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

June 3, 2021

Global Positioning System (GPS) Device

Specialist's Factual Report
By Sean Payne

1. EVENT SUMMARY

Location:	Palmer, AK
Date:	March 27, 2021
Aircraft:	Airbus Helicopter AS-350 B3
Registration:	N351SH
Operator:	Soloy Helicopters LLC
NTSB Number:	WPR21FA143

2. GROUP

A group was not convened.

3. DETAILS OF INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following global positioning system (GPS) device:

Device Manufacturer/Model:	Garmin Aera 660
Serial Number:	Unknown

3.1. Device Description

The Garmin Aera 660 is a portable touch-screen mapping device that can display the aircraft's position on taxi diagrams, IFR, and VFR charts on a 5-inch color display. The unit's database includes obstacle and terrain features.

3.2. Data Recovery

The device was undamaged and is shown in figure 1. The device was connected to a PC running the manufacturer's suggested software and was downloaded normally.

Figure 1. Photo of undamaged Garmin Aera 660 GPS.

3.3. Data Description

The data extracted included approximately 10,000 tracklog points from March 3, 2021 through March 29, 2021.[1, 2] Data relevant to the accident investigation was recorded starting 14:37:46 AKDT and ending 18:36:42 AKDT on March 27, 2021. These data described 4 separate power cycles of the device and were associated with four different flights which occurred on the date of the accident.

According to the manual for the Garmin aera GPS 660, the track log recording starts as soon as the aera 660 gets a location fix. Therefore, the beginning of each tracklog may not accurately indicate the time in which the helicopter was started, or when the device was turned on.

3.4. 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.

[1] All dates and times are referenced to Alaska daylight time (AKDT).
[2] Some data was recorded after the accident date. These data were likely the result of the device being powered on accidently during the handing of the device post-accident.

Table 1. GPS Data Parameters

Parameter Name	Parameter Description
Date	Date for recorded data point (MM/DD/YYYY)
Time	Time (AKDT) for recorded data point (HH:MM:SS)
Latitude	Recorded Latitude (degrees)
Longitude	Recorded Longitude (degrees)
GPS Alt	Recorded GPS Altitude (feet)
Groundspeed	Average derived groundspeed (knots)
Track	Average derived true course (degrees)

3.5. OVERLAYS AND TABULAR DATA

All times are given in AKDT. The weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording.

Figure 2 is a graphical overlay generated using Google Earth for the entire accident flight. The accident flight consisted of four separate GPS recordings. These four separate recordings are depicted as separate colors. The first track is depicted in pink, the second track is depicted in green, the third track is depicted in yellow, and the final accident track is depicted in red.

Figure 3 is a depiction of the GPS track showing the helicopter's departure from Wasilla Airport, Wasilla, Alaska (PAWS) and the helicopter's arrival at a private residence. The session began at 14:37:46 and ended at 14:52:10. The helicopter subsequently departed the private residence which is also depicted on the second leg. Data for the second leg began at 15:51:26.

Figure 4 is a depiction of the GPS track for the aircraft's arrival and departure at the private residence. The end time for the arrival leg (14:52:10) and the start time for the departure leg are depicted (15:51:26).

Figure 5 is a depiction of the GPS track for the helicopter's second leg from the private residence to various mountainous areas. The end time of the second leg is shown (17:43:39).

Figure 6 is a depiction of the GPS tracks for the helicopter's maneuvers in the vicinity of a mountainous area along leg two. The data suggested that the helicopter made multiple touchdowns in this area.

Figure 7 is a slanted view of the helicopter's GPS tracks in the vicinity of a mountainous area along leg two. The slanted view highlights the terrain in this region.

Figure 8 is a depiction of the GPS track for the helicopter's arrival from leg two to a second mountainous area. Subsequent tracks have been removed for clarity. Data ended in this region at 17:43:39.

Figure 9 is a depiction of the GPS track showing the helicopter's tracks in the vicinity of the second mountainous area. A third leg is shown in yellow. Data for the third leg began at 17:56:15 and ended at 18:07:46. Subsequent tracks have been removed for clarity.

Figure 10 is a depiction of the GPS track for the helicopter's departure on the 4th and final (accident) leg. The accident leg is shown in red. Data recording for this leg began at 18:24:42.

Figure 11 is an overview of the helicopter's GPS tracks for the accident leg (shown in red). The start and end time of the data is presented. The final resting place of the wreckage is depicted as a yellow pin.

Figure 12 is a depiction of the GPS track for the helicopter during the accident leg of the flight. Key times are depicted. As the helicopter approached the ridgeline, it made a counterclockwise circle at 18:32:23. The aircraft then approached along the ridgeline to the northeast. At 18:33:38, the helicopter made another counterclockwise circle and approached the top of the ridgeline by 18:35:46. For a further description, refer to the next figures. The final resting place of the wreckage is depicted as a yellow pin.

Figure 13 is a slanted view of the final tracklog points for the accident leg. Previous portions of the accident leg have been removed for clarity. The helicopter approached the ridgeline from the counterclockwise circle described in figure 11 at 18:34:16. Recorded GPS data then showed nearly stationary points between 18:34:35 and approximately 18:35:09. By 18:35:09, the helicopter had begun a clockwise circle from the stationary area of data. Data points between 18:35:26 and 18:35:36 show the helicopter approaching the top of the ridgeline. After 18:35:36, GPS data shows the helicopter in extremely close proximity to the ridgeline. The final points of data show the helicopter taking a southern track toward the final wreckage site. These final points potentially contain invalid GPS altitude and position data. The final resting place of the wreckage is depicted as a yellow pin.

Figure 14 is a top-down view of the final tracklog points for the accident leg. Previous portions of the accident leg have been removed for clarity. The final resting place of the wreckage is depicted as a yellow pin.

Figure 15 is an askew figure depicting the final portion of the accident flight. The helicopter is in close proximity to the ridgeline starting around 18:35:36. By 18:36:08, the helicopter's tracks had begun moving away from the ridgeline. A total of 32 seconds had passed between these two GPS positions. The GPS tracks then showed a path of varying altitude away from the ridgeline. In situations involving impact, or abrupt movement of a GPS device, subsequent tracks have been known to contain error. Some GPS systems record this error. This GPS system did not contain a parameter recording GPS accuracy conditions. The final resting place of the wreckage is depicted as a yellow pin.

Figure 16 is a plot of tabular data from the GPS for the entire recorded GPS session from the accident leg. The recorded GPS altitude, the derived groundtrack and derived groundspeed are depicted. The helicopter's likely time of impact is depicted as 18:35:44.5 AKDT. An area of potentially invalid data is highlighted between 18:36:08 AKDT and 18:36:42 AKDT.

