

National Transportation Safety Board

Office of Research and Engineering

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WPR24LA106

COCKPIT DISPLAY - RECORDED FLIGHT DATA

Specialist's Factual Report

November 27, 2024

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A. ACCIDENT

Location: Whitehorn, California
Date: March 8, 2024
Time: 1325 pacific daylight time (PST)
2125 coordinated universal time (UTC)
Airplane: Cirrus SR22, private operator, N2824M

B. COCKPIT DISPLAY - RECORDED FLIGHT DATA SPECIALIST

Specialist: Steven Smith
Mechanical Engineer (Recorder Specialist)
National Transportation Safety Board (NTSB)

C. DETAILS OF THE INVESTIGATION

A group was not convened. The NTSB Vehicle Recorder Division received the following electronic devices:

Recorder Manufacturer/Model: Avidyne PFD
Part Number: 700-00006-000
Recorder Serial Number: 20345384

Recorder Manufacturer/Model: Avidyne MFD Compact Flash Card
Part Number: Unknown
Recorder Serial Number: Unknown

1.0 Avidyne Primary Flight Display Description

The Avidyne primary flight display (PFD) unit includes 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 PFD unit has external pitot/static inputs for altitude, airspeed, and vertical speed information. Each PFD contains two flash memory devices mounted on a riser card. The flash memory stores information the PFD unit uses to generate the various PFD displays. Additionally, the PFD has a data logging function, which is used by the manufacturer for maintenance and diagnostics. Maintenance and diagnostic information recording consist of system information, event data and flight data.

The PFD samples and stores several data streams in a sequential fashion; when the recording limit of the PFD is reached, the oldest record is dropped, and a new record is added. Data from the Attitude/Heading Reference System (AHRS) is recorded at a rate of 5 Hz. Air data information such as pressure altitude, indicated airspeed, and vertical speed are recorded at 1 Hz. Global Positioning System (GPS) and navigation display and setting data are recorded at a rate of 0.25 Hz, and

information about pilot settings of heading, altitude, and vertical speed references are recorded when changes are made.

1.1 Avidyne PFD Data Recovery

The Avidyne PFD was in good condition and the data were downloaded using the manufacturer's procedure and converted to engineering units using laboratory tools. Figure 1 shows the Avidyne PFD as received by the NTSB Vehicle Recorder Laboratory.



Figure 1. Avidyne PFD as received by the NTSB Vehicle Recorder Laboratory.

1.2 Avidyne PFD Recording Description

The PFD recording contained records of 19 power cycles and approximately 19.69 hours of data. The accident flight was associated with the last power cycle.¹ The duration of the last power cycle was 8.2 minutes. Timing of the PFD data is measured in seconds from power-on. The last recorded position sample does not align with the reported wreckage location. The last recorded position at 13:19:18 PST, is approximately 222 feet from the reported wreckage location.

1.2.1 Avidyne PFD Parameters Provided

Table 1 lists the PFD parameters verified and provided in this report.

¹ During the normal data retrieval process, power is applied to the PFD. Therefore, the accident data is not necessarily the last power cycle recorded.

Table 1. Avidyne PFD data parameters provided.

Parameter Name (unit)	Parameter Description (unit)
Accel Lat (g)	Lateral Acceleration (gravitational acceleration)
Accel Long (g)	Longitudinal Acceleration (gravitational acceleration)
Accel Vert (g)	Vertical Acceleration (gravitational acceleration)
Airspeed Ind (kts)	Indicated Airspeed (knots)
Alt Press (ft)	Pressure Altitude (feet)
Groundspeed (kts)	Groundspeed (knots)
Hdg Mag (deg)	Magnetic Heading (degrees)
Latitude (deg)	Latitude (degrees)
Longitude (deg)	Longitude (degrees)
Pitch (deg)	Pitch Angle (degrees)
Roll (deg)	Roll Angle (degrees)
Time UTC Hrs	Coordinated Universal Time Hours
Time UTC Min	Coordinated Universal Time Minutes
Time UTC Sec	Coordinated Universal Time Seconds

1.3 Avidyne PFD Time Correlation

Correlation of the PFD time to UTC was established by comparing the recorded automatic dependent surveillance - broadcast (ADS-B) time, latitude, and longitude parameters to the same recorded PFD parameters. It was determined that the PFD time recorded was ahead of the ADS-B time and required an offset by subtracting 4 seconds. The PFD time was then converted from UTC to PST. The difference between PST and UTC is 8 hours, or 28,800 seconds. The accident flight data has been offset from the recorded PFD time to PST by subtracting 28,804 seconds.

