

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



CEN23FA340

GLOBAL POSITIONING SYSTEM DEVICES

Specialist's Factual Report

July 26, 2024

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A. ACCIDENT

Location: Oakdale, Illinois
Date: July 31, 2023
Time: 1310 central daylight time (CDT)
1810 coordinated universal time (UTC)
Helicopter: UH-1H, Kash Helicopter Services LLC, N567VF

B. GLOBAL POSITIONING SYSTEM DEVICES SPECIALIST

Specialist: Matthew Yandrick
Electronics Engineer – Recorder Specialist
National Transportation Safety Board (NTSB)

C. DETAILS OF THE INVESTIGATION

A global positioning system (GPS) group was not convened. The NTSB Vehicle Recorder Division received the following GPS devices:

Recorder Manufacturer/Model: Ag-NAV GUIA Platinum P771
Recorder Serial Number: 771170068

Recorder Manufacturer/Model: Garmin Aera 510
Recorder Serial Number: 1QR003704

1.0 Ag-NAV GUIA Platinum P771 Description

The Ag-NAV GUIA Platinum P771 is a compact GPS device used to provide pilots customizable agricultural spray application data on a color moving map. The unit has an 8.4-inch touch screen display and is enclosed in a ruggedized housing. The moving map displays a customizable interface which allows pilots to monitor application information and navigational landmarks. The device includes a built-in wireless internet adapter, as well as a 3G SIM card slot for mobile internet. The device has an obstacle warning feature which is compatible with FAA tower obstacle data and provides pilots warnings regarding incoming obstacles and power lines.

1.1 Ag-NAV GUIA Platinum P771 Data Recovery

The Ag-NAV GUIA Platinum P771 was in good condition and data were downloaded normally using the manufacturer's procedure. Figure 1 is the front and side view of the Ag-NAV device, as received.



Figure 1. Photo of front and side view of Ag-NAV GUIA Platinum P771, as received.

1.2 Ag-NAV GUIA Platinum P771 Recording Description

The data downloaded contained 15 data files related to the accident flight on July 31, 2023. The recording started at 07:18:04 CDT and ended at 13:10:11.9 UTC. Data were recorded at 5 Hz.

In the Ag-NAV settings, a laser altimeter was selected to capture altitude above ground level (AGL). An altimeter offset of -4.00 feet was entered.

1.2.1 Ag-NAV GUIA Platinum P771 Engineering Unit Conversions

Conversion of the GPS data from the raw recorded information to engineering units is performed by Ag-NAV. Groundspeed data, as provided by Ag-NAV, was converted from miles per hour (mph) to knots (kts).

Appendix A Table 1 lists the Ag-NAV GPS parameters verified and provided in this report.

1.3 Ag-NAV GUIA Platinum P771 Timing Correlation

Ag-NAV GUIA Platinum P771 data was recorded in UTC. The difference between CDT and UTC was 5 hours, or 18,000 seconds. The accident flight data has been offset from the recorded UTC to CDT by subtracting 18,000 seconds.

2.0 Garmin Aera 510 Description

The Garmin Aera 510 is a portable GPS receiver capable of storing date, route-of-flight, and flight-time information. A detailed tracklog including latitude, longitude, GPS elevation, date, time, course, and groundspeed information is stored within the unit whenever the receiver has a lock on the GPS navigation signal. All recorded data is stored in non-volatile memory.¹ The unit contains hardware and software permitting the download of recorded waypoint, route, and tracklog information to a PC via a built-in USB port. An internal battery is used as backup power to the internal memory and real-time clock during those periods when main power is removed.

2.1 Garmin Aera 510 Data Recovery

The Garmin Aera 510 was in good condition and the data were downloaded normally using the manufacturer's procedure. Figure 2 is the front view of the Garmin Aera 510 device, as received.



Figure 2. Photo of front view of Garmin Aera 510, as received.

2.2 Garmin Aera 510 Recording Description

The data extracted included 5 sessions from July 27, 2023, through July 31, 2023. The accident flight was the last recording that started at 07:10:31 CDT and

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

ended at 13:11:12 CDT on July 31, 2023. The data rate varied from 1 second per sample to greater than 60 seconds per sample.