Figure 17 is a plot of tabular data from the GPS for the end of the accident leg. The helicopter's likely time of impact is depicted as 18:35:44.5 AKDT. An area of potentially invalid data is highlighted between 18:36:08 AKDT and 18:36:42 AKDT.

Tabular data used to generate figures 2 through 17 are included as Attachment 1. This attachment is provided in electronic comma-delimited (.CSV) format.

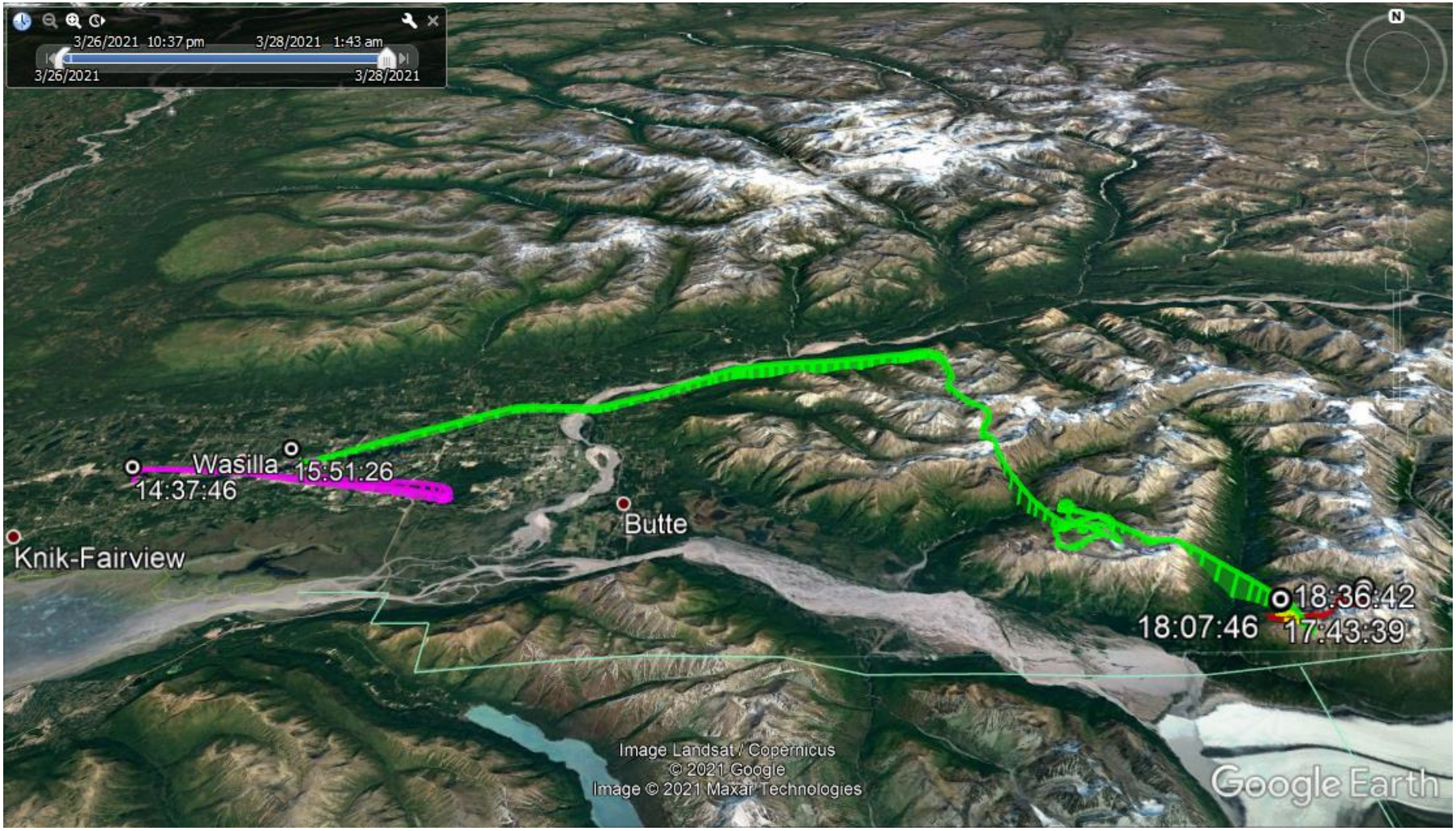

Figure 2. A depiction of the GPS tracks for the entire set of data relevant to the accident. Four separate GPS recording sessions are depicted in four different colors.