2.0 Avidyne Multi-Function Display Description

The Avidyne multi-function flight display (MFD) unit is able to display the pilot checklist, terrain/map information, approach chart information and other aircraft/operational information depending on the specific configuration and options that are installed. One of the options available is a display of comprehensive engine monitoring and performance data.

Each MFD contains a compact flash (CF) memory card located in a slot on the side of the unit. This memory card contains all of the software that the MFD needs to operate. Additionally, this card contains all of the checklist, approach charts, and map information that the unit uses to generate the various cockpit displays.

During operation, the MFD display receives information from several other units that are installed on the aircraft. Specifically, the MFD receives GPS position, time and track data from the aircraft's GPS receiver. The MFD may also receive information from the aircraft concerning altitude, engine and electrical system parameters, and outside air temperature. This data is also stored on the unit's CF memory card.

The MFD generates new data files for each MFD power-on cycle. The oldest file is dropped and replaced by a new recording once the storage limit has been reached. MFD data are sampled every six seconds and is recorded to memory once every minute. If an interruption of power occurs during the minute between MFD memory write cycles, data sampled during that portion of a minute are not recorded.

2.1 Avidyne MFD Compact Flash Data Recovery

The Avidyne MFD Compact Flash card was in good condition and the data were downloaded using the manufacturer's procedure.

2.2 Avidyne MFD Compact Flash Recording Description

The MFD CF card contained 136 data files. One data file was identified as recording during the accident flight. The data file was 8.1 minutes in duration.

2.2.1 Avidyne MFD Compact Flash Parameters Provided

Table 2 lists the MFD parameters verified and provided in this report. This aircraft engine is configured with 6 cylinders. In the data plots, the '#' is replaced with the appropriate cylinder ID.

Table 2. Avidyne MFD data parameters provided.

Parameter Name (unit)	Parameter Description (unit)
AMPS (A)	Bus Current (amps)
C# (degF)	Cylinder Head Temperature # (degrees Fahrenheit)
E# (degF)	Exhaust Gas Temperature # (degrees Fahrenheit)
FF (gph)	Fuel Flow (gallons per hour)
LAT (deg)	Latitude (degrees)
LON (deg)	Longitude (degrees)
MAP (inHg)	Manifold Pressure (inches of Mercury)
OILP (psi)	Oil Pressure (pounds per square inch)
OILT (degF)	Oil Temperature (degrees Fahrenheit)
SPD (rpm)	Engine Speed (revolutions per minute)
UTC TIME (HH:MM:SS)	Coordinated Universal Time (Hours:Minutes:Seconds)
VOLTS (V)	Bus Voltage (volts)

2.3 Avidyne MFD Compact Flash Time Correlation

Correlation of the MFD time to UTC was established by comparing the recorded ADS-B time, latitude, and longitude parameters to the same recorded MFD parameters. The MFD time matched the ADS-B time. The MFD time was then converted from UTC to PST. The difference between PST and UTC is 8 hours, or 28,800 seconds. The accident flight data has been offset from the recorded MFD time to PST by subtracting 28,800 seconds.

D. FIGURES AND TABULAR DATA

Figures 2 and 3 contain Avidyne PFD and MFD data recorded during the event on March 8, 2024. All the parameters listed in tables 1 and 2 are plotted except UTC Hours, UTC Minutes, UTC Seconds, Latitude, and Longitude.

Figure 2 is time history plot of Avidyne PFD parameters for the entire flight. Figure 3 is a time history plot of Avidyne MFD parameters for the entire flight.

These figures are configured such that right turns are indicated by the trace moving toward the bottom of the page, left turns towards the top of the page, and nose up attitudes towards the top of the page.

The Avidyne PFD and MFD data indicated the following sequence of events:

- **13:08:32 PST:** The Avidyne PFD was powered on and recording data.
- **13:10:37 PST:** The Avidyne MFD was powered on and recording data.
- **13:11:18 PST:** The aircraft began to taxi to runway 12.
- **13:15:23 PST:** The aircraft began takeoff roll at Shelter Cove Airport (0Q5) from runway 12.
- **13:15:43 PST:** The aircraft rotated and began to climb. The indicated airspeed was 77 kts.
- **13:16:30 PST:** The aircraft was climbing, and was at a pressure altitude of 574 ft. The indicated airspeed was 127 kts. Engine speed, manifold pressure, and fuel flow were 2630 rpm, 28.2 inHg, and 25.5 gph, respectively.
- **13:17:42 PST:** The aircraft was climbing, and was at a pressure altitude of 2,192 ft. The indicated airspeed was 126 kts. Engine speed, manifold pressure, and fuel flow were 2620 rpm, 26.5 inHg, and 25.2 gph, respectively.
- **13:17:48 PST:** Engine speed began to reduce from 2540 rpm.

