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

March 13, 2013

# GPS Device Factual Report

**Specialist's Factual Report**
**by Bill Tuccio**

## A. EVENT

| | |
|---|---|
| Location: | Dover, Delaware |
| Date: | January 13, 2013 |
| Aircraft: | Piper PA-28R-200 |
| Registration: | N4975S |
| Operator: | Private |
| NTSB Number: | ERA13LA111 |

## B. GROUP - No Group

## C. SUMMARY

On January 13, 2013, at about 1842 eastern standard time, a Piper PA-28R-200, N4975S, was substantially damaged during a forced landing following multiple attempts to land at several airports in the vicinity of Dover, Delaware. The private pilot was fatally injured and was the sole occupant of the airplane. Night instrument meteorological conditions prevailed and an instrument flight rules flight plan was filed. The personal flight was conducted under the provisions of 14 *Code of Federal Regulations* Part 91 and originated from the Kaolin Field Airport (OKZ), Sandersville, Georgia.

## D. DETAILS OF INVESTIGATION

The NTSB Vehicle Recorder Laboratory received the following device:

| | |
|---|---|
| GPS Manufacturer/Model: | Garmin aera 796 |
| Serial Number: | 2CY003159 |

### Garmin aera 796 Device Description

The Garmin aera 796 is a battery-powered, portable, multi-function display and GPS receiver with a 7-inch diagonal, high resolution, LCD touch screen display. The unit includes a built-in Jeppesen database and is capable of receiving XM satellite radio

for flight information including NEXRAD Radar, lightning, METARs, TAFs, 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 is capable of storing and displaying 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 for up to 50 flights. A detailed track log – including latitude, longitude, date, time, and GPS altitude information for an unspecified number of points – is stored within the unit whenever the receiver has a lock on the GPS navigation signal. Position is updated within the track log as a function of time or distance moved, depending on how the unit has been configured. Once the current track log memory becomes full, new information either overwrites the oldest information or recording stops, depending on how the unit is configured. The current track log can be saved to long-term memory. Track log storage may be activated or de-activated at user discretion. All recorded data is stored in non-volatile memory.

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 main power is removed.

## GPS Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the unit had sustained significant impact damage, as shown in figure 1. An internal inspection revealed the main internal board was intact, as shown in figure 2. Figure 2 shows the main, non-volatile memory chip, the SanDisk SDIN4C2-8G, was intact and secured to the board.

The SanDisk SDIN4C2-8G chip was removed from the main internal board and the 169-connection ball grid array (BGA) was re-soldered, as shown in figure 3. The memory contents of the chip were successfully read and track log data points were decoded from the 8 gigabyte binary memory image.