The Aera 510 GPS receiver provided elevation by converting GPS altitude to mean sea level (MSL)-based altitude (GPS-MSL altitude).

2.2.1 Garmin Aera 510 Engineering Unit Conversions

GPS leg speed data, as provided by Garmin Aera, was converted from miles per hour (mph) to knots (kts).

Appendix A Table 1 lists the Garmin GPS parameters verified and provided in this report.

2.3 Garmin Aera 510 Timing Correlation

Garmin Aera 510 data experienced GPS week rollover, which occurs every 1024 weeks, or 7168 days. The accident flight date has been offset by adding 7168 days. The accident flight time was recorded in CDT (local time).

D. OVERLAYS AND TABULAR DATA

Data obtained from the Ag-NAV GUIA Platinum P771 and Garmin Aera 510 were used to produce the following overlays, figures, and tabular data. Figure 3 is a graphical overlay using Google Earth of the entire accident flight. The flight originated at Mt. Vernon Outland Airport (MVN), Mt. Vernon, Illinois. The Ag-NAV recording started approximately 7 minutes 33 seconds after the Garmin recording started.

Figure 4 is a zoomed overlay detailing the end of the recording. The Ag-NAV recording ended approximately 1 minute before the Garmin recording ended. The end of the recording was located near Hayes Road in Oakdale, Illinois. The weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording.

Figure 5 to Figure 7 are plots of parameters recorded on the Ag-NAV GUIA Platinum P771 and Garmin Aera 510. Figure 5 is a plot of the entire accident recording. Figure 6 is a plot of parameters recorded during the last 10 minutes of the flight. Figure 7 is a plot of parameters recorded during the last 2 minutes of the flight.

Figure 5 to Figure 7 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 corresponding tabular data used to create Figure 3 to Figure 7 are provided in electronic comma-separated value (CSV) format as attachment 1 to this report.

Submitted by:

