

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



CEN23FA270

RECORDED FLIGHT DATA

Group Chair's Factual Report

November 17, 2023

TABLE OF CONTENTS

A. ACCIDENT.....	3
B. RECORDED FLIGHT DATA GROUP	3
C. DETAILS OF THE INVESTIGATION	3
1.0 DEVICE DESCRIPTIONS	3
1.1 ICON Aircraft DAC.....	3
1.2 Garmin Aera 796.....	4
1.3 Trig TN72 GPS Receiver.....	4
2.0 DATA RECOVERY.....	4
2.1 ICON Aircraft DAC.....	4
2.2 Garmin Aera 796.....	6
2.3 Trig TN72 GPS Receiver.....	7
D. OVERLAYS AND TABULAR DATA.....	8
APPENDIX A. VERIFIED AND PROVIDED PARAMETERS	18

A. ACCIDENT

Location: Onamia, Minnesota
Date: June 30, 2023
Time: 13:49 central daylight time (CDT)
Airplane: ICON A5, private operator, N239BA

B. RECORDED FLIGHT DATA GROUP

Group Chair	Kyle Garner Sr. Aerospace Engineer – Recorder Specialist National Transportation Safety Board (NTSB)
Group Member	Rodolfo Correa Director, Engineering ICON Aircraft

C. DETAILS OF THE INVESTIGATION

A recorded flight data group was convened on July 19, 2023, at the NTSB's flight data recorder laboratory in Washington, DC.¹

The NTSB Vehicle Recorder Division received the following devices:

Device Manufacturer/Model:	ICON Aircraft DAC
Part Number:	ICA010394
Device Serial Number:	0124

Device Manufacturer/Model:	Garmin Aera 796
Device Serial Number:	2CY014971

Device Manufacturer/Model:	Trig TN72 GPS Receiver
Device Serial Number:	X346

1.0 Device Descriptions

1.1 ICON Aircraft DAC

The ICON DAC is a data recording device that automatically records parametric data including GPS information, flight data, engine data, discrete parameters, and faults at recording rates of up to 10 Hz. The DAC has a proprietary

¹ The group only examined and downloaded the ICON DAC. The Garmin Aera 796 and Trig TN72 were examined at a later date by the NTSB only.

interface and accessing the files requires the use of hardware owned by ICON Aircraft.

1.2 Garmin Aera 796

The Garmin Aera 796 is a battery-powered multi-function display and GPS receiver with a 7-inch diagonal high-resolution touch screen. The unit includes a built-in Jeppesen database and can receive XM satellite radio for flight information including NEXRAD Radar, lightning, METARs, 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 can store and display 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. A detailed track log including latitude, longitude, date, time, course, and GPS altitude information is stored within the unit whenever the receiver has a lock on the GPS navigation signal. The position is updated within the track log as a function of time or distance moved, depending on how the unit has been configured. The current track log can be saved to long-term memory. Tracklog storage may be activated or deactivated at the user's discretion. All recorded data is stored in non-volatile memory².

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 the main power is removed.

1.3 Trig TN72 GPS Receiver

The Trig TN72 is a GPS receiver used as an ADS-B position source for a Trig transponder. The device meets the position requirements of Title 14 *Code of Federal Regulations* Part 91.227 and, when paired with a transponder, antenna, and display, enables the pilot to have a real-time view of other aircraft in their vicinity.

2.0 Data Recovery

2.1 ICON Aircraft DAC

The device was in good condition and the data were downloaded using a recovery kit provided by the aircraft's manufacturer. A photo of the device, as received, is shown in Figure 1.

² Non-volatile memory is semiconductor memory that doesn't require external power for data retention.

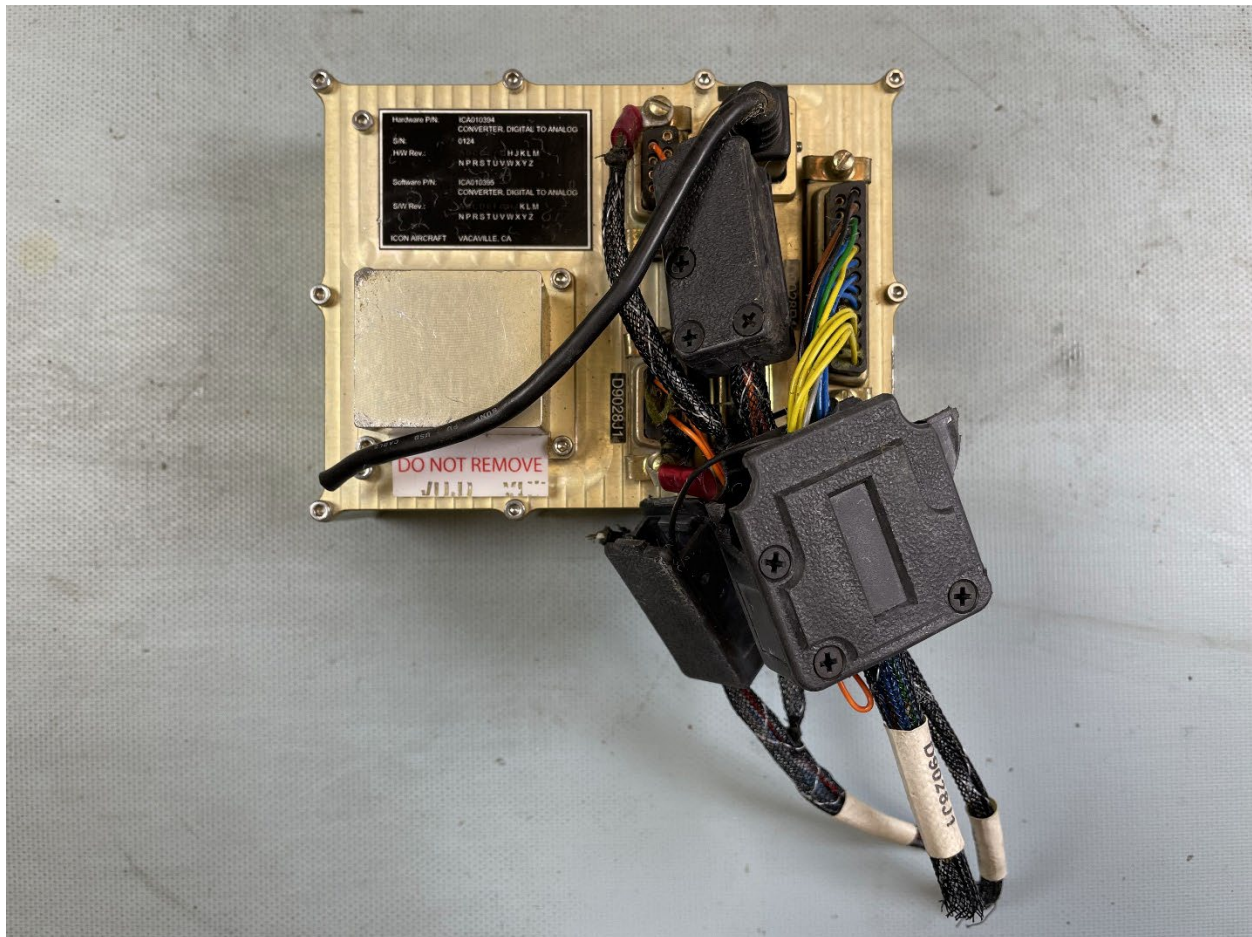


Figure 1. ICON DAC, as received.