**Figure 1. Photo of damaged Garmin aera 796.**

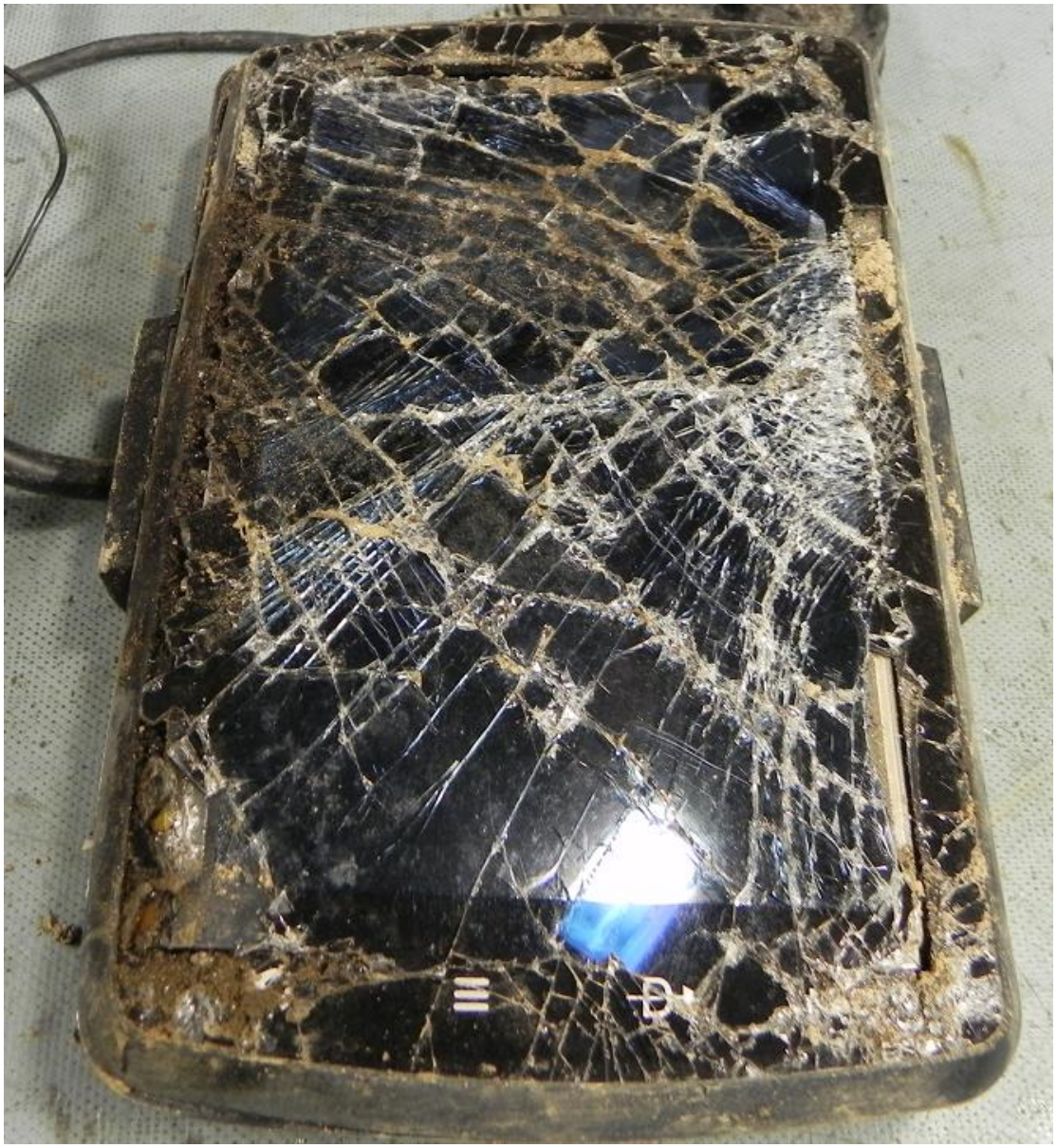


**Figure 2. Photo of Garmin aera 796 main memory board with magnified chip inset.**

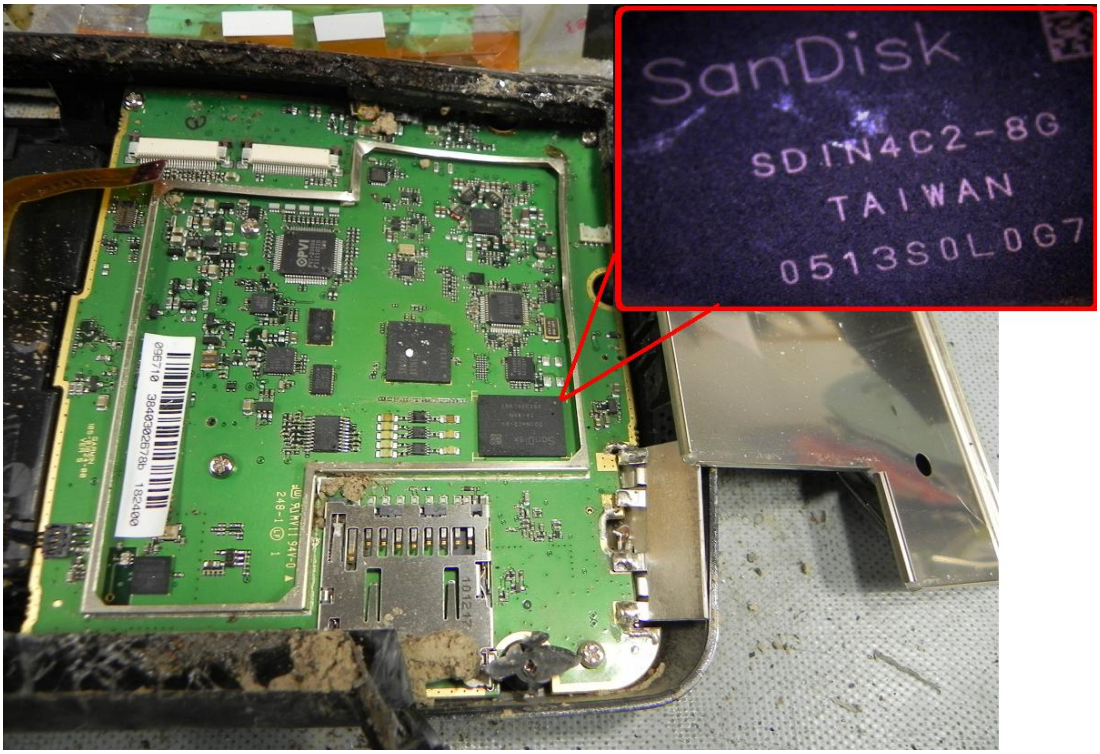
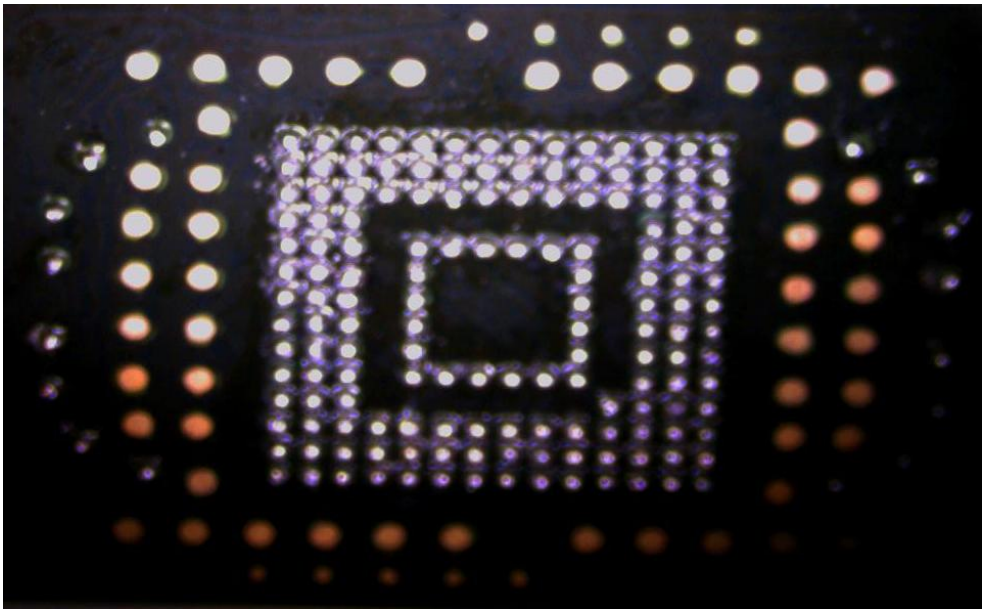



**Figure 3. Photo of SanDisk SDIN4C2-8G after BGA was re-soldered.**



## GPS Data Description

A total 756 points were extracted from the binary memory image. The recorded data was from the time period January 13, 2013 at 2000:37 UTC through January 13, 2013 at 2345:33 UTC. The recorded data began while the accident flight was over North Carolina at about 9,000 feet enroute to the Delmarva Peninsula. Additional track data or other information may have existed on the binary memory image; however no efforts were made to recover such additional information.