Matthew Yandrick
Electronics Engineer – Recorder Specialist

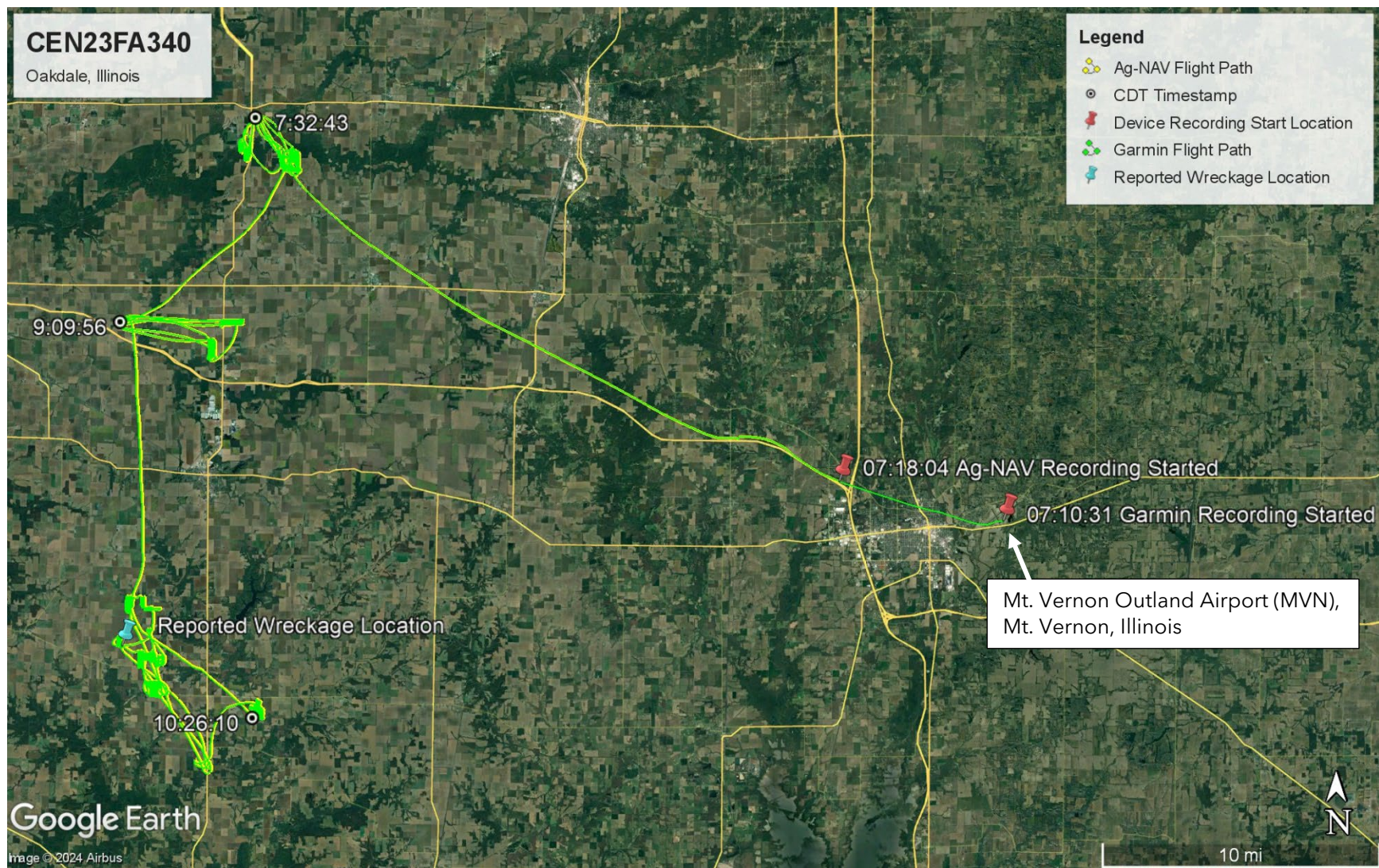


Figure 3. Google Earth overlay showing the entire accident flight.