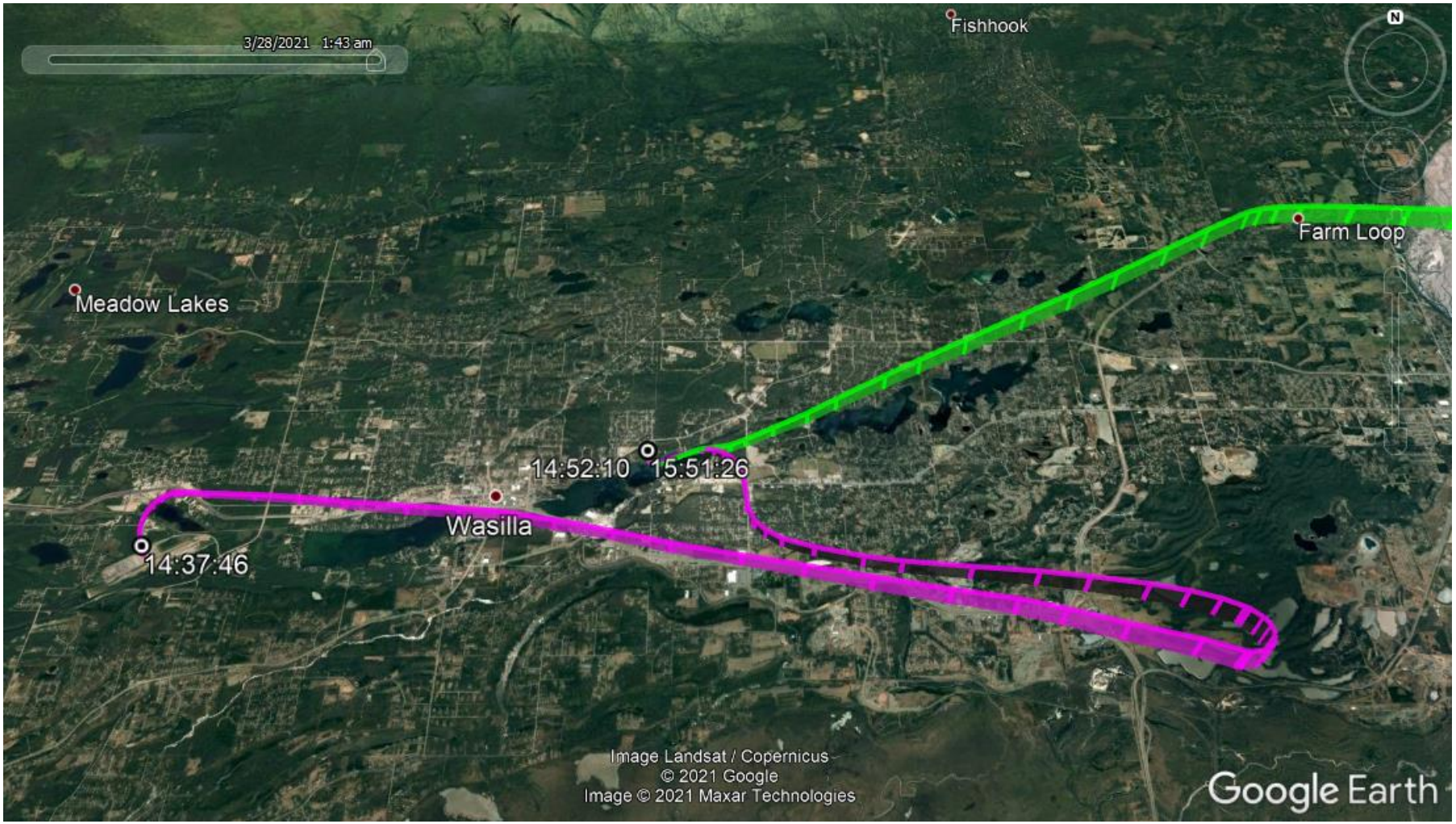

Figure 3. A depiction of the GPS showing the helicopter's departure from Wasilla Airport (PAWS) and the helicopter's arrival at a private residence. The helicopter subsequently departed the private residence which is depicted. Start and end times of each leg is depicted.

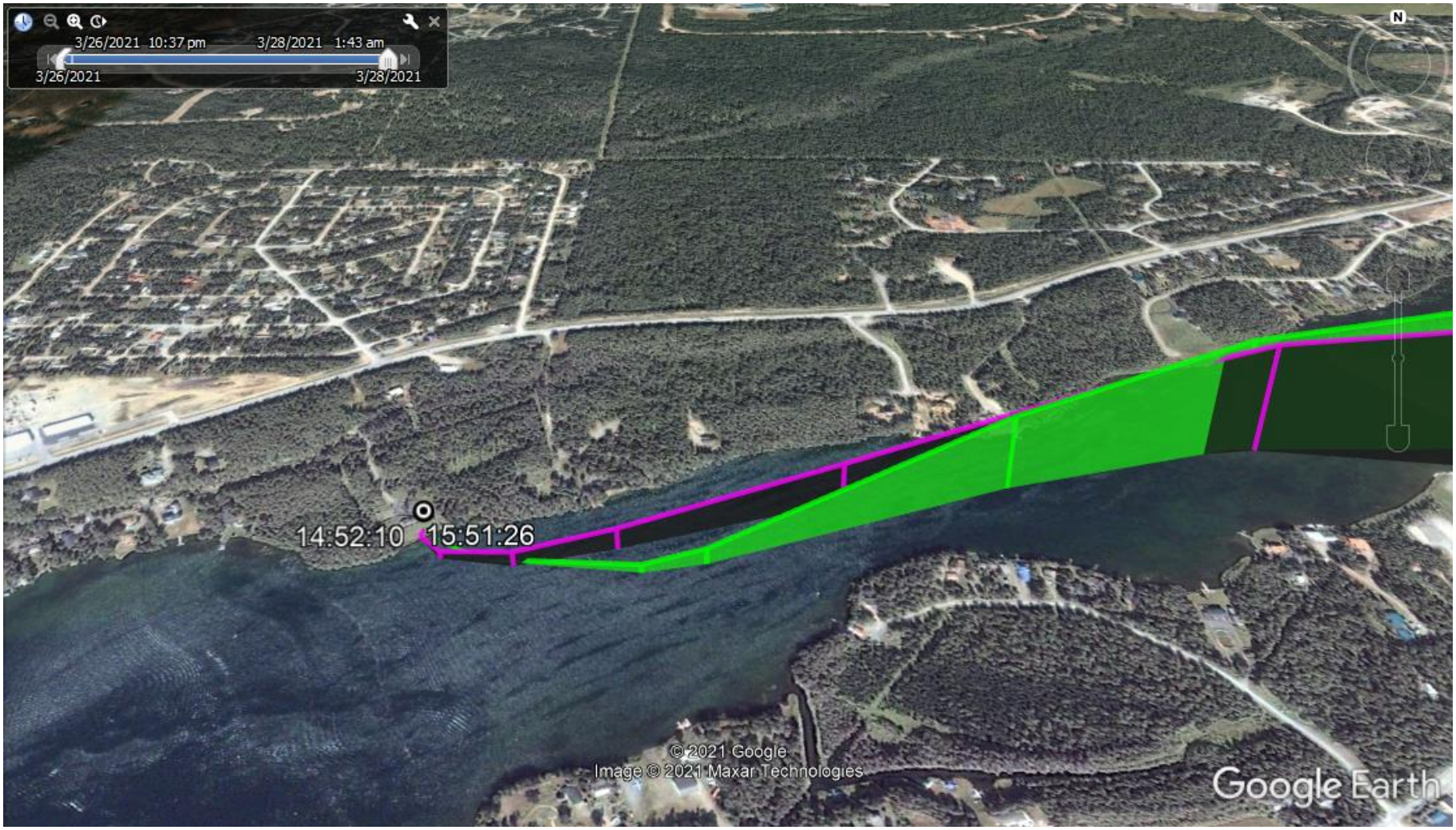

Figure 4. A depiction of the GPS tracks for the aircraft's arrival and departure at the private residence. The end time for the arrival leg and the start time for the departure leg is depicted.