## GPS 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.

**Table 1: GPS Data Parameters**

| Parameter Name | Parameter Description |
|---|---|
| Date | Date for recorded data point (MM/DD/YYYY) |
| Time | Time (UTC) for recorded data point (HH:MM:SS) |
| Latitude | Recorded Latitude (degrees) |
| Longitude | Recorded Longitude (degrees) |
| GPS Alt | Recorded Mean Sea Level (MSL) Altitude (feet) |
| Groundspeed | Average groundspeed between current and previous data point (knots) |
| Track | Average true course between current and previous data point (degrees) |

## OVERLAYS AND TABULAR DATA

Figures 4 through 13 were generated using Google Earth. Figures 5 through 13 depict the aircraft flight path overlaid on the Federal Aviation Administration digital Sectional Raster Aeronautical Chart, published July 26, 2012 and effective through February 7, 2013.

Figure 4 shows an overview of the accident flight recording. The recording began at 2000:09 UTC while the aircraft was over North Carolina at about 9,200 feet, proceeding northeast. The aircraft remained at about 9,000 feet until about 2138 UTC, when the aircraft started a descent.

Figure 5 shows an annotated overview of the aircraft route over the Delmarva Peninsula. Each segment in figure 5 is sequentially marked from 1 to 14 to show the flight path order, as well as for cross reference to other figures in this report. Where a detailed figure exists for a particular segment, the figure is noted in parentheses. The segments are:

1. Northeast descending through about 9,000 feet to about 5,000 feet, at about 2138 UTC;
2. Most northerly progress of flight prior to southerly diversion, at about 2150 UTC (see figure 6);
3. Proceeding southerly towards the Salisbury-Ocean City Wicomico Regional Airport (SBY), at about 2210 UTC;
4. Turn southeast for first approach at SBY, at about 2219 UTC;
5. First missed approach at SBY, at about 2224 UTC (see figure 7);
6. Course reversal for second approach into SBY, at about 2239 UTC;
7. Second approach into SBY, at about 2248 UTC (see figure 8);

8. Second missed approach at SBY, at about 2250 UTC (see figures 8 and 9);
9. Northerly transition to the Sussex County Airport (GED), at about 2258 UTC;
10. Outbound for course reversal for the approach at GED, at about 2303 UTC;
11. Course reversal for GED approach, at about 2309 UTC;
12. Missed approach at GED, at about 2325 UTC (see figure 10);
13. Northerly transition towards Dover, Delaware, at about 2336 UTC (see figure 11);
14. Course reversal and descent near end of flight, at about 2342 UTC (see figures 12 and 13).

Figure 6 shows the north-most progress of the flight (segment #2), during the initial diversion to the south. At about 2150 UTC, the aircraft began a turn to the south when it was about 2 nautical miles (nm) south of the Delaware Airpark (33N) at about 5,000 feet.

Figure 7 shows the first approach into SBY (segment #5). At 2222:01 UTC, the aircraft was proceeding southeasterly and descending out of 1,664 feet. The minimum recorded altitude on the approach was 581 feet at 2224:13 UTC.

Figure 8 shows the second approach into SBY (segments #7 and #8). At 2247:53 UTC, the aircraft was proceeding southeasterly and descending out of 1,711 feet.

Figure 9 shows all recorded points between 2249:22 UTC and 2250:34 UTC, as the aircraft turned from southeast to northwest during the second missed approach at SBY. The minimum recorded altitude while the aircraft was proceeding southeast was about 928 feet; after the aircraft began a right turn towards the northwest, the altitude generally continued to decrease. The minimum recorded altitude was 529 feet at 2250:11, when the aircraft had turned towards the northwest. The aircraft began to climb again after 2250:34 UTC, as the aircraft turned left towards the southeast.

Figure 10 shows all recorded points during the missed approach at GED (segment #12). The aircraft descended to a minimum recorded altitude of 250 feet at 2325:30 UTC.

Figure 11 shows an overview of the northerly transition towards Dover, Delaware until the end of the recording (segments #13 and #14). The aircraft passed Dover AFB (DOV) at about 2338 UTC at about 2,000 feet.

Figure 12 shows the start of the final descent of the aircraft in the vicinity of the Smyrna VOR. At about 2341 UTC, the aircraft began to descend out of 2,000 feet, as the aircraft turned right from a northerly track towards a southerly track.