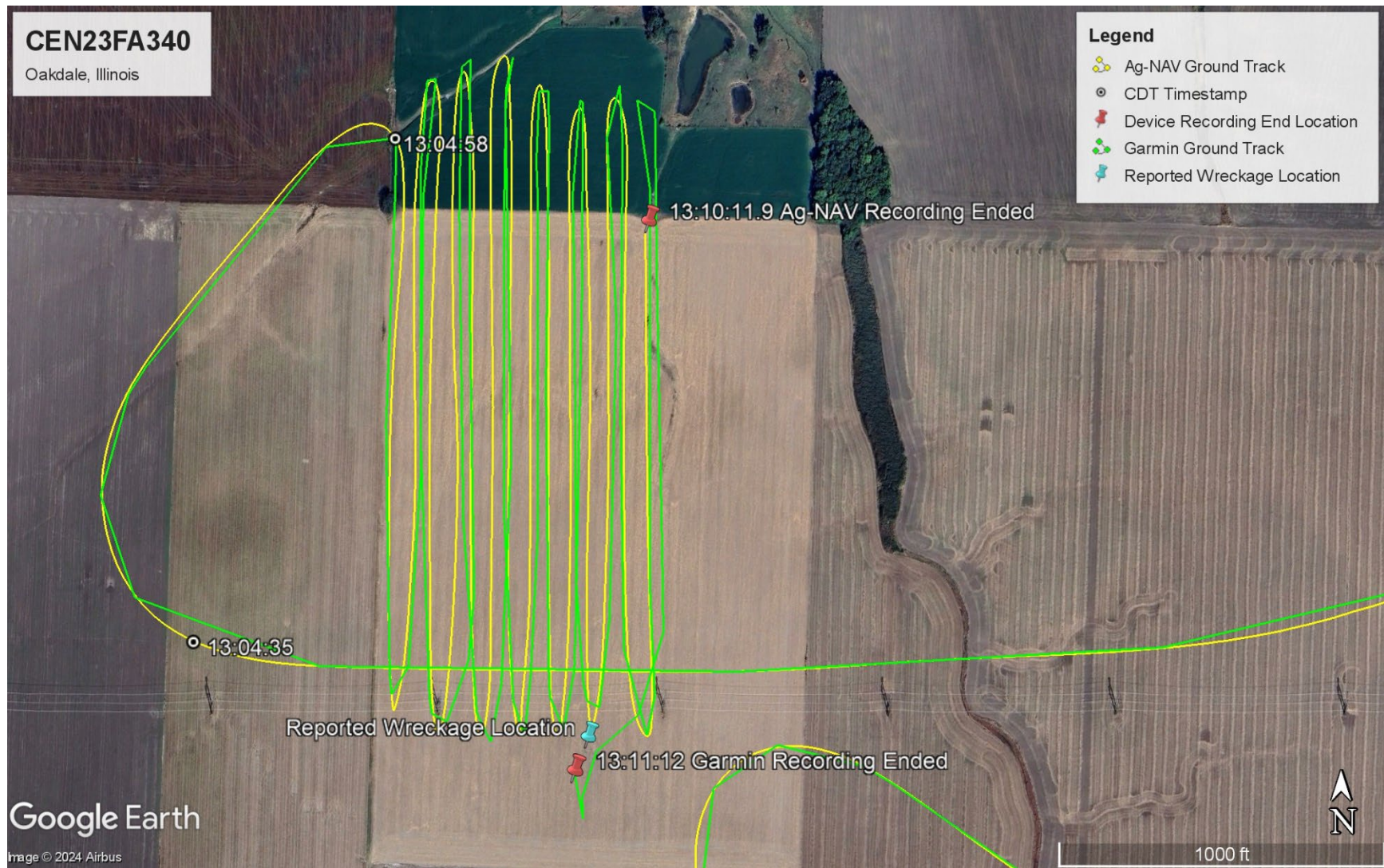


Figure 4. Google Earth overlay showing the accident flight's final recorded segment.

KASH HELICOPTER SERVICES LLC, Bell UH-1H, N567VF