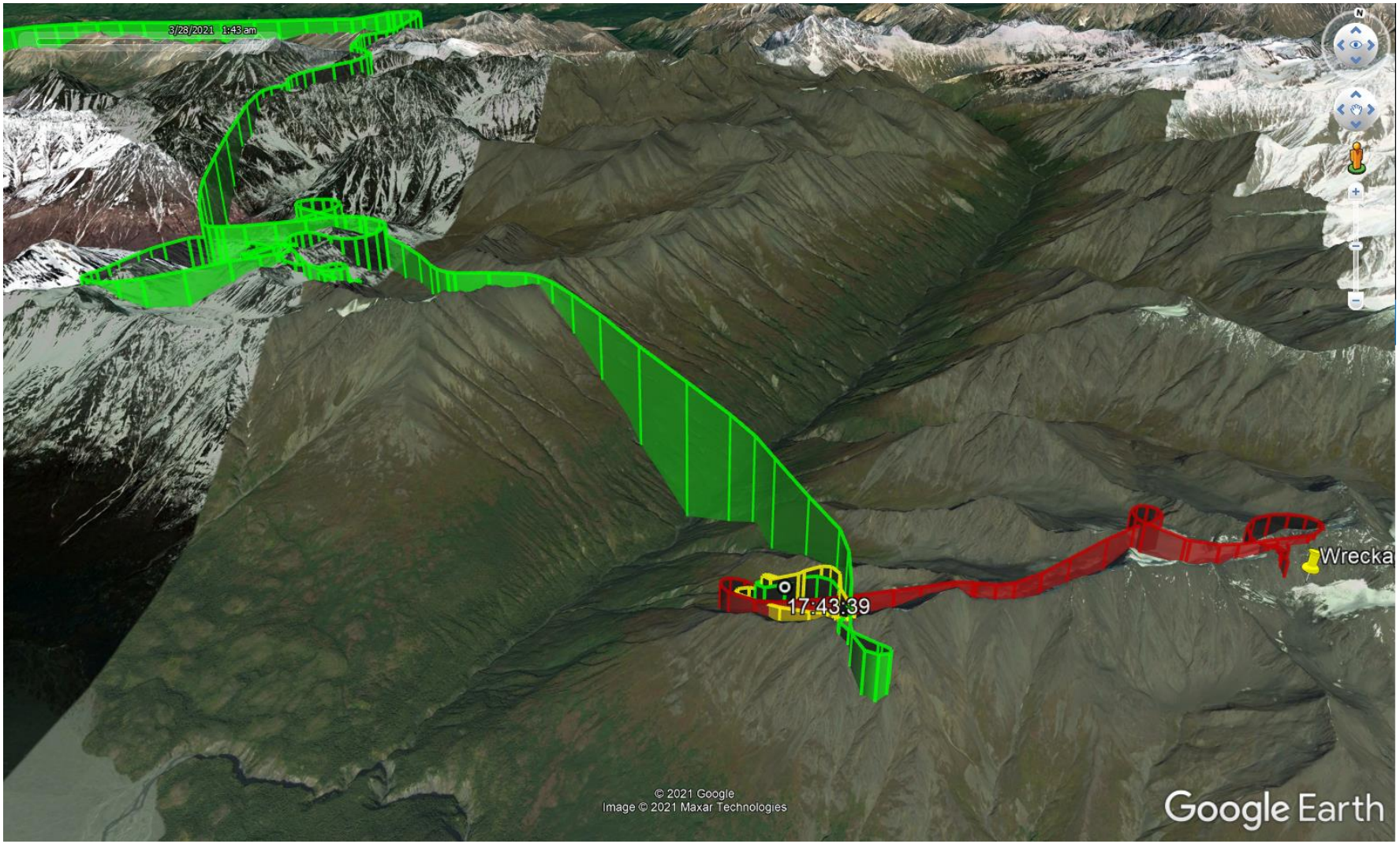

Figure 5. A depiction of the GPS tracks for the helicopter's second leg (green track) from the private residence to various mountainous areas. The end time of the second leg is shown (17:43:39).

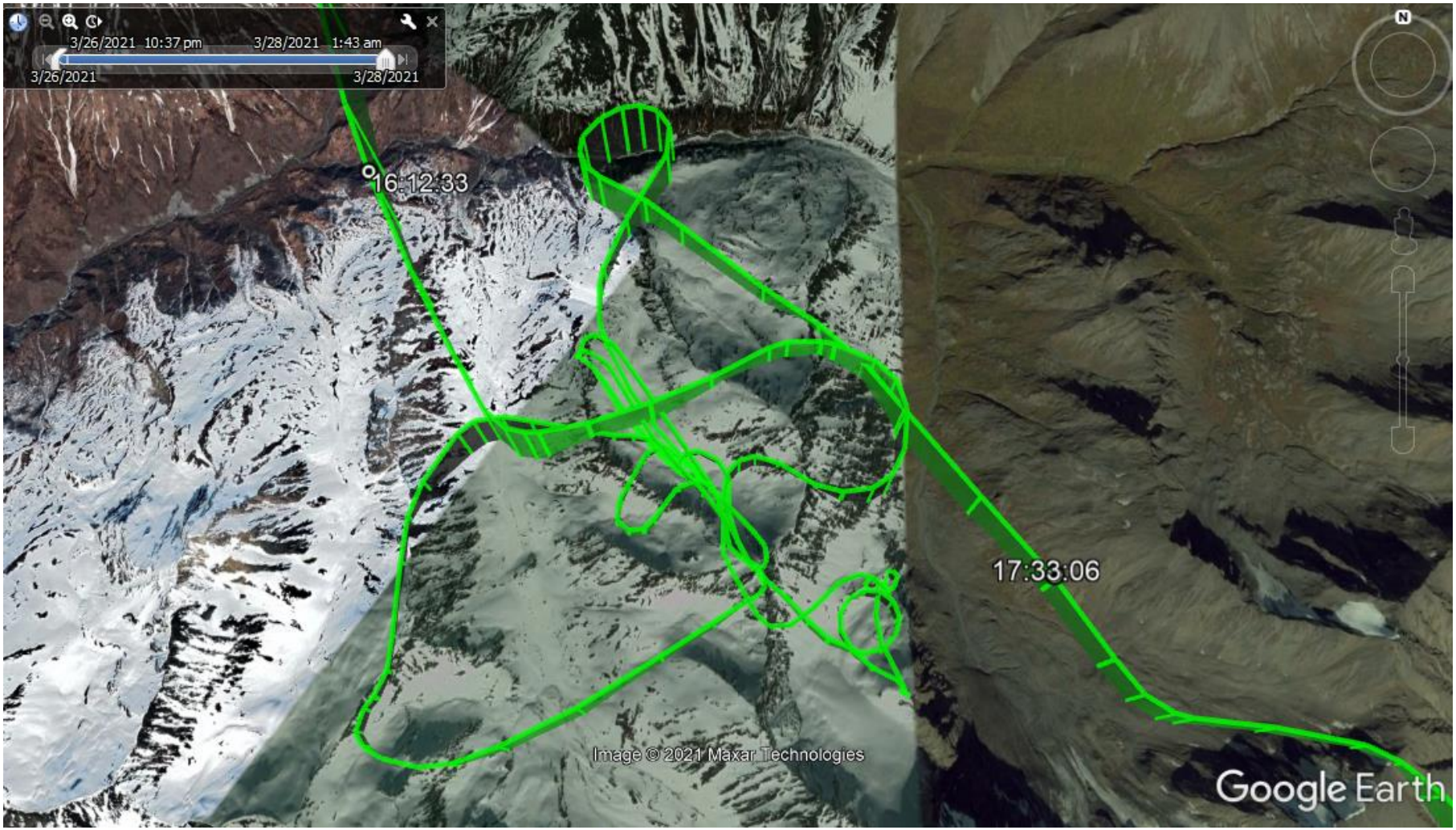

Figure 6. A depiction of the GPS tracks for the helicopter's maneuvers in the vicinity of a mountainous area along leg two. The data suggested that the helicopter made multiple touchdowns in this area.