- **13:18:00 PST:** Pressure altitude was 2,376 ft and indicated airspeed was 128 kts. Engine speed and fuel flow began rapidly reducing from 2480 rpm and 20.2 gph, respectively.
- **13:18:03 PST:** Indicated airspeed began to reduce from 136 kts to 133 kts.
- **13:18:06 PST:** Engine speed and fuel flow were 2090 rpm and 0.9 gph.
- **13:18:20 PST:** The aircraft was at a maximum pressure altitude of 2,488 ft and began to descend.
- **13:18:43 PST:** The last recorded Avidyne MFD data sample. Engine speed and fuel flow were 1310 rpm and 0.4 gph, respectively.
- **13:18:47 PST:** Vertical acceleration changed from 0.6 g to 1.49 g in the next second. The indicated airspeed was 84 kts.
- **13:18:54 PST:** The aircraft began a left turn.
- **13:19:18 PST:** Last recorded Avidyne PFD data sample. The aircraft pressure altitude was 1,186 ft and the indicated airspeed was 17 kts. The last recorded position was 39.97598648, -123.97899628.

Figures 4 and 5 are graphical overlays derived from the Avidyne PFD data and generated using Google Earth presenting the entire accident flight from 0Q5 and the final portion of the recording, respectively. Weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording.

The corresponding Avidyne PFD tabular data used to create figures 2, 4, and 5 are provided in electronic comma-separated value (CSV) format as attachment 1 to this report. The corresponding Avidyne MFD tabular data used to create figure 3 is provided in CSV format as attachment 2 to this report. The corresponding ADS-B tabular data is provided in CSV format as attachment 3 to this report.

Submitted by:

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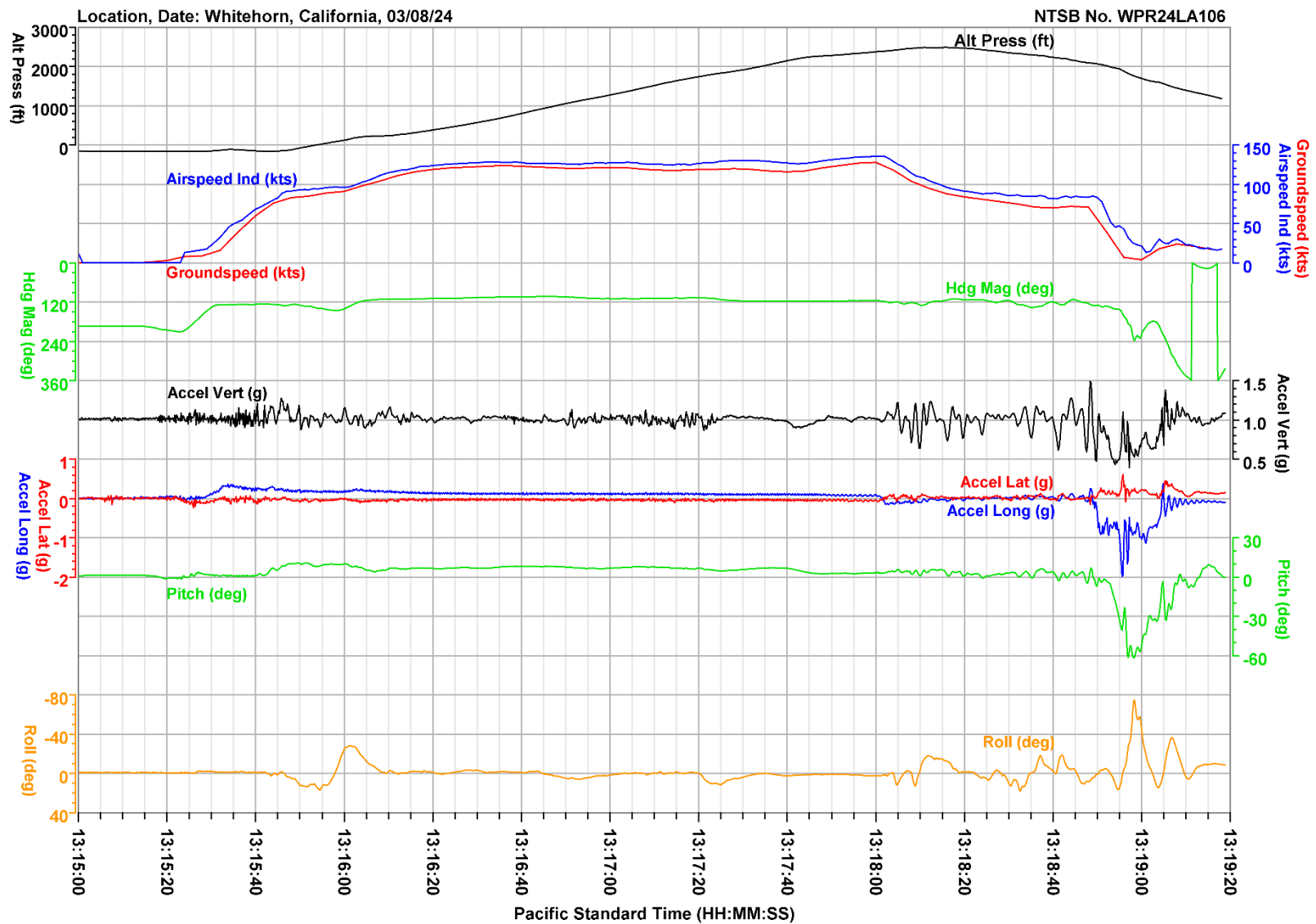