The DAC contained data from the date of aircraft delivery in 2019 up to the date of the accident. Data from the accident flight and a flight on May 13, 2023, were imported into a commercially available Engine Monitoring Debriefing System (EMDS) software platform and exported in a comma-separated value (CSV) and Keyhole Markup Language (KML) format for review.

Parameters were exported from the EMDS software in engineering units and no further conversions were required. The DAC recorded GPS time in Greenwich Mean Time (GMT). Correlation of the data to the event local time, CDT, was established by using the recorded hours, minutes, and seconds and then applying an additional -5 hours offset to change GMT to CDT.

The DAC recorded engine parameters, electrical system parameters, discrete states, airspeed, angle of attack, and aircraft load factor, along with GPS information including altitude. In all, there were 369 individual parameters recorded, some of which were duplicates. Parameters were generally recorded at rates between 1-10 Hz. There was no flight attitude information such as pitch or roll recorded.

Table A-1 in Appendix A lists the ICON DAC parameters verified and provided in this report. Additionally, table A-2 describes the unit abbreviations used in this report.

2.2 Garmin Aera 796

The device arrived wet with no visible exterior damage. The device was opened and the circuit board containing the non-volatile memory chip showed signs of corrosion, as shown in Figure 2. The circuit board was cleaned and dried using established laboratory procedures.

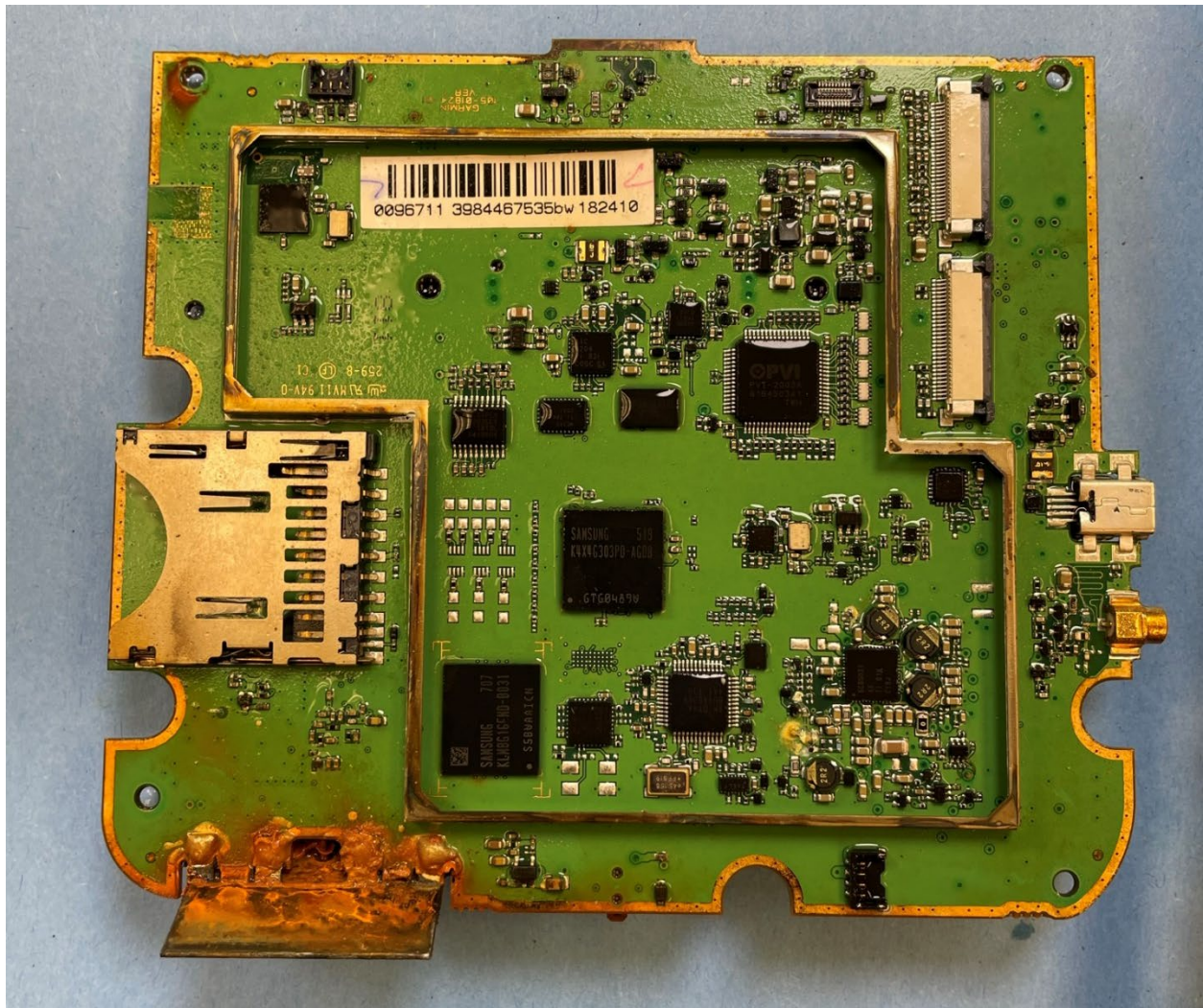


Figure 2. Garmin Aera 796 circuit board, as received.

After drying, the non-volatile memory chip was removed from the circuit board and imaged. A Garmin definition file was used to convert the chip image file to engineering units, however, the conversion was unsuccessful. After consultation with the Investigator-in-Charge and due to the successful download of the ICON DAC, which contained similar parameters to those on the Garmin Aera 796, further data

recovery attempts were not performed. Thus, no data were recovered from the device.

2.3 Trig TN72 GPS Receiver

The device arrived wet with no visible exterior damage, as shown in Figure 3.



Figure 3. Trig TN72, as received.