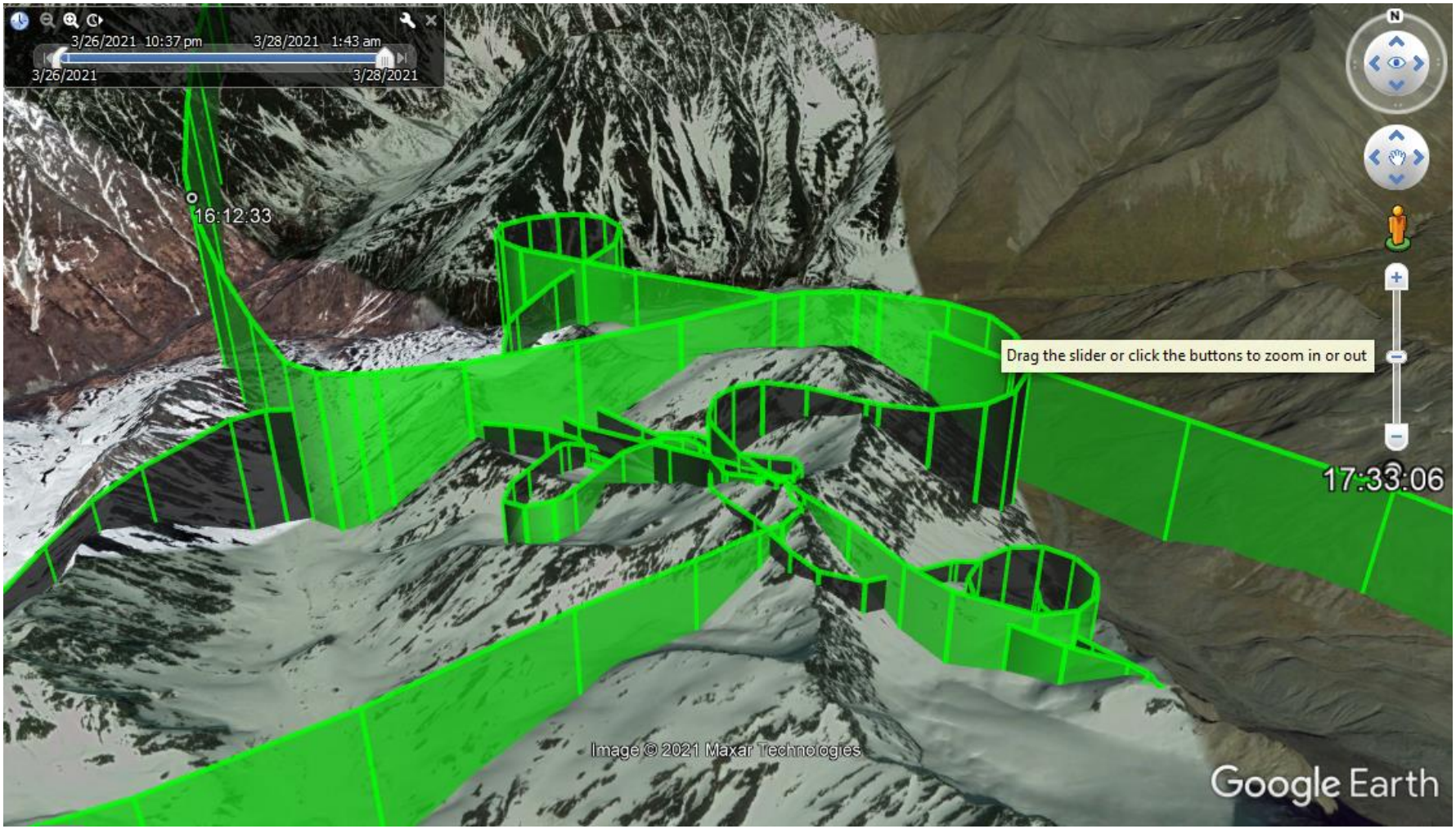

Figure 7. A slanted view of the helicopter's GPS tracks in the vicinity of a mountainous area along leg two. The slanted view highlights the terrain in this region.

Figure 8. A depiction of the GPS tracks for the helicopter's arrival from leg two to a second mountainous area. Subsequent tracks have been removed for clarity. Data ended for this recorded session at 17:43:39.

Figure 9. A depiction of the GPS tracks showing the helicopters tracks in the vicinity of the second mountainous area. A third leg is shown in yellow. Data began at 17:56:15 and ended at 18:07:46. Subsequent tracks have been removed for clarity.

Figure 10. A depiction of the GPS tracks for the helicopter's departure on the 4th and final (accident) leg. The accident leg is shown in red. Data recording for this leg began at 18:24:42.

Figure 11. A overview of the helicopter's GPS tracks for the accident leg (shown in red). The start and end time of the data is shown. The final resting place of the wreckage is depicted as a yellow pin.