Figure 2. Time history plot of PFD parameters for the entire flight.

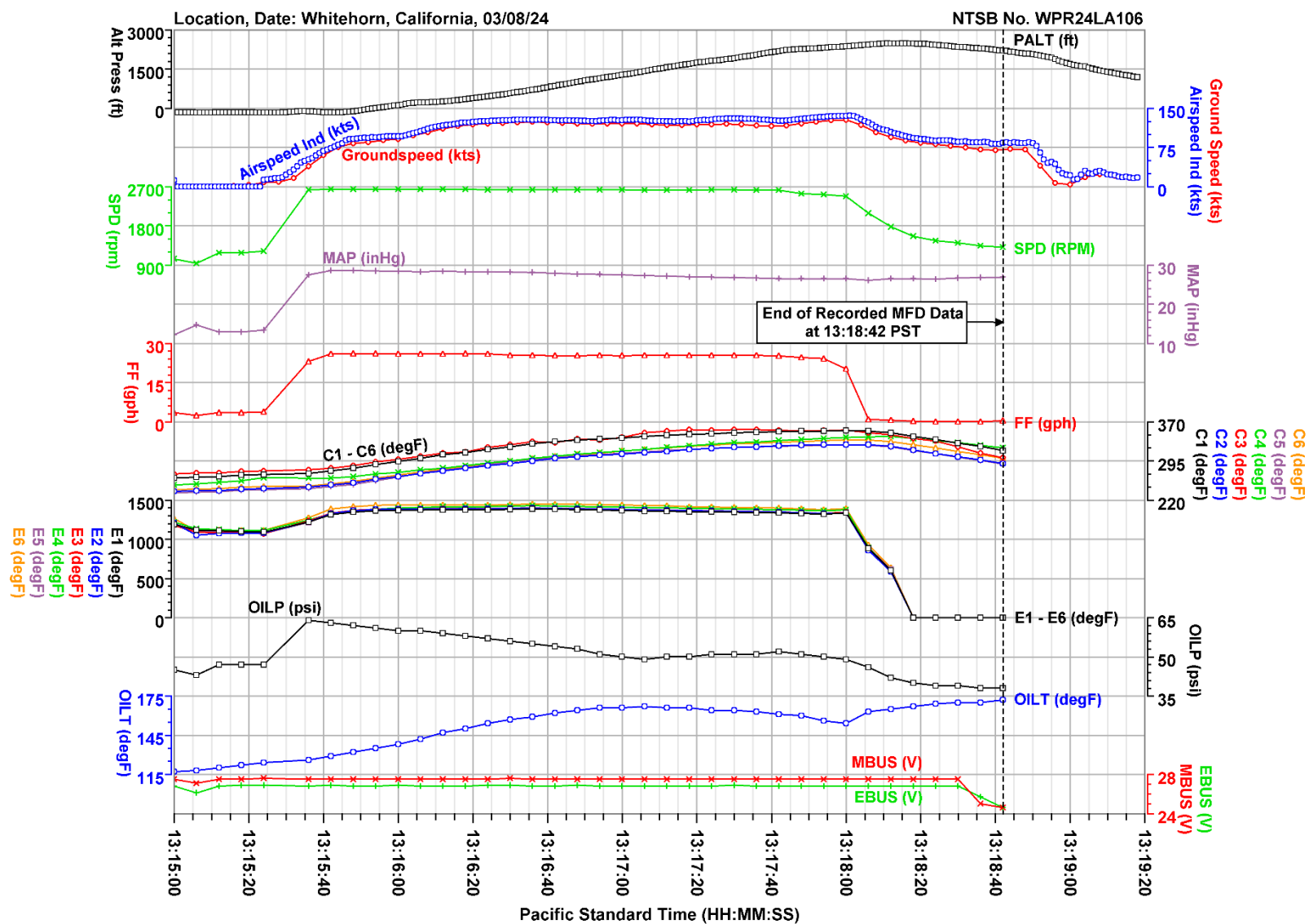


Figure 3. Time history plot of MFD parameters for the entire flight.