After consultation with the device manufacturer, it was determined that the device did not contain any non-volatile memory. Thus, no data were recovered from the device.

D. OVERLAYS AND TABULAR DATA

Figures 4 to 12 contain data recorded on the ICON DAC on the day of the accident, June 30, 2023.

The accident aircraft's engine was started at 12:54:27 CDT on the ground at Anoka County-Blaine Airport, Blaine, Minnesota. The data show the aircraft taxied to runway 27, departed at about 13:01 CDT, and tracked north toward Millie Lacs Lake. The aircraft overflowed the southern shore of Millie Lacs Lake at about 1,000 feet above ground level (AGL) and continued in a descent tracking to the north-northwest. After travelling 5 nautical miles over the lake, at 13:50:58 CDT, the final data point recorded by the DAC indicated the aircraft was at 1265 feet GPS altitude (approximately 12 feet AGL), 291 degrees GPS track, 78 knots indicated airspeed, and had an engine speed of 5722 RPM. Note that data are written to the DAC every one second, thus, up to one second of data could be lost from the DAC in the event of a sudden power interruption.

Figure 4 and Figure 5 show basic flight data and engine data, respectively, for the entire accident flight.

Figure 6 and Figure 7 show basic flight data and engine data, respectively, for the final two minutes of the accident flight.

Figures 8 to 12 show the aircraft's flight path overlayed on satellite imagery using Google Earth. Note that the weather and lighting conditions in Google Earth are not representative of the conditions at the time of the accident.

The corresponding tabular data used to create figures 4 to 7 is provided in electronic comma-separated value (CSV) format as attachment 1 to this report. The KML file used to generate figures 8 to 12 is provided as attachment 2 to this report.

Submitted by:

Kyle Garner
Sr. Aerospace Engineer - Recorder Specialist

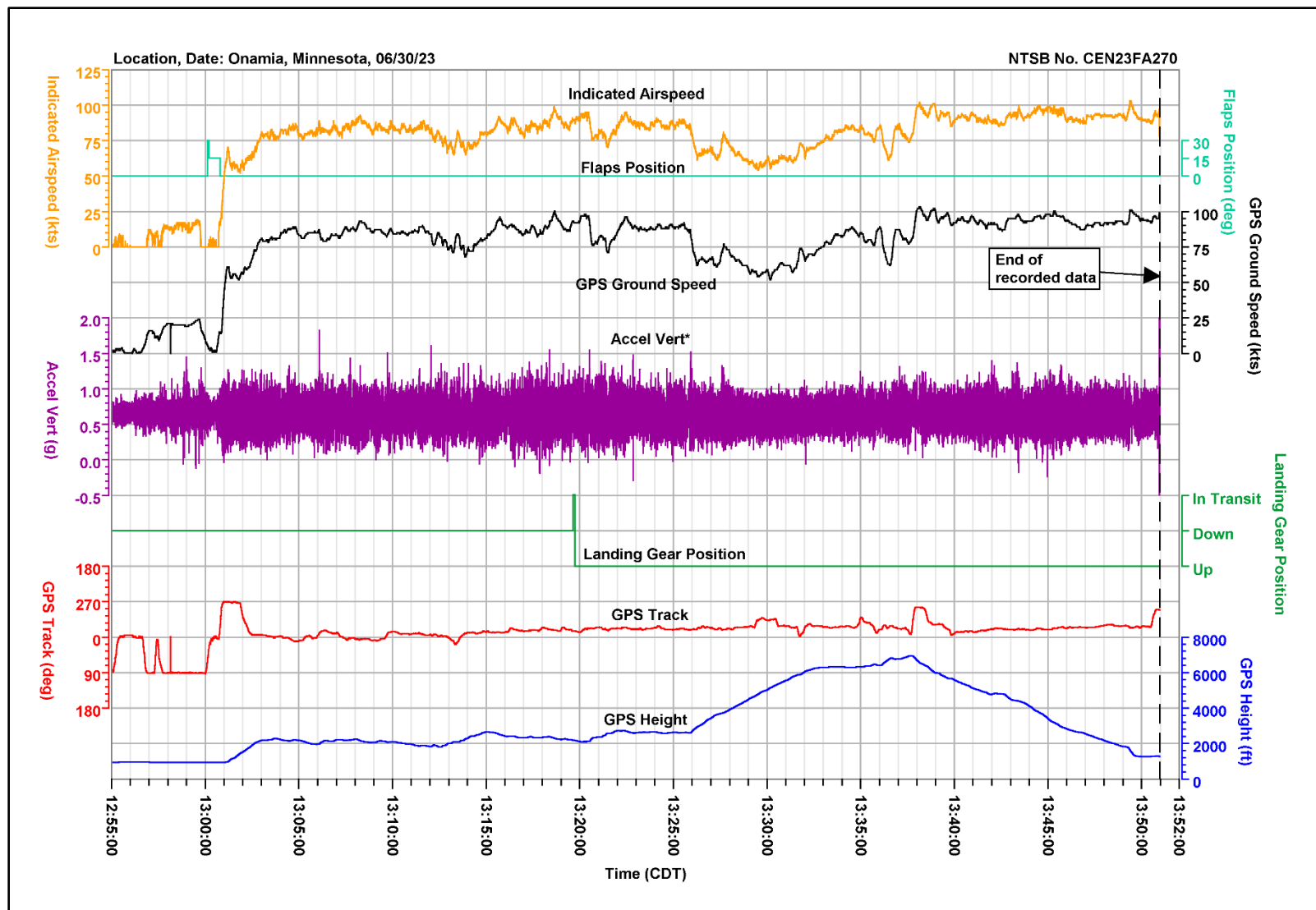


Figure 4. Plot of basic flight data for entire accident flight - 12:55:00 to 13:50:58 CDT.³

³ Note: the Accel Vert parameter is clipped to a maximum of 2.0g for readability. The 7.93g spike before the accident is shown in Figure 6.

