	Engine Speed	FDM
EngineSpeed_1426 (rpm)	Engine Speed	ECU Lane A Log 1426
EngineSpeed_1427 (rpm)	Engine Speed	ECU Lane A Log 1427
EngineSpeed_1428 (rpm)	Engine Speed	ECU Lane A Log 1428
EngineSpeed_770 (rpm)	Engine Speed	ECU Lane B Log 770
EngineSpeed_771 (rpm)	Engine Speed	ECU Lane B Log 771
Flap Handle Position	Flap Handle Position	FDM
FuelFlow_1426	Fuel Flow	ECU Lane A Log 1426
FuelFlow_1427	Fuel Flow	ECU Lane A Log 1427
FuelFlow_1428	Fuel Flow	ECU Lane A Log 1428
GPS Height (ft)	GPS Altitude	FDM
GPS Track (deg)	GPS Course Over Ground	FDM
Hour (hr)[A]	UTC Hours	FDM
Indicated Airspeed	Indicated Airspeed	FDM
Landing Gear Position	Landing Gear Position	FDM
Latitude (deg)[A]	Latitude	FDM
Longitude (deg)[A]	Longitude	FDM
ManifoldAirPressure_1426 (kPa)	Manifold Pressure	ECU Lane A Log 1426
ManifoldAirPressure_1427 (kPa)	Manifold Pressure	ECU Lane A Log 1427
ManifoldAirPressure_1428 (kPa)	Manifold Pressure	ECU Lane A Log 1428
Minute (min)[A]	UTC Minutes	FDM
OilPressure_770 (kPa)	Oil Pressure	ECU Lane B Log 770
OilPressure_771 (kPa)	Oil Pressure	ECU Lane B Log 771
Second[A]	UTC Seconds	FDM
Throttle Position (%)	Throttle Position	FDM

[A] Parameter provided in tabular data only

Table A-2. Unit abbreviations.

Units Abbreviation	Description
rpm	revolutions per minute
deg	degrees
degC	degrees Celsius
ft	feet
%	percent
kPa	kilopascals
hr	hours
min	minutes
sec	seconds