Figure 13 shows the continued descent of the aircraft until the end of the recording. At about 2344 UTC, the aircraft passed about 1.1 nm west of the Chandelle Estates Airport (0N4). The last recorded point was at 2345:33 UTC at 507 feet, while the aircraft was proceeding in a southerly direction.

Tabular data used to generate figures 4 through 13 are included as Attachment 1. This attachment is provided in electronic comma-delimited value (.CSV) format.

**Figure 4. Google Earth overlay of the entire accident flight recording.**

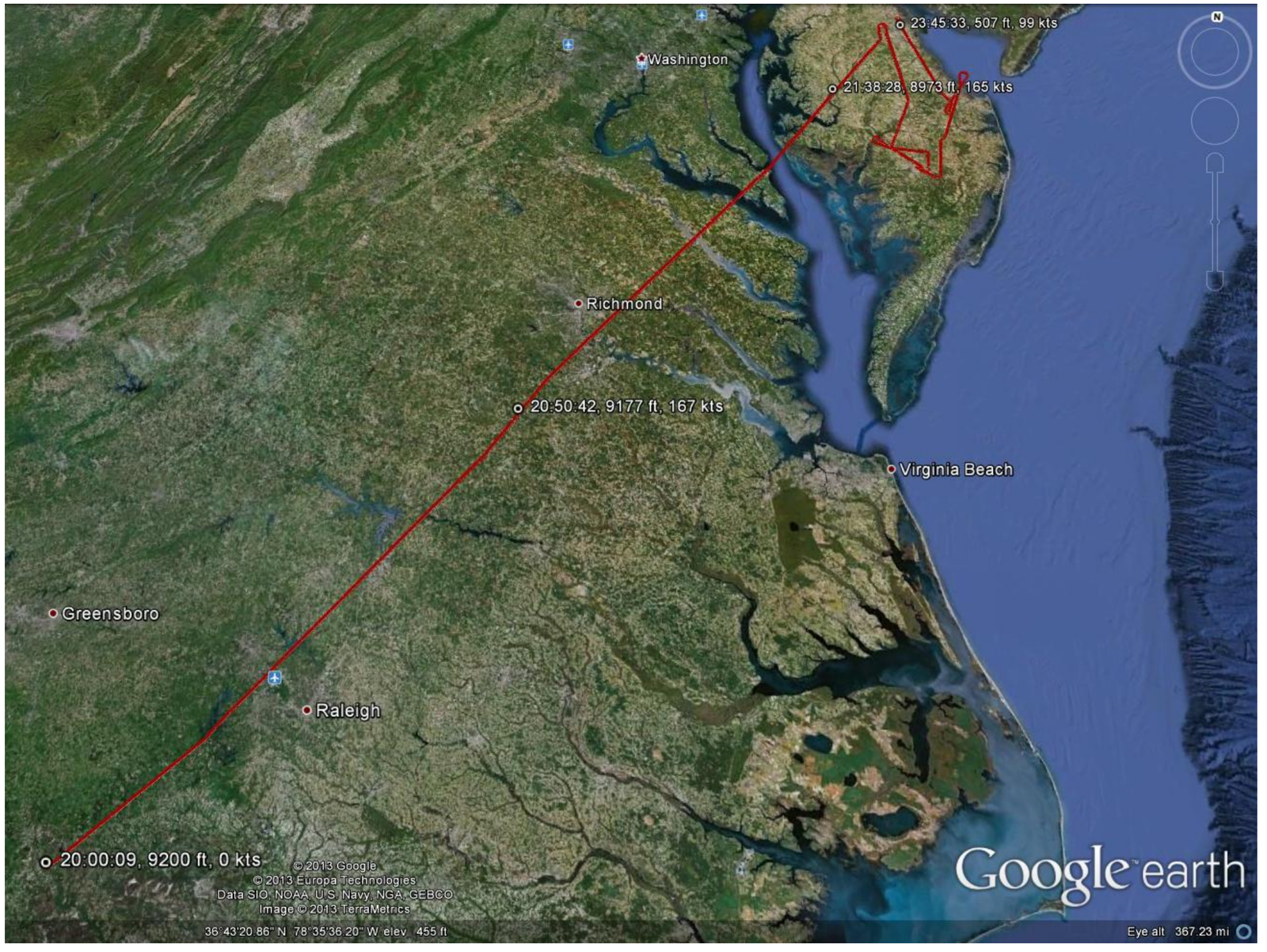


**Figure 5. Annotated Google Earth overlay of the aircraft route over the Delmarva Peninsula.**

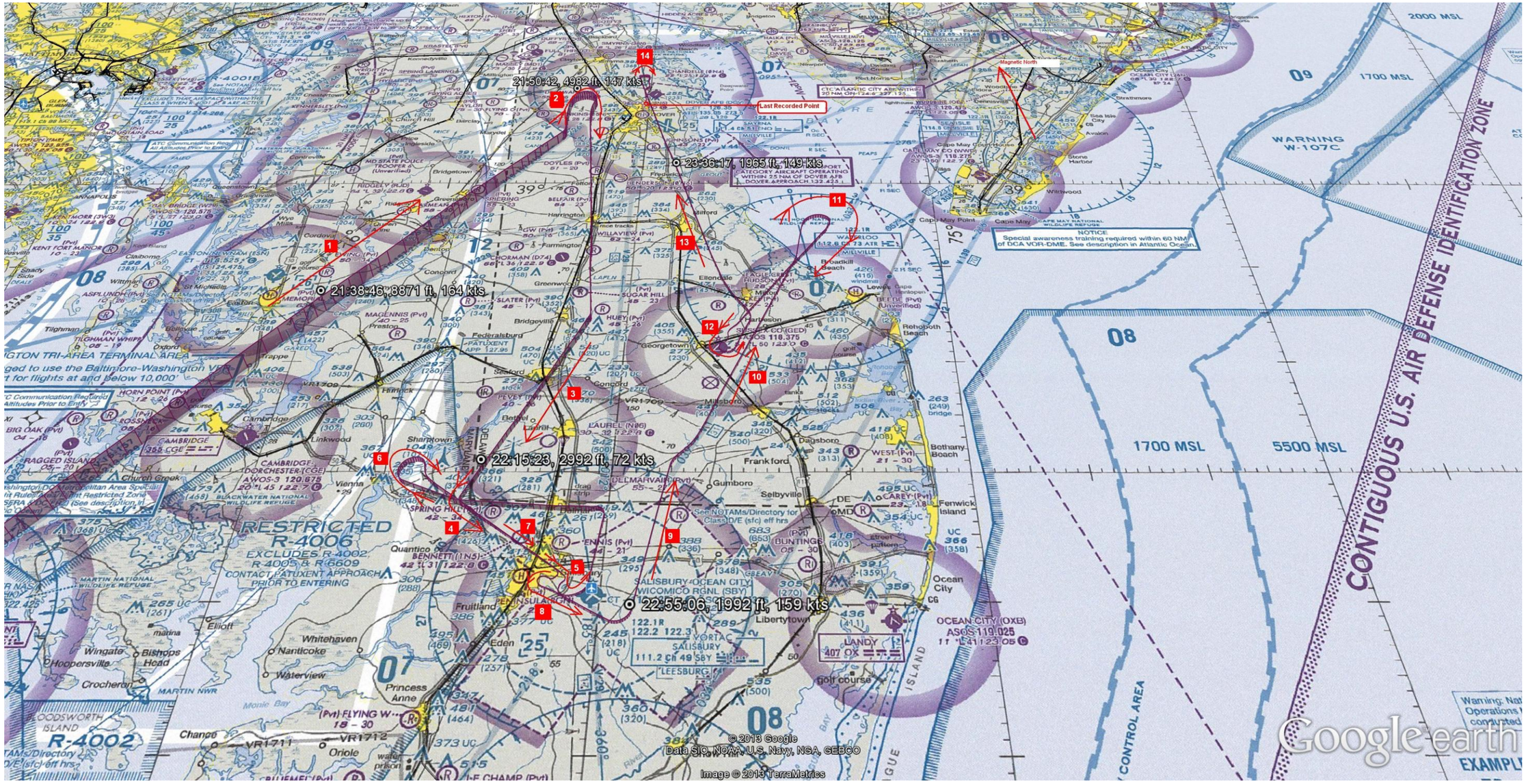


**Figure 6. Google Earth overlay of the initial turn to the south.