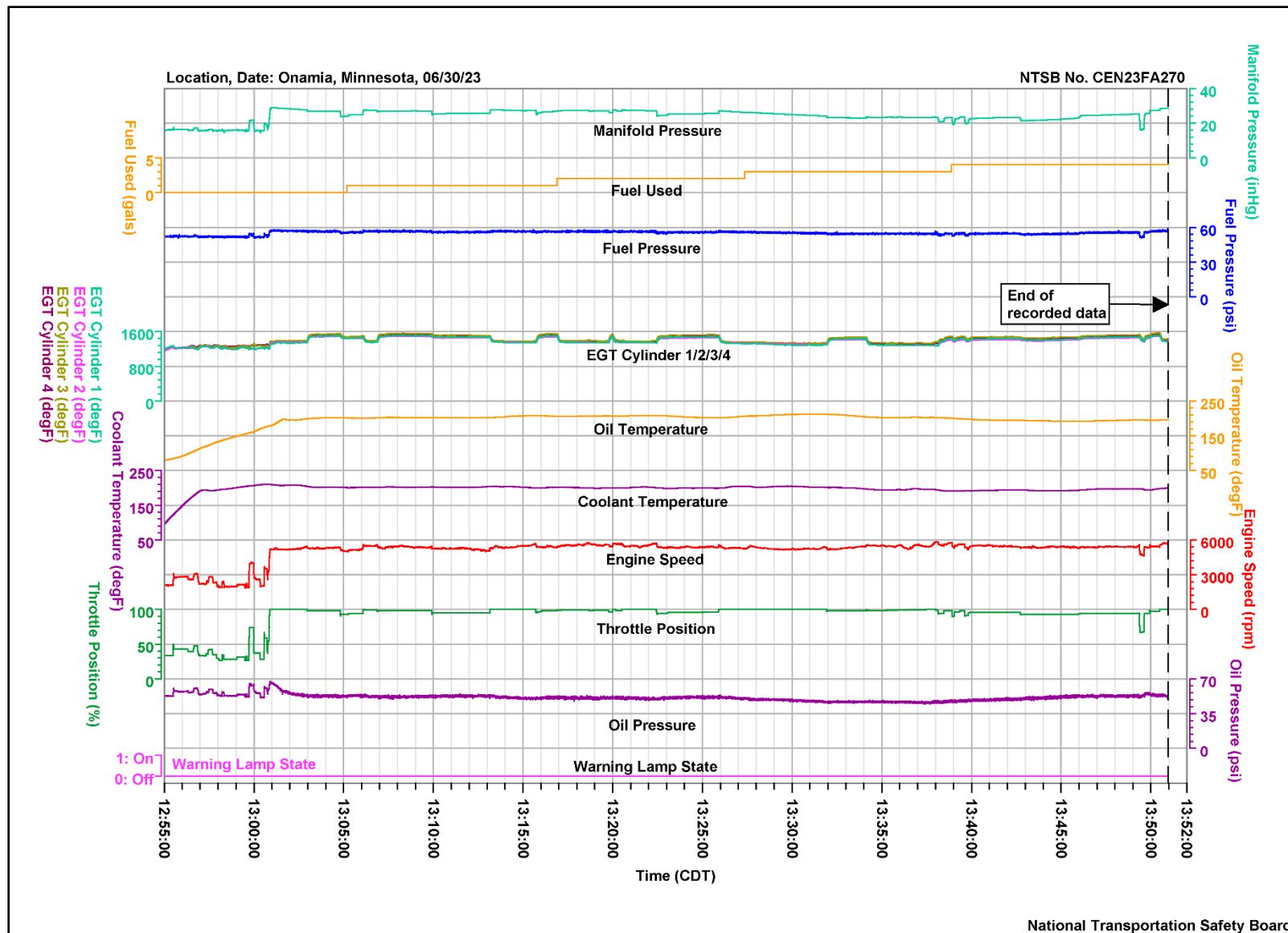


Figure 5. Plot of engine data for the entire accident flight - 12:55:00 to 13:50:58 CDT.

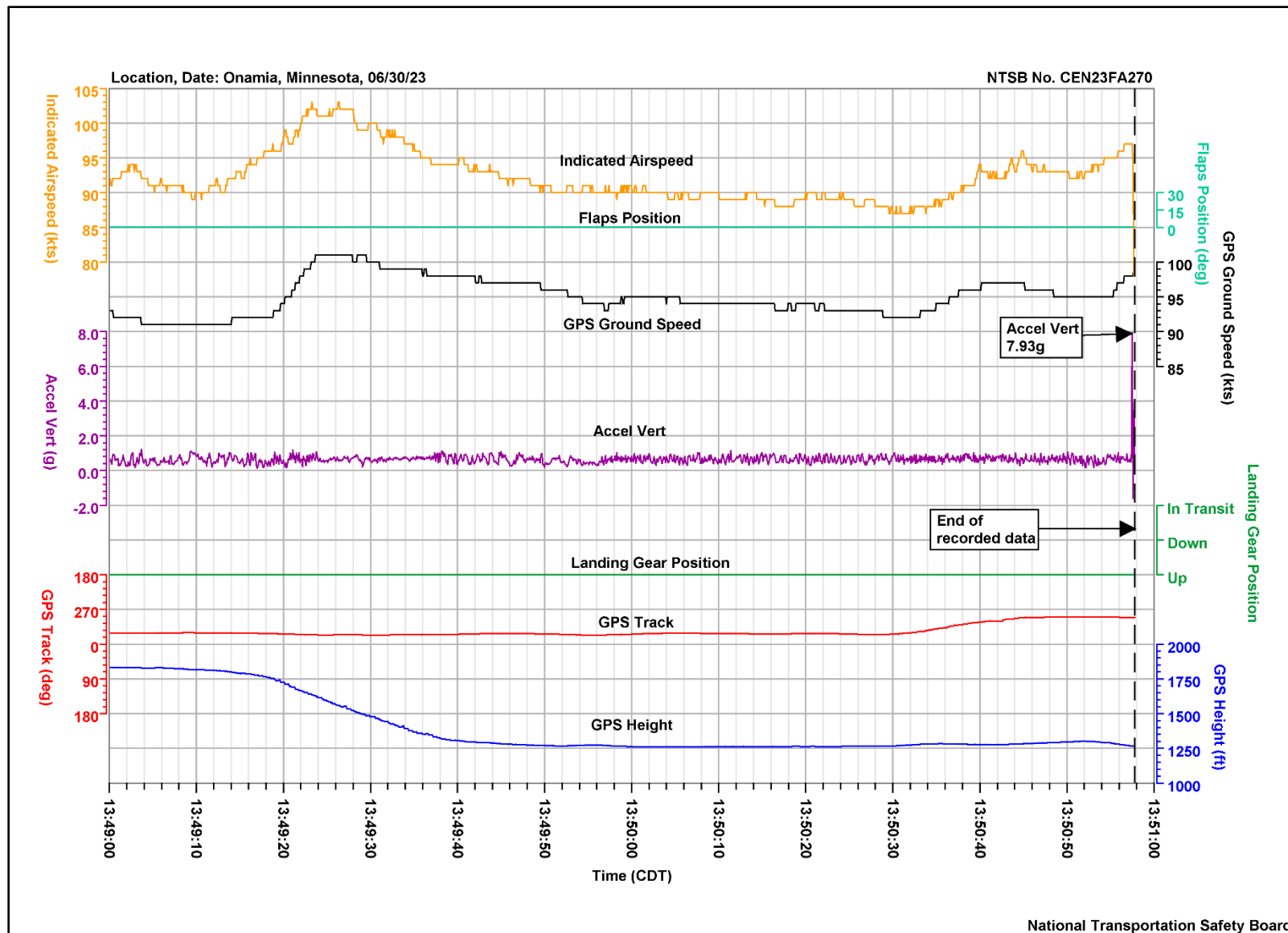


Figure 6. Plot of basic flight data for final two minutes of accident flight - 13:49:00 to 13:50:58 CDT.