Location, Date: Oakdale, IL, 07/31/23

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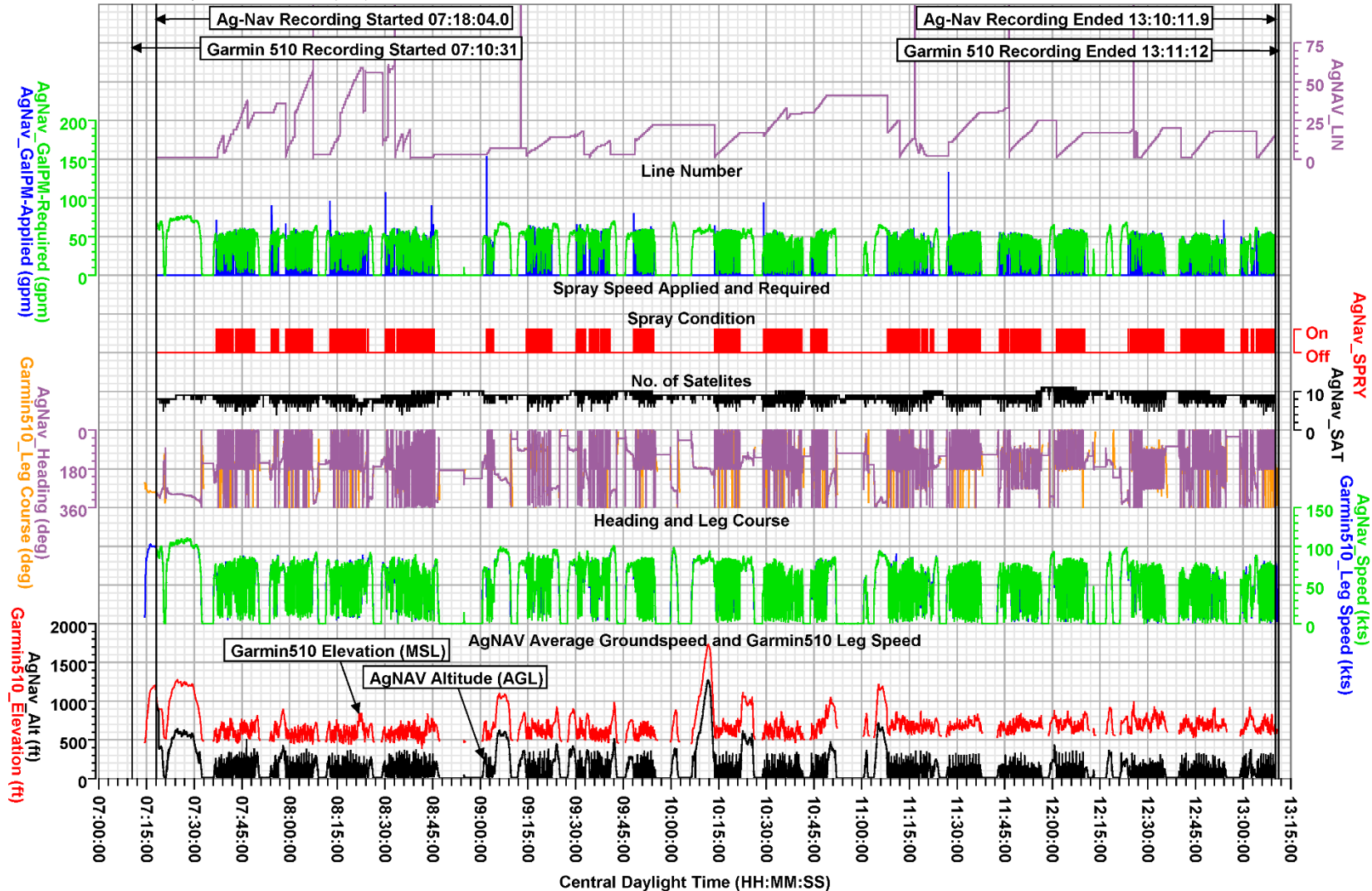