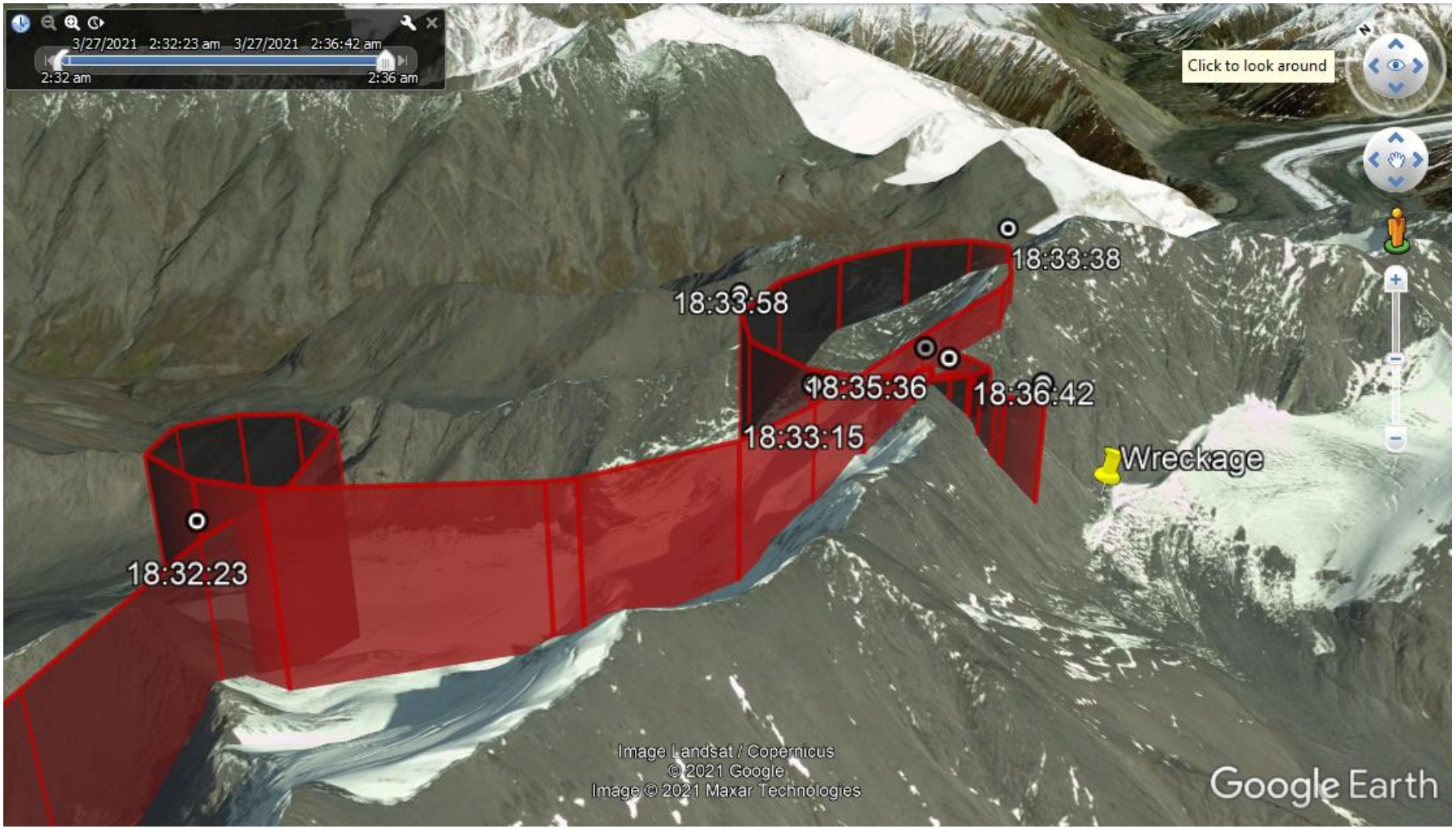

Figure 12. A depiction of the GPS tracks for the helicopter during the accident leg of the flight. Key times are depicted. The final resting place of the wreckage is depicted as a yellow pin.

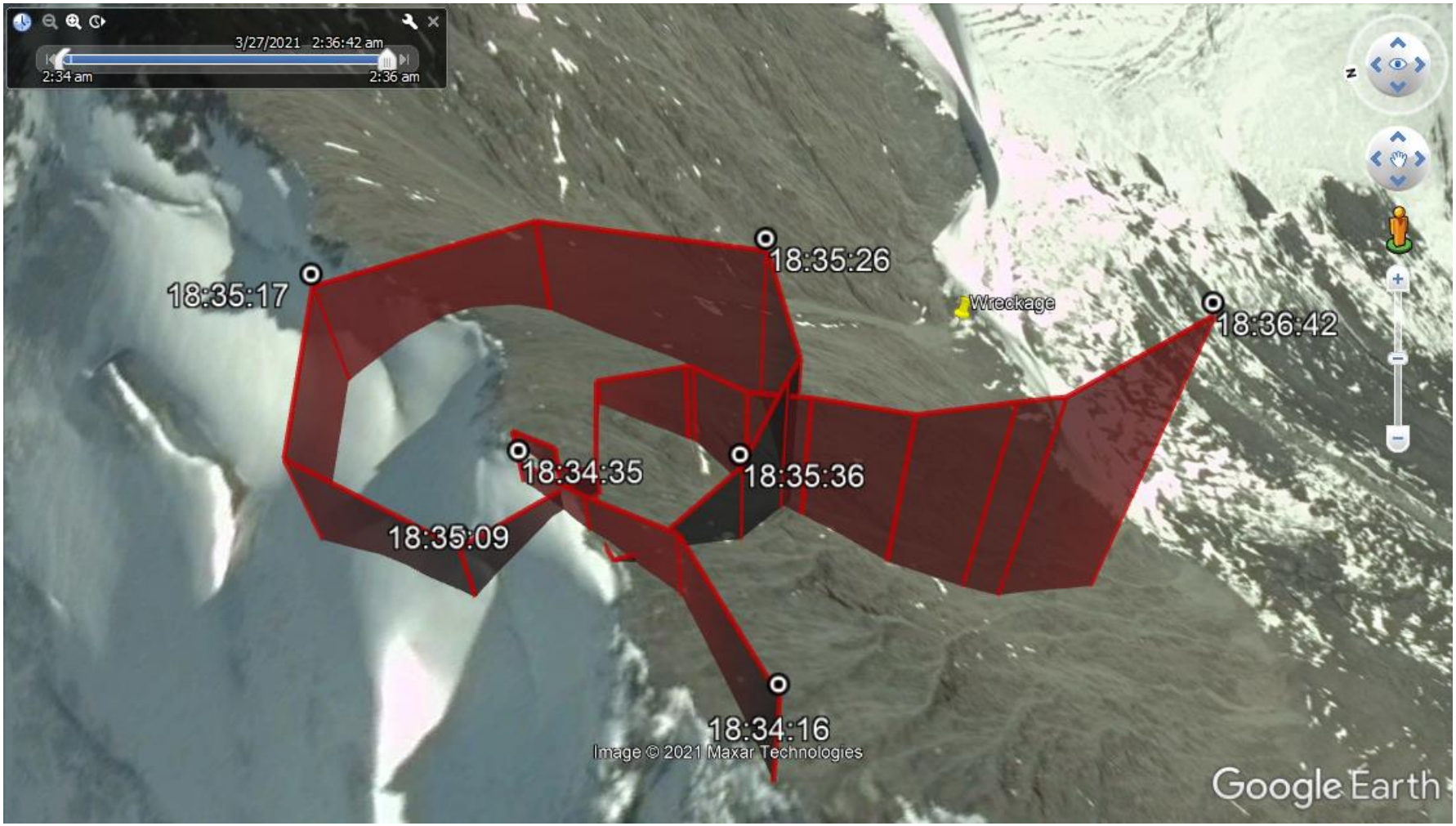

Figure 13. An askew view of the final tracklog points for the accident leg. Previous portions of the accident leg have been removed for clarity. The final resting place of the wreckage is depicted as a yellow pin.