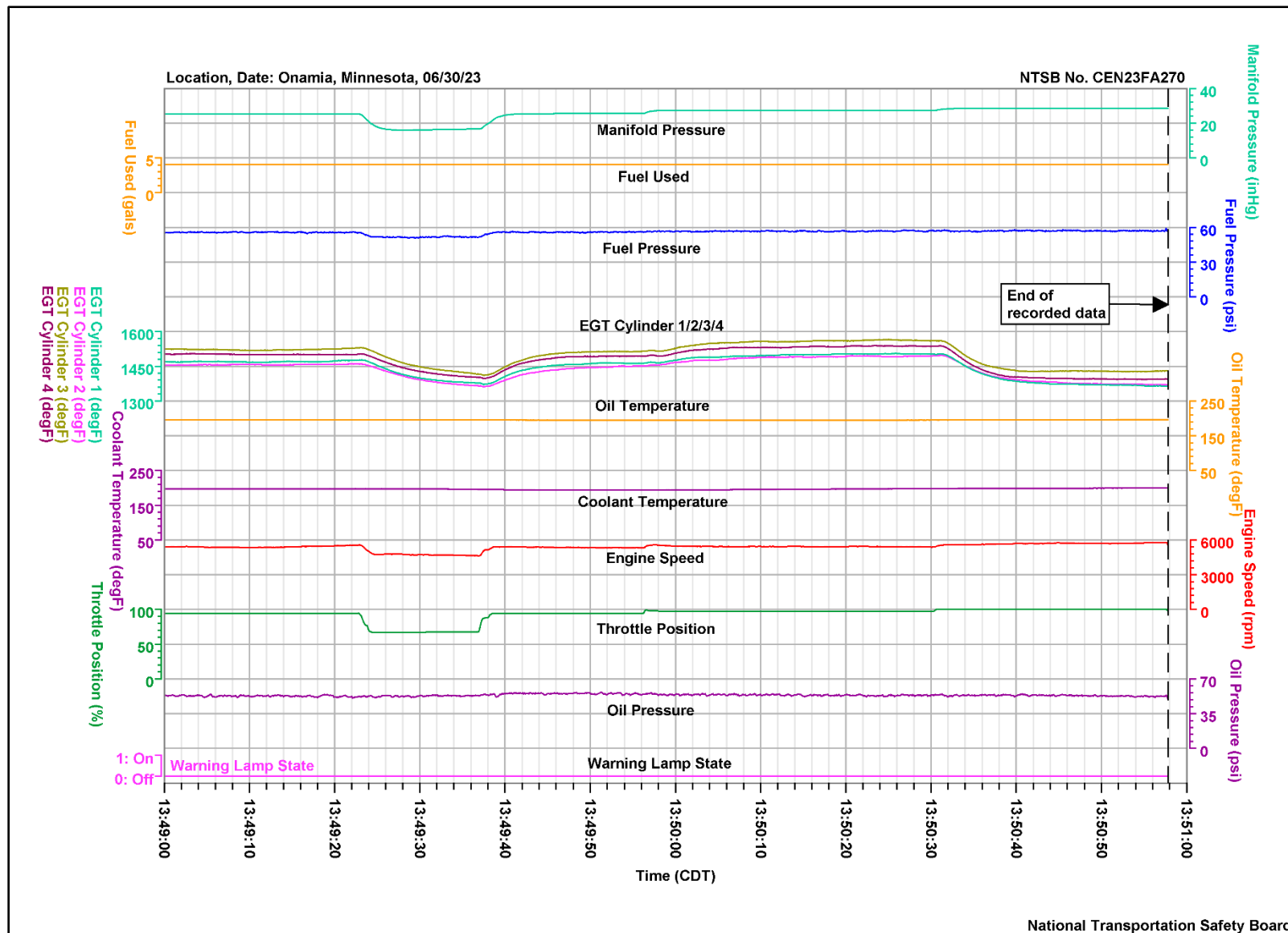


Figure 7. Plot of engine data for final two minutes of accident flight - 13:49:00 to 13:50:58 CDT.