Figure 5. Plot of GPS parameters during the entire accident flight.

KASH HELICOPTER SERVICES LLC, Bell UH-1H, N567VF

Location, Date: Oakdale, IL, 07/31/23

NTSB No. CEN23FA340

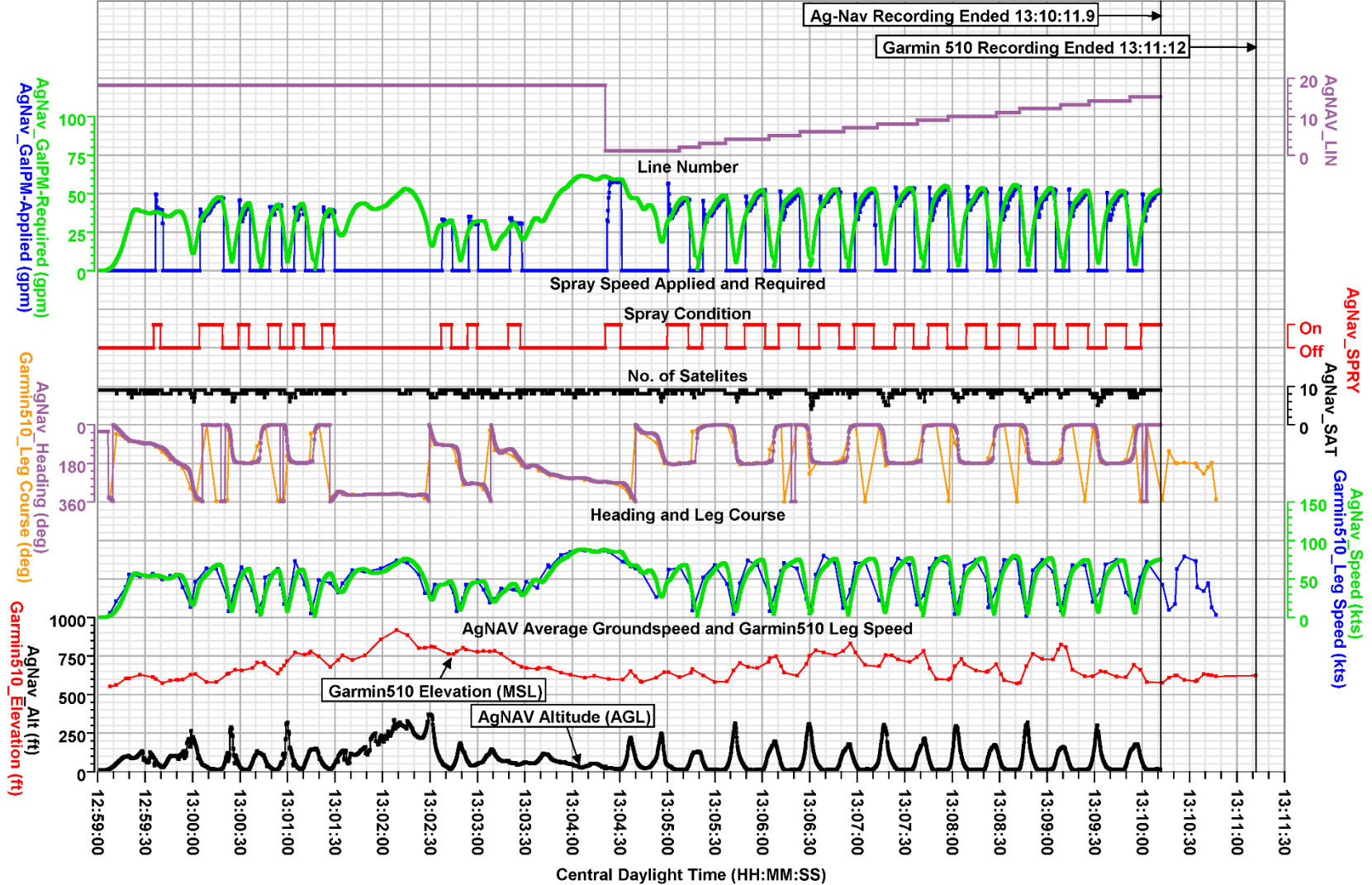


Figure 6. Plot of GPS parameters during the final 10 minutes.