Figure 14. A top down view of the final tracklog points for the accident leg. Previous portions of the accident leg have been removed for clarity. The final resting place of the wreckage is depicted as a yellow pin.

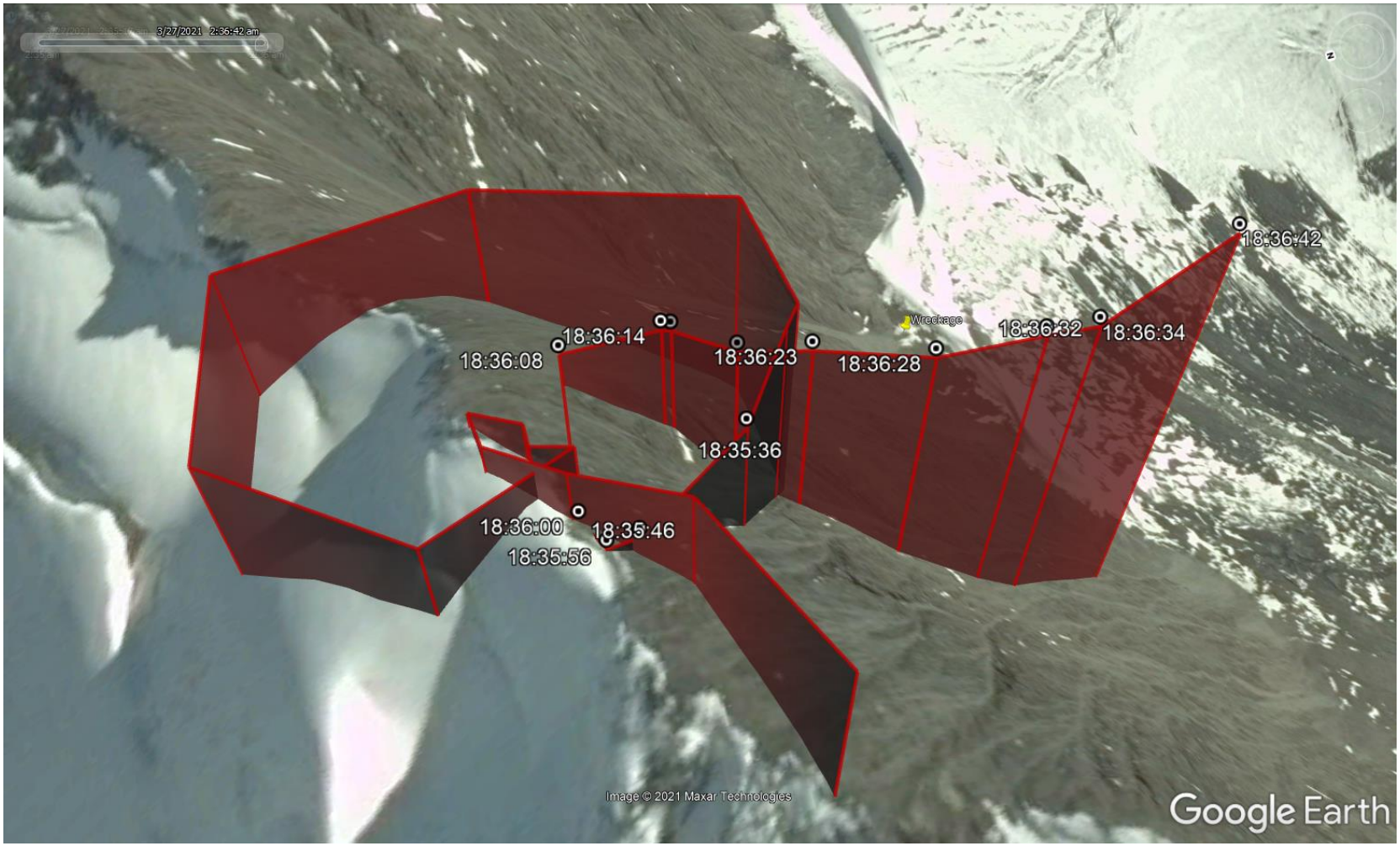

Figure 15. An askew figure depicting the final portion of the accident flight. Previous portions of the accident leg have been removed for clarity. The helicopter was in close proximity to the ridgeline starting around 18:35:36. By 18:36:08, the helicopter's tracks had begun moving away from the ridgeline. The final resting place of the wreckage is depicted as a yellow pin.