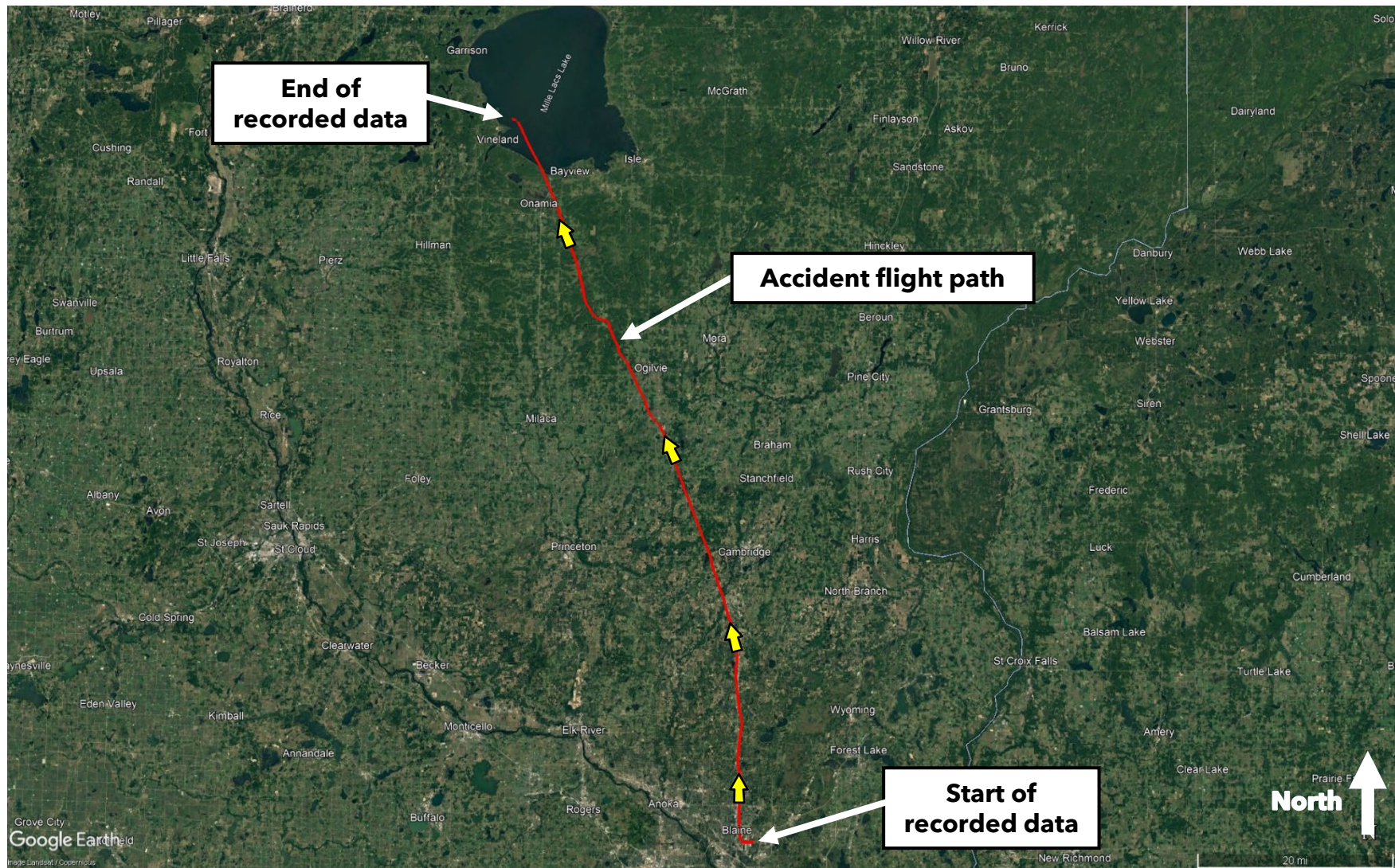


Figure 8. Google Earth overlay of the entire accident flight path.

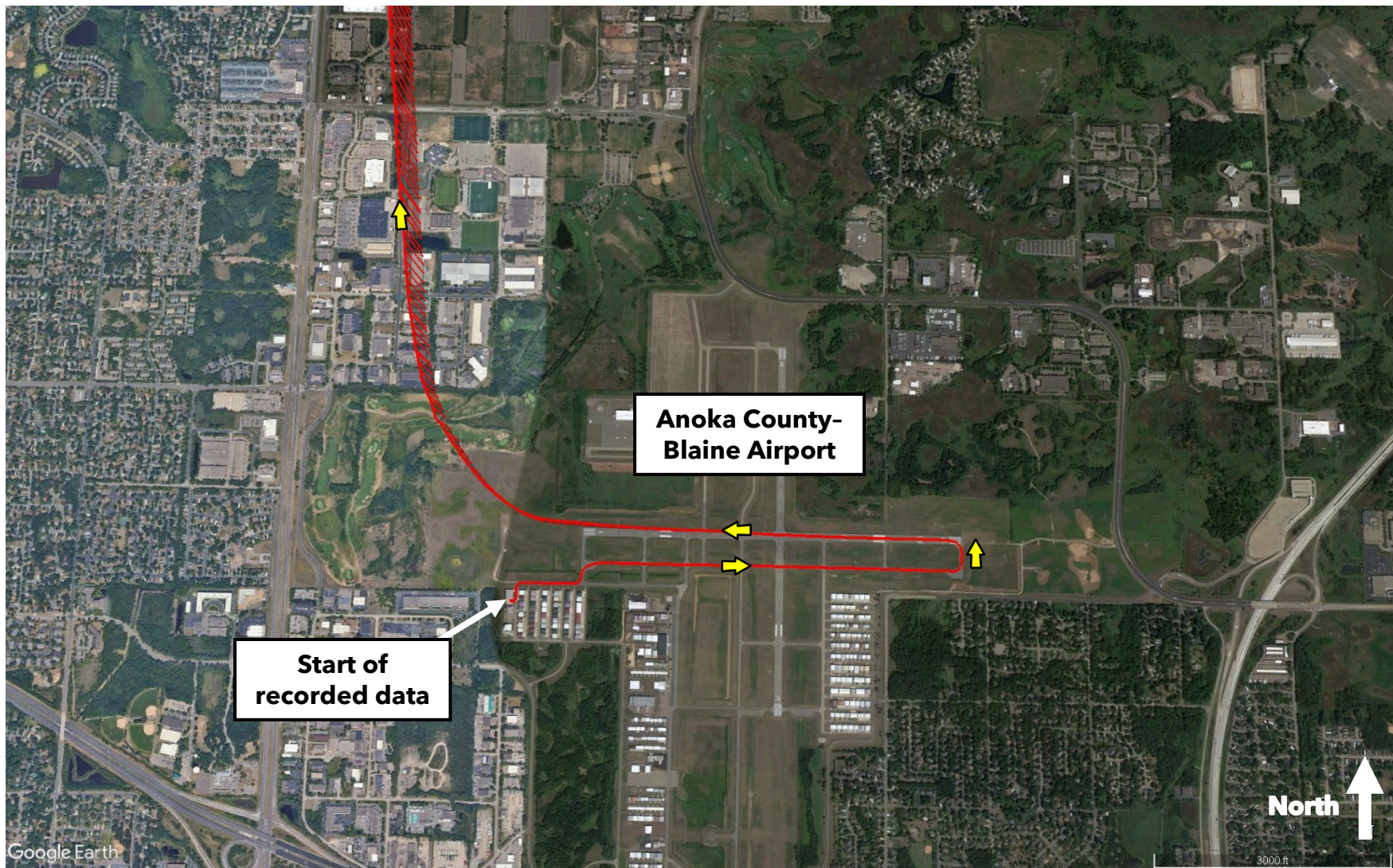


Figure 9. Google Earth overlay of the beginning of the accident flight path.