Figure 4. Google Earth overlay of the entire event flight using PFD data.

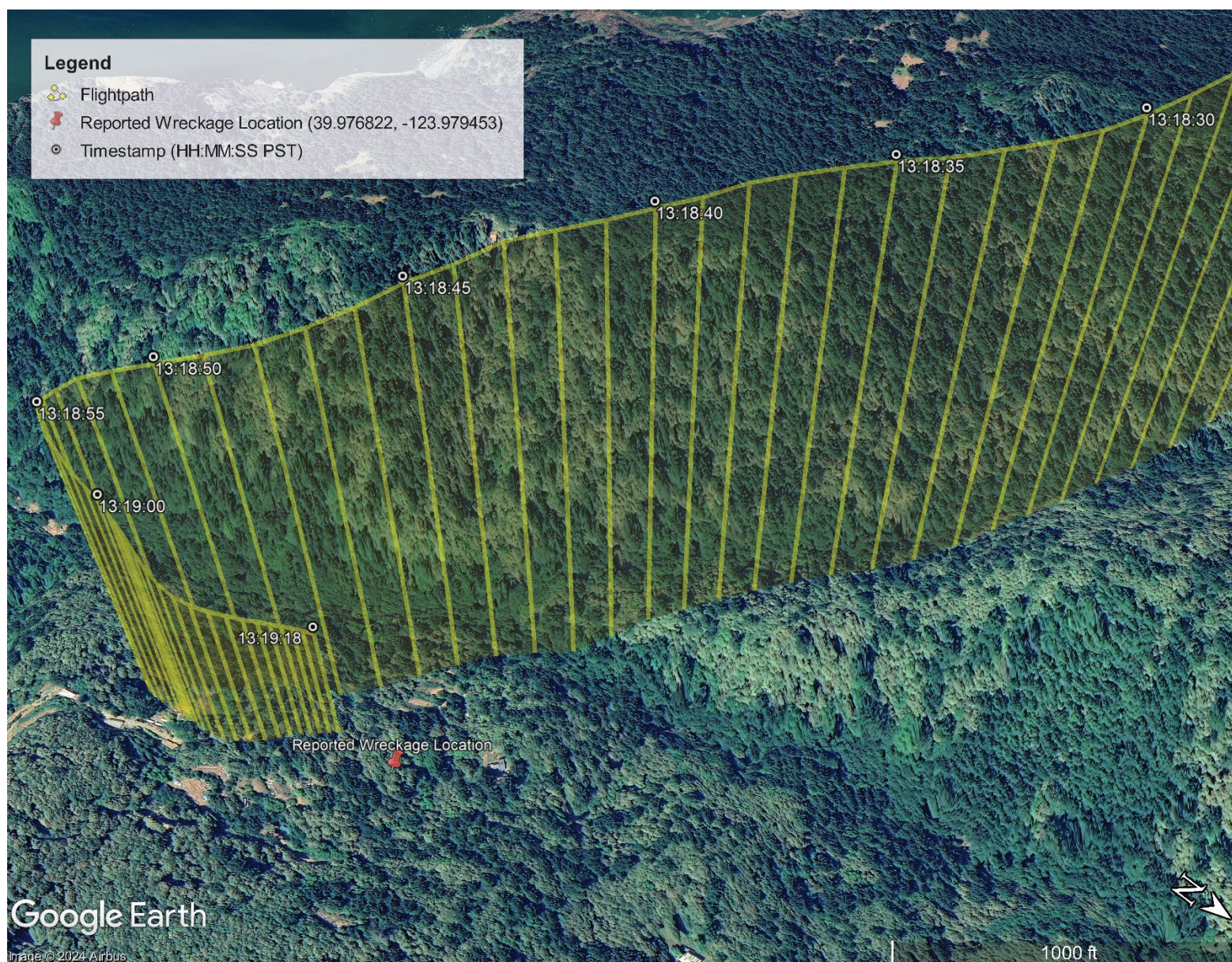


Figure 5. Google Earth overlay of the final portion of the PFD recording.