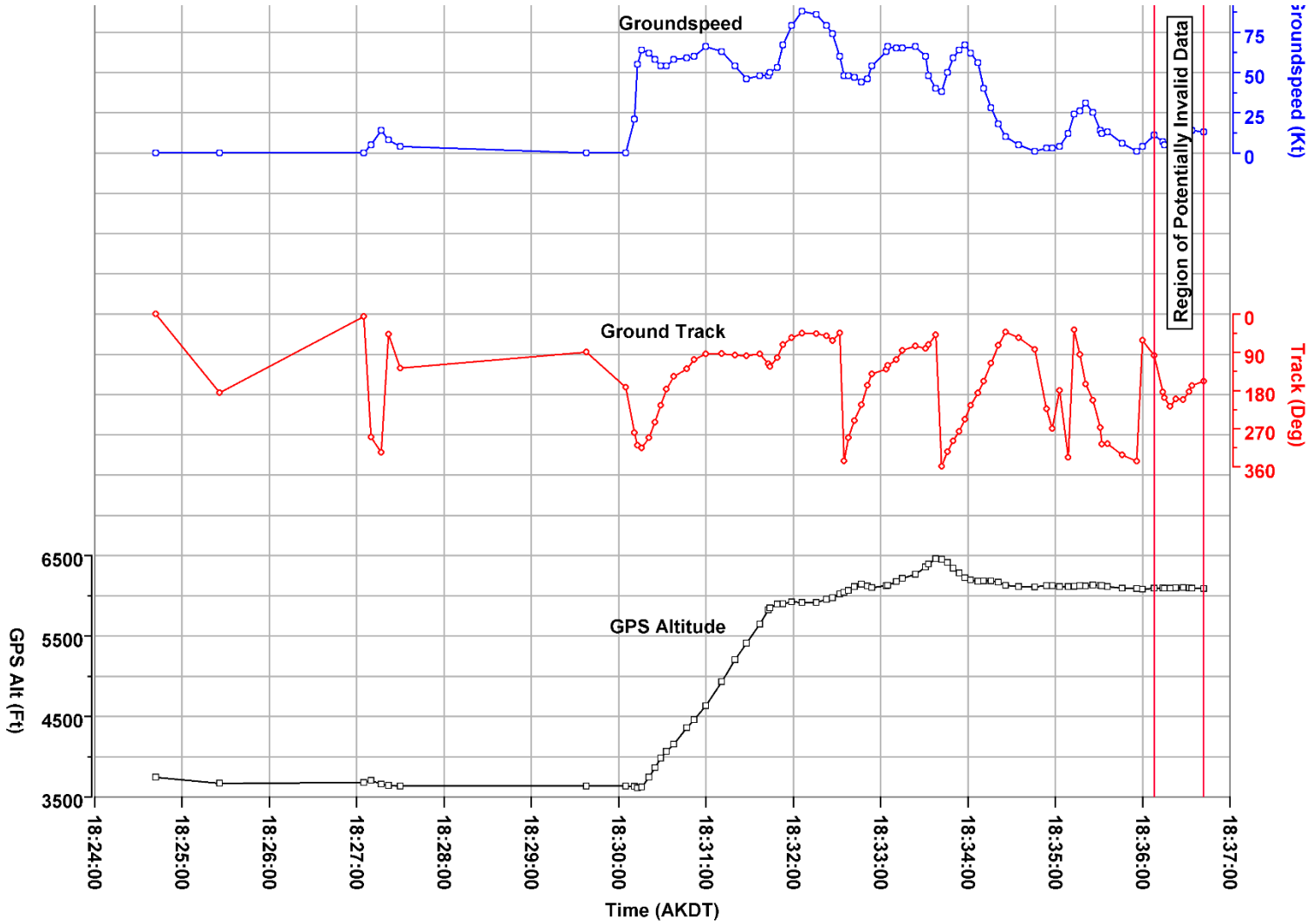

Figure 16. A plot of tabular data from the GPS for the entire final accident leg. The helicopter was in close proximity to the ridgeline starting around 18:35:36. An area of potentially invalid data is highlighted between 18:36:08 AKDT and 18:36:42 AKDT.

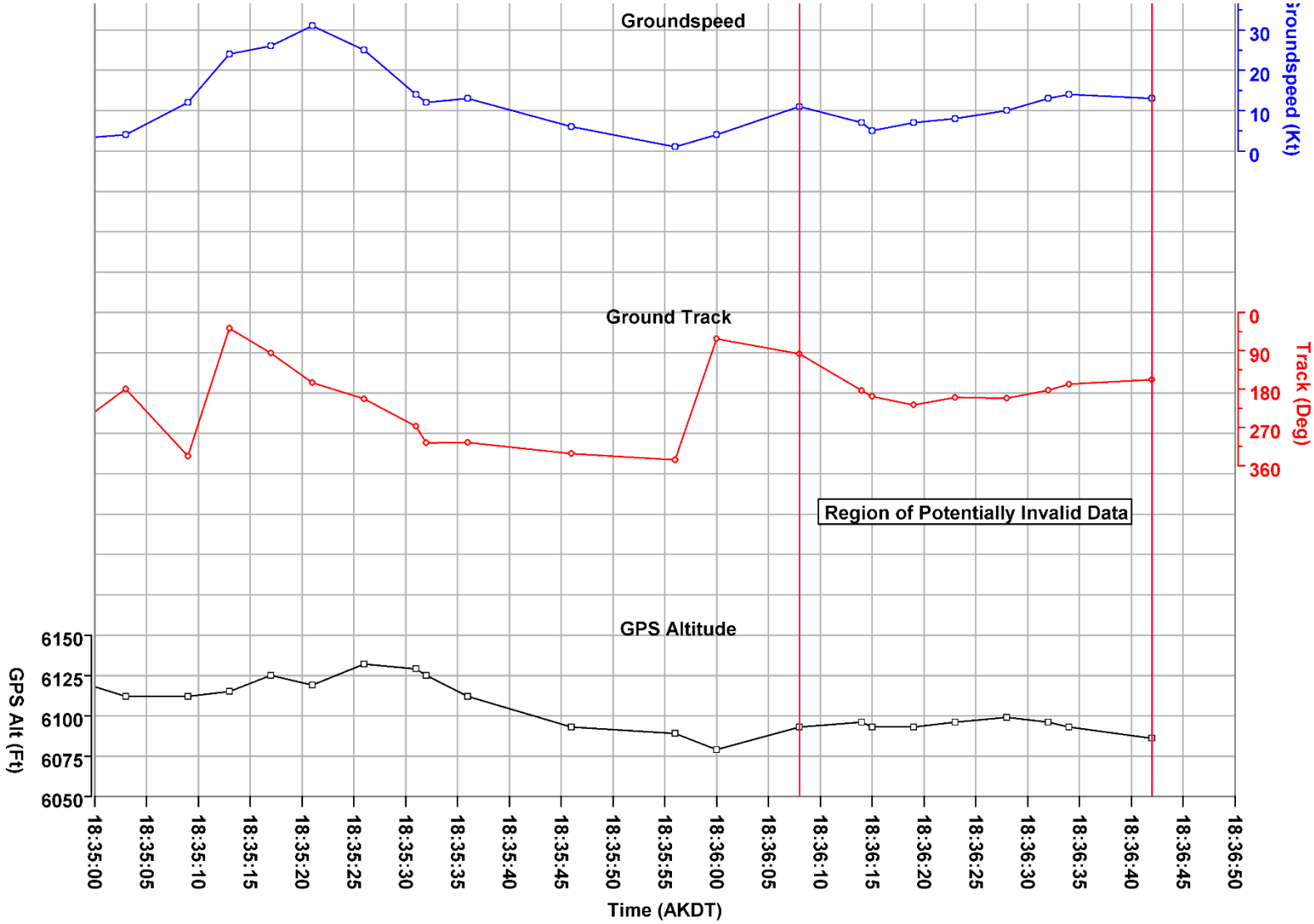

Figure 17. A plot of tabular data from the GPS for the end of the final accident leg. The helicopter was in close proximity to the ridgeline starting around 18:35:36. An area of potentially invalid data is highlighted between 18:36:08 AKDT and 18:36:42 AKDT.