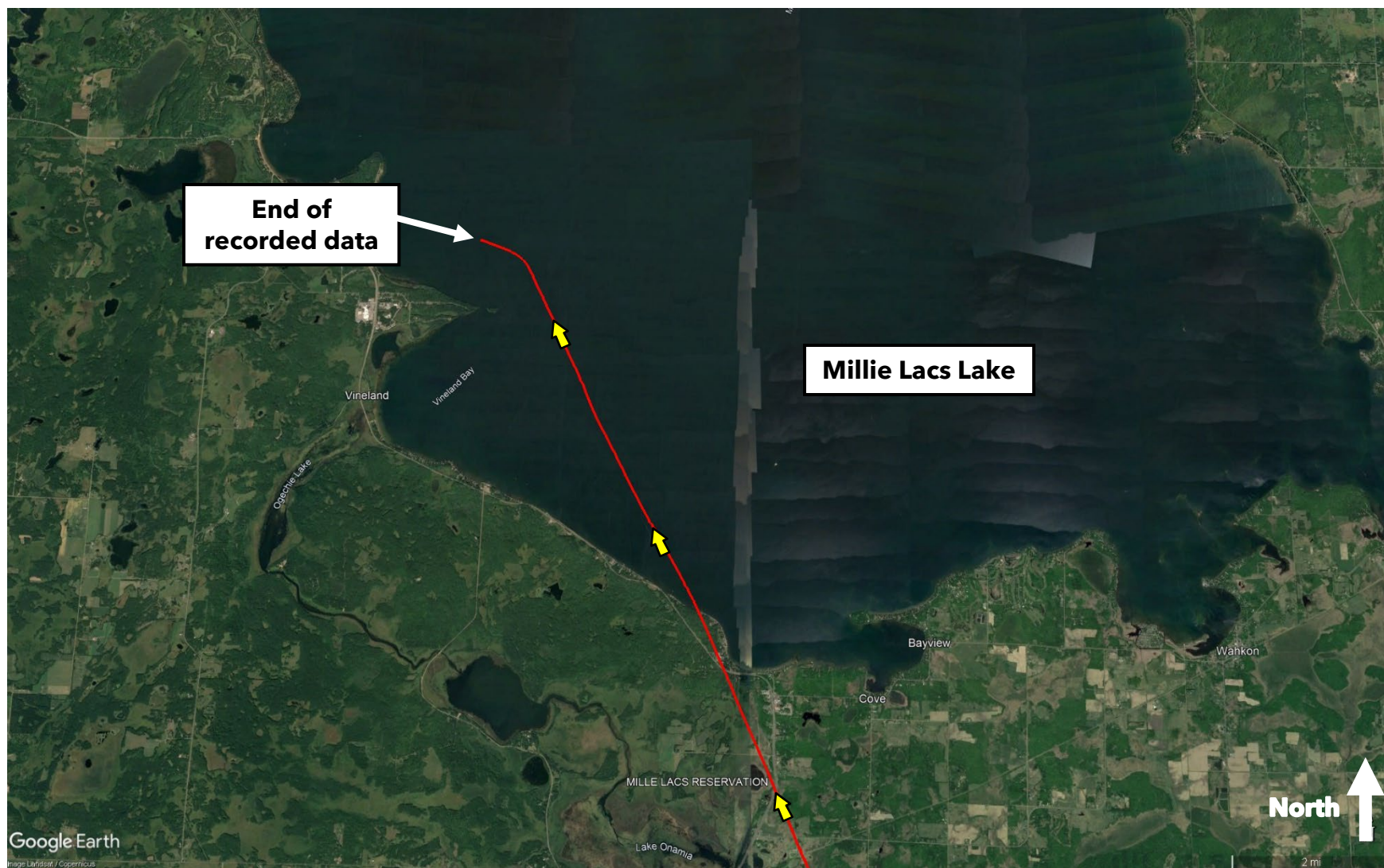


Figure 10. Google Earth overlay of the end of the accident flight path.

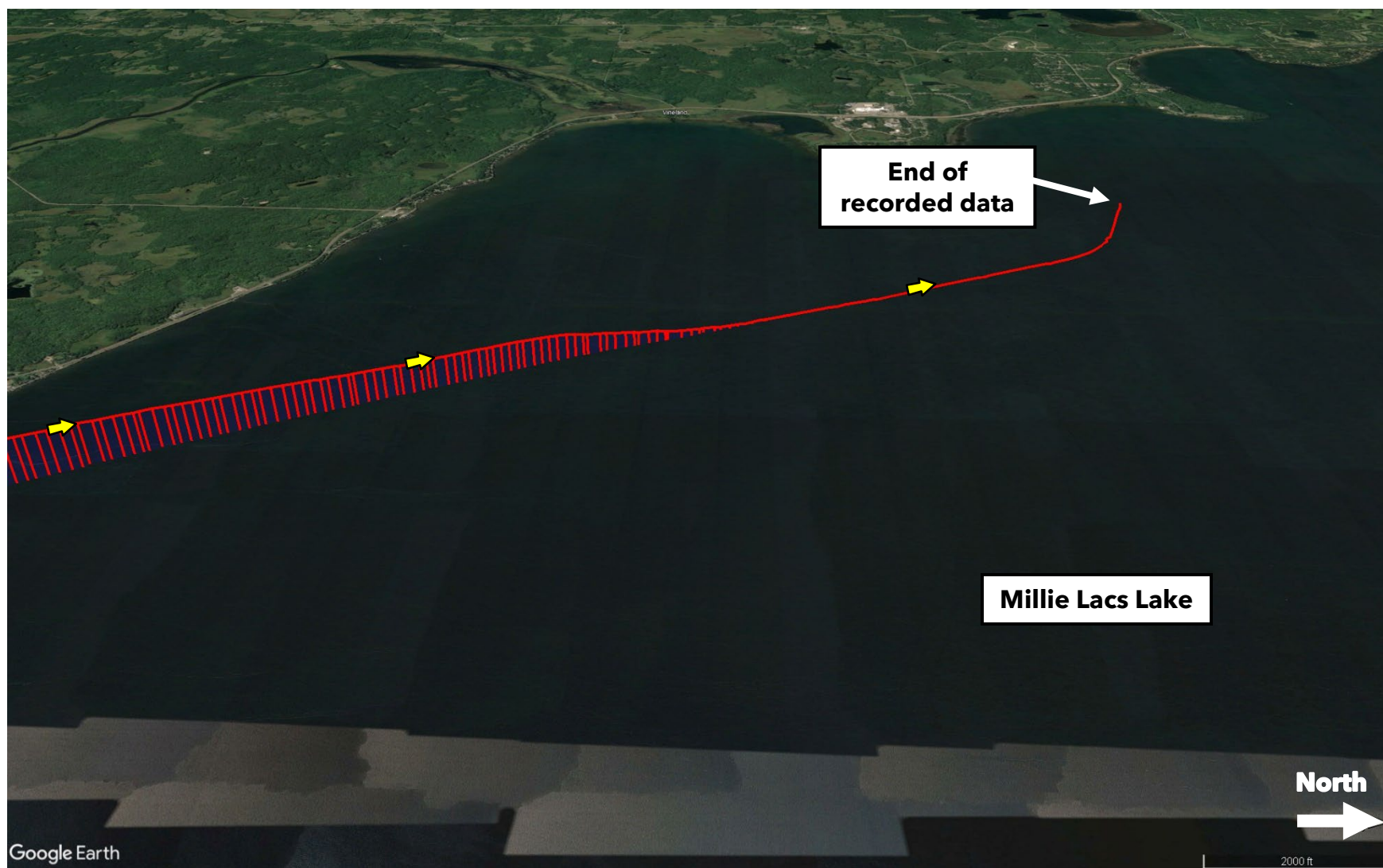


Figure 11. Google Earth overlay of the end of the accident flight path - profile view facing west.

