

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division

Washington, D.C. 20594

October 31, 2013

GPS Factual Report

**Specialist's Factual Report
by Bill Tuccio, Ph.D.**

A. EVENT

Location: Boulder, Utah
Date: January 19, 2013
Aircraft: Cessna 140
Registration: N2341N
Operator: Private
NTSB Number: WPR13FA095

B. GROUP - No Group

C. SUMMARY

On January 19, 2013, about 1501 mountain standard time, a Cessna 140, N2341N, sustained substantial damage when it struck power lines while maneuvering near Boulder, Utah. The airplane was registered and operated by the pilot under the provisions of Title 14 *Code of Federal Regulations* Part 91. The certificated commercial pilot and passenger were fatally injured. Visual meteorological conditions prevailed and no flight plan was filed for the personal flight. The local flight departed from Escalante Municipal Airport (1L7) Escalante, Utah at an undetermined time.

D. DETAILS OF INVESTIGATION

The NTSB Vehicle Recorder Laboratory received the following device:

GPS Manufacturer/Model:	Lowrance AIRMAP 1000
Serial Number:	11724472

Lowrance AIRMAP 1000 Description

The Lowrance AIRMAP 1000 is a WASS¹-capable, battery operated hand-portable 12-channel mapping GPS unit equipped with a 320 x 320 pixel 16-level grayscale LCD display, soft key controls, and support for custom maps. The unit has the capability of performing E-6B² calculations. It contains a slot for a multi-media card (MMC) or Secure Digital (SD) FLASH³ memory card. This card may be used to transfer and store custom map, waypoint⁴, route⁵, and trail⁶ data to and from a desktop PC to the GPS unit. A serial interface using NMEA 0183⁷ communication protocols is mounted in the back of the GPS unit, but the internal operating software does not support the download of saved data via this serial port.

The Lowrance AIRMAP 1000 can store up to 100 routes composed of up to 100 waypoints each. The unit can also store trail data composed of up to 10,000 latitude-longitude points per trail. Up to 100 individual trails may be named and saved by the user. Once the limit has been reached for recording continuously updated trail data trail, older latitude/longitude points are overwritten with new data on a first-in, first-out basis. The AIRMAP 1000 may be programmed to update trail data in one of three ways: automatically, by time, or by distance traveled. The default 'automatic' mode only updates trail data when the GPS unit senses that position has changed by at least 0.1 miles, or that direction has changed by 2° or more. Updating by time may be set to record a new latitude / longitude point every 1 to 9,999 seconds. Updating by distance may be set to record a new latitude/longitude point whenever the distance traveled from the last update exceed anywhere from 0.01 miles to 9.99 miles. All recorded data is stored internally in non-volatile memory⁸, and may be copied to a MMC or SD card inserted in a card slot in the battery compartment. The data is stored in a Lowrance proprietary *.usr file format. This card may be read using a standard desktop PC running the Microsoft Windows operating system.

¹ Wide Area Augmentation System. WAAS is based on a network of approximately 25 ground reference stations that covers a very large service area. Signals from GPS satellites are received by wide area ground reference stations (WRSs). Each of these precisely surveyed reference stations receive GPS signals and determine if any errors exist. Each WRS in the network relays the data to the wide area master station (WMS) where correction information is computed. The WMS calculates correction algorithms and assesses the integrity of the system. A correction message is prepared and uplinked to a geosynchronous satellite via a ground uplink system (GUS). The message is then broadcast from the satellite on the same frequency as GPS (L1, 1575.42MHz) to receivers on board aircraft (or hand-held receivers) which are within the broadcast coverage area of the WAAS. WAAS-capable receivers are capable of basic GPS accuracy to approximately 7 meters vertically and horizontally.

² E-6B is refers to mechanical and electronic tools assisting common flight related computations.

³ FLASH Memory is a form of re-writeable, non-volatile memory that can retain data without external power - provided that the chip is not heated beyond the data retention temperature limit as stated in the datasheet

⁴ Geographical point specified by a set of latitude and longitude data along with descriptive information.

⁵ An ordered list of waypoints.

⁶ Linked list of latitude and longitude data representing the position of the aircraft as a function of time.

⁷ NMEA, National Marine Electronics Association. NMEA Standard 0183 is an ASCII-based serial communication protocol.

⁸ Non-volatile memory is semiconductor memory that does not require external power for data retention.

GPS Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed that the unit had sustained minor damage, as shown in figure 1. Power was applied to the accident unit and it started normally. Data was downloaded normally, without difficulty.

Figure 1. Front of Lowrance AIRMAP 1000.



GPS Data Description

The downloaded data contained 2,000 datapoints; each point consisting only of latitude and longitude, without time or altitude information. The recorded points were overlaid on Google Earth. While the tracks were in the vicinity of the accident, none of the tracks were consistent with the known accident location.