KASH HELICOPTER SERVICES LLC, Bell UH-1H, N567VF

Location, Date: Oakdale, IL, 07/31/23

NTSB No. CEN23FA340

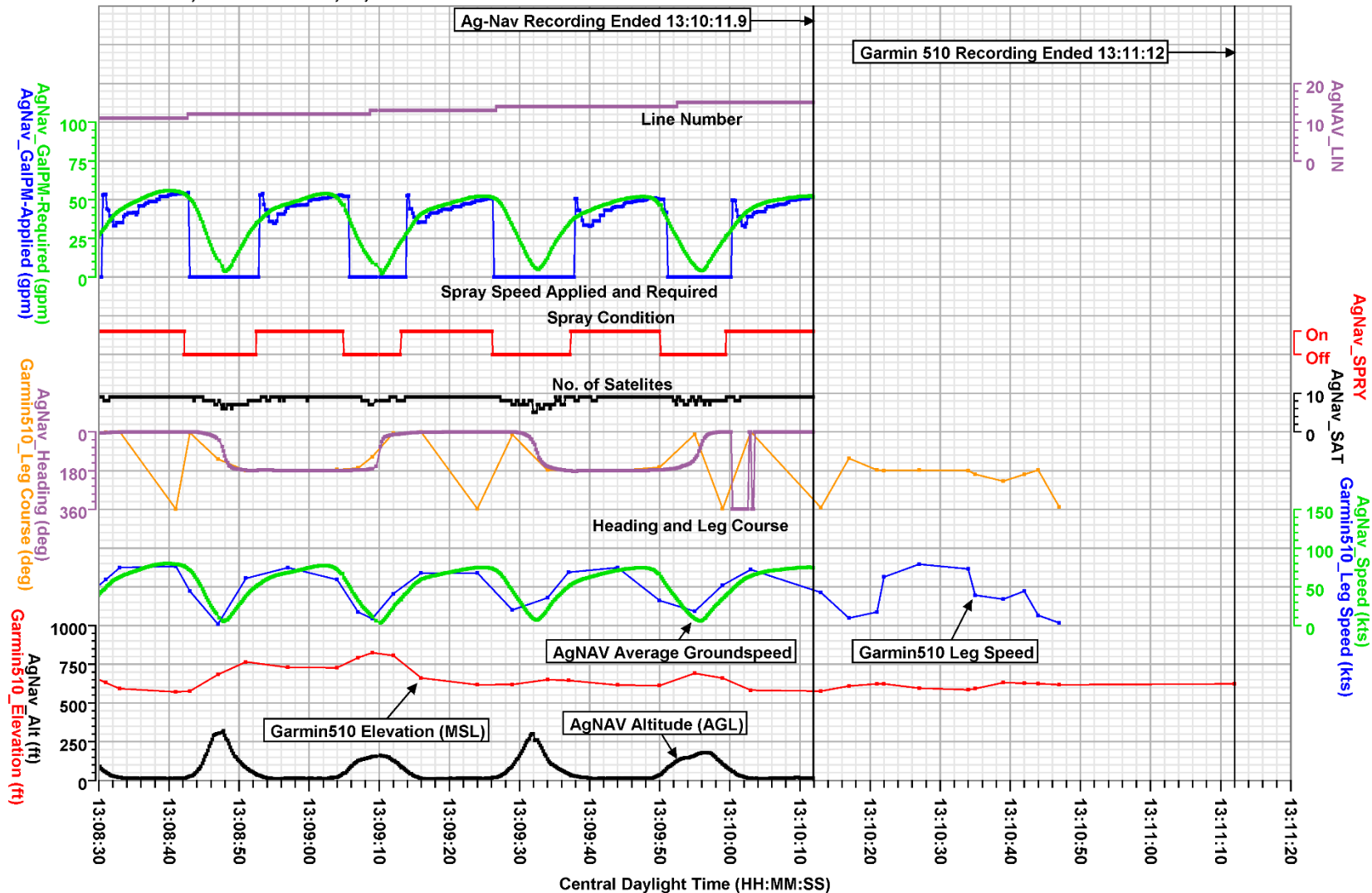


Figure 7. Plot of GPS parameters during the final 2 minutes.

APPENDIX A. VERIFIED AND PROVIDED PARAMETERS FROM AG-NAV GUIA PLATINUM P771 AND GARMIN AERA 510

This appendix describes the parameters provided and verified in this report. Table 1 lists the Ag-NAV GUIA Platinum P771 and Garmin Aera 510 parameters and describes the unit abbreviations used in this report.

Table 1. Verified and provided parameters.

Parameter Name (unit)	Parameter Description (unit)	Source
Time (HH:MM:SS)	GPS Time for Recorded Data Point (hours:minutes:seconds)	Ag-NAV, Garmin
AgNAV_LAT (deg)	Latitude (degrees)	Ag-NAV
AgNAV_LON (deg)	Longitude (degrees)	Ag-NAV
AgNAV_ALT (ft)	GPS Altitude Above Ground Level (feet)	Ag-NAV
AgNAV_SAT	Number of Satellites Used	Ag-NAV
AgNAV_SPRY	Spray Condition (0=OFF, 1=ON)	Ag-NAV
AgNAV_LIN	Line Number in the Pre-Programming Task Currently Being Flown	Ag-NAV
AgNAV_SPkts (kts)	Derived Average Groundspeed (knots)	Ag-NAV
AgNAV_HEAD (deg)	Average Derived Ground Track/Heading (degrees, true)	Ag-NAV
AgNAV_GalPMA (gpm)	Applied Spray Speed (gallons per minute)	Ag-NAV
AgNAV_GalPMR (gpm)	Required Spray Speed (gallons per minute)	Ag-NAV
Garmin510_LAT (deg)	Latitude (degrees)	Garmin
Garmin510_LON (deg)	Longitude (degrees)	Garmin
Garmin510_Elevation (ft)	Geometric Height Above Mean Sea Level (feet)	Garmin
Garmin510_Leg Speed (kts)	Leg Speed (knots)	Garmin
Garmin510_Leg Course (deg)	Leg Course (degrees, true)	Garmin