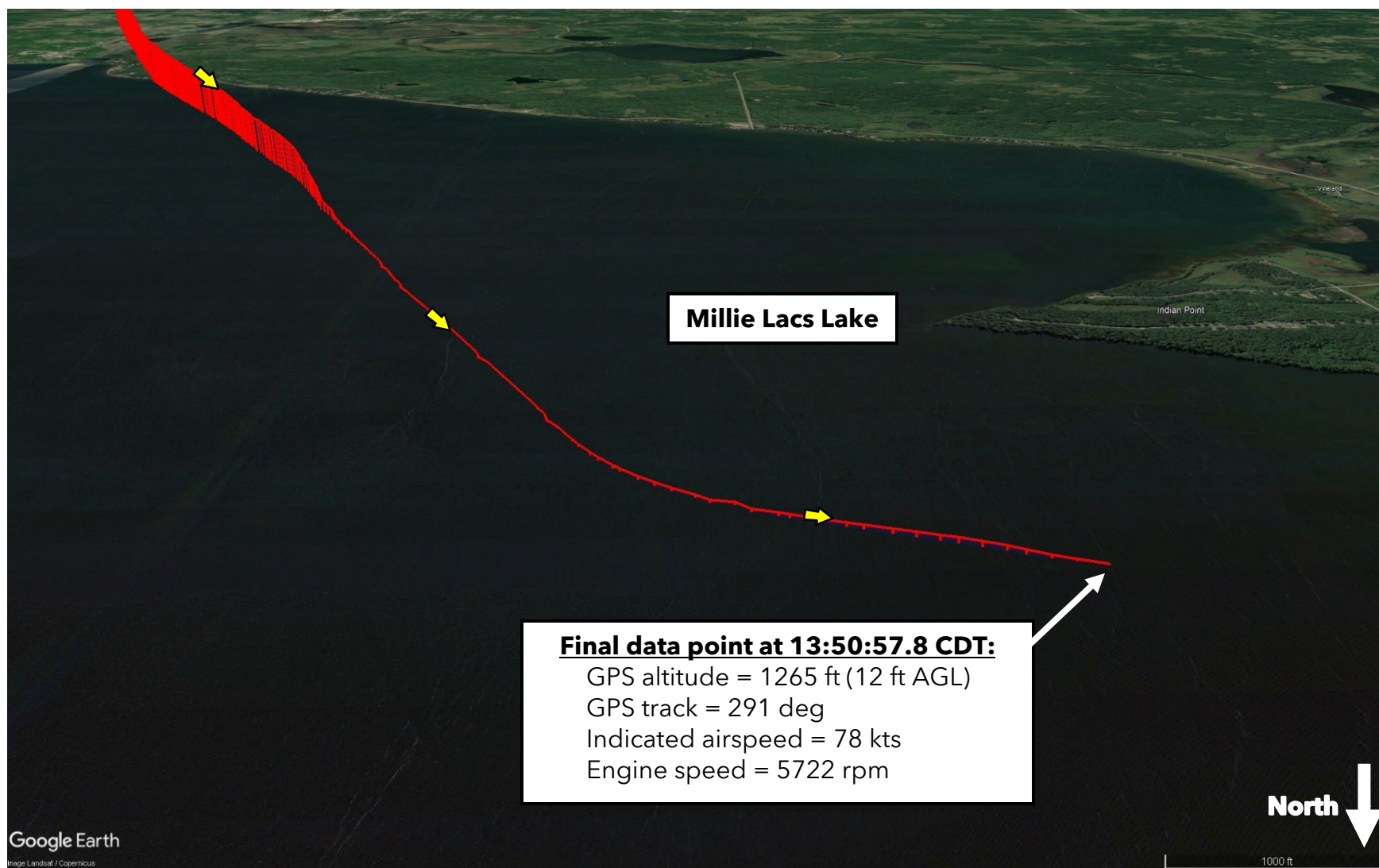


Figure 12. Google Earth overlay of the end of the accident flight path - profile view facing south.

APPENDIX A. VERIFIED AND PROVIDED PARAMETERS

This appendix describes the parameters provided and verified in this report. Table 1 lists the plot/table labels, parameter names, and units. Additionally, table 2 describes the unit abbreviations used in this report.

Table A-1. Verified and provided DAC parameters.

Plot/Table Labels	Parameter Names	Units
Accel Vert	Vertical acceleration	g
Coolant Temperature	Engine coolant temperature	degF
EGT Cylinder 1	Exhaust gas temperature cylinder 1	degF
EGT Cylinder 2	Exhaust gas temperature cylinder 2	degF
EGT Cylinder 3	Exhaust gas temperature cylinder 3	degF
EGT Cylinder 4	Exhaust gas temperature cylinder 4	degF
Engine Speed	Engine speed	rpm
Flaps Position	Flaps position	deg
Fuel Pressure	Fuel pressure	psi
Fuel Used	Fuel used	gals
GPS Ground Speed	GPS ground speed	kts
GPS Height	GPS height	ft
GPS Track	GPS track	deg
Hour	Time - UTC hour	hrs
Indicated Airspeed	Indicated airspeed	kts
Landing Gear Position	Landing gear position	
Latitude	Latitude position	deg
Longitude	Longitude position	deg
Manifold Pressure filtered	Manifold pressure	inHg
Minute	Time - UTC minutes	min
Oil Pressure	Engine oil pressure	psi
Oil Temperature	Engine oil temperature	degF
Second	Time - UTC seconds	sec
Throttle Position	Throttle position	%
Warning Lamp State	Warning lamp state	

Note: Parameters with a blank unit description in table 1 are discretes. A discrete is typically a 1-bit parameter that is either a 0 state or a 1 state where each state is uniquely defined for each parameter.

Table A-2. Unit abbreviations.

Unit Abbreviation	Description
deg	degrees
degF	degrees Fahrenheit
ft	feet
g	unit of gravitation acceleration
gals	gallons
hrs	hours
inHg	inches of Mercury
kts	knots
min	minutes
psi	pounds per square inch

Unit Abbreviation	Description
rpm	revolutions per minute
sec	seconds