**

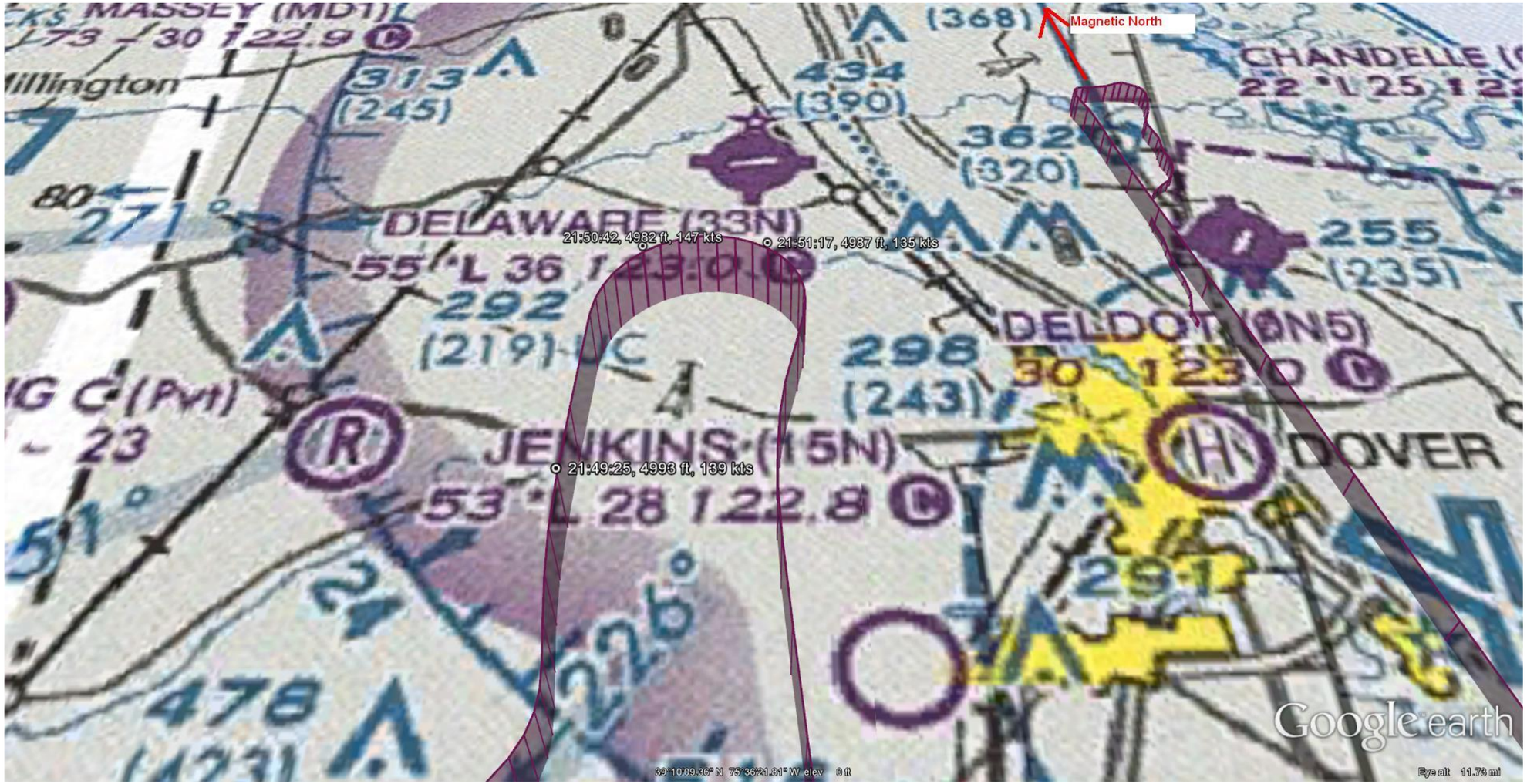


**Figure 7. Google Earth overlay of the first approach into SBY.**

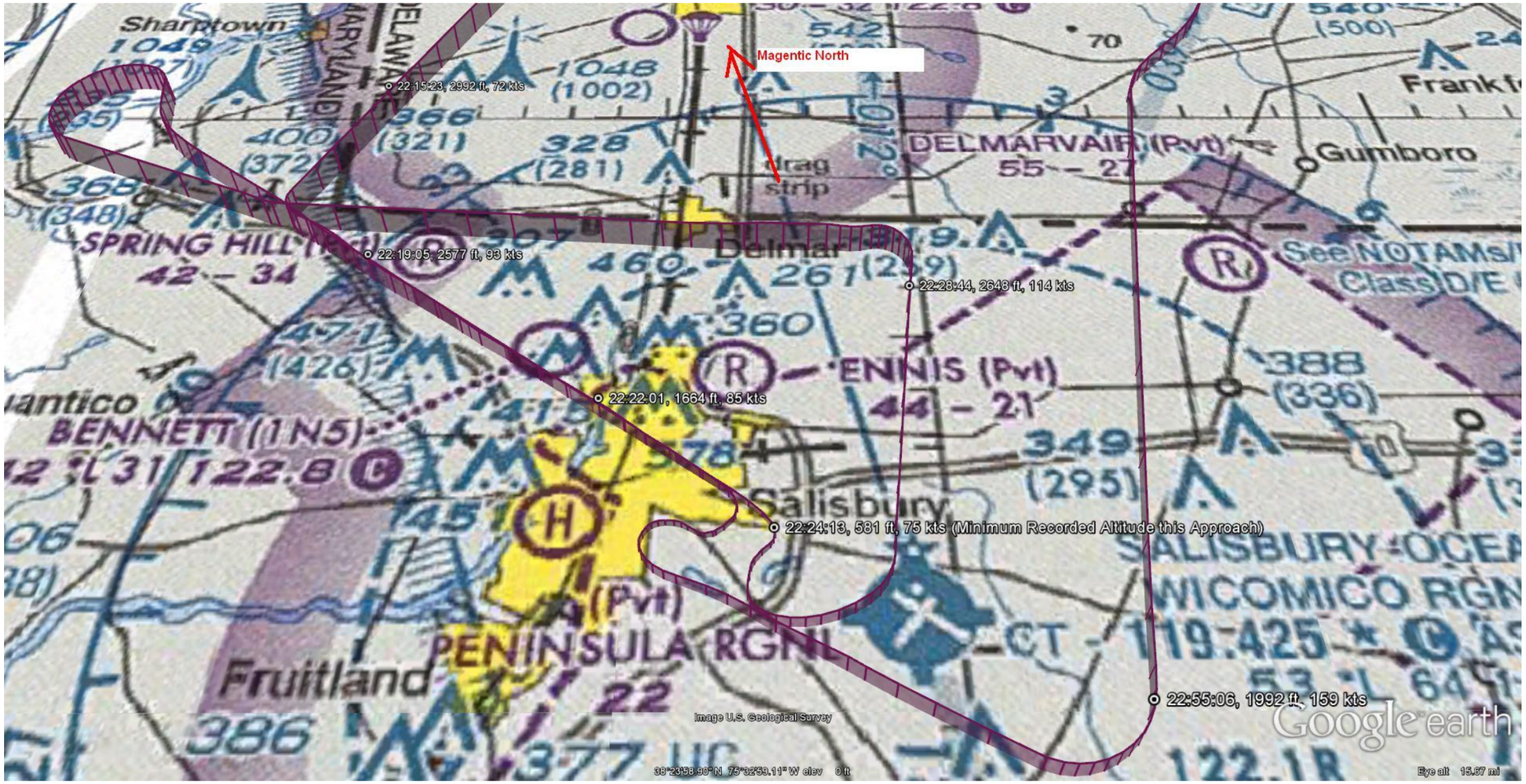


**Figure 8. Google Earth overlay of the second approach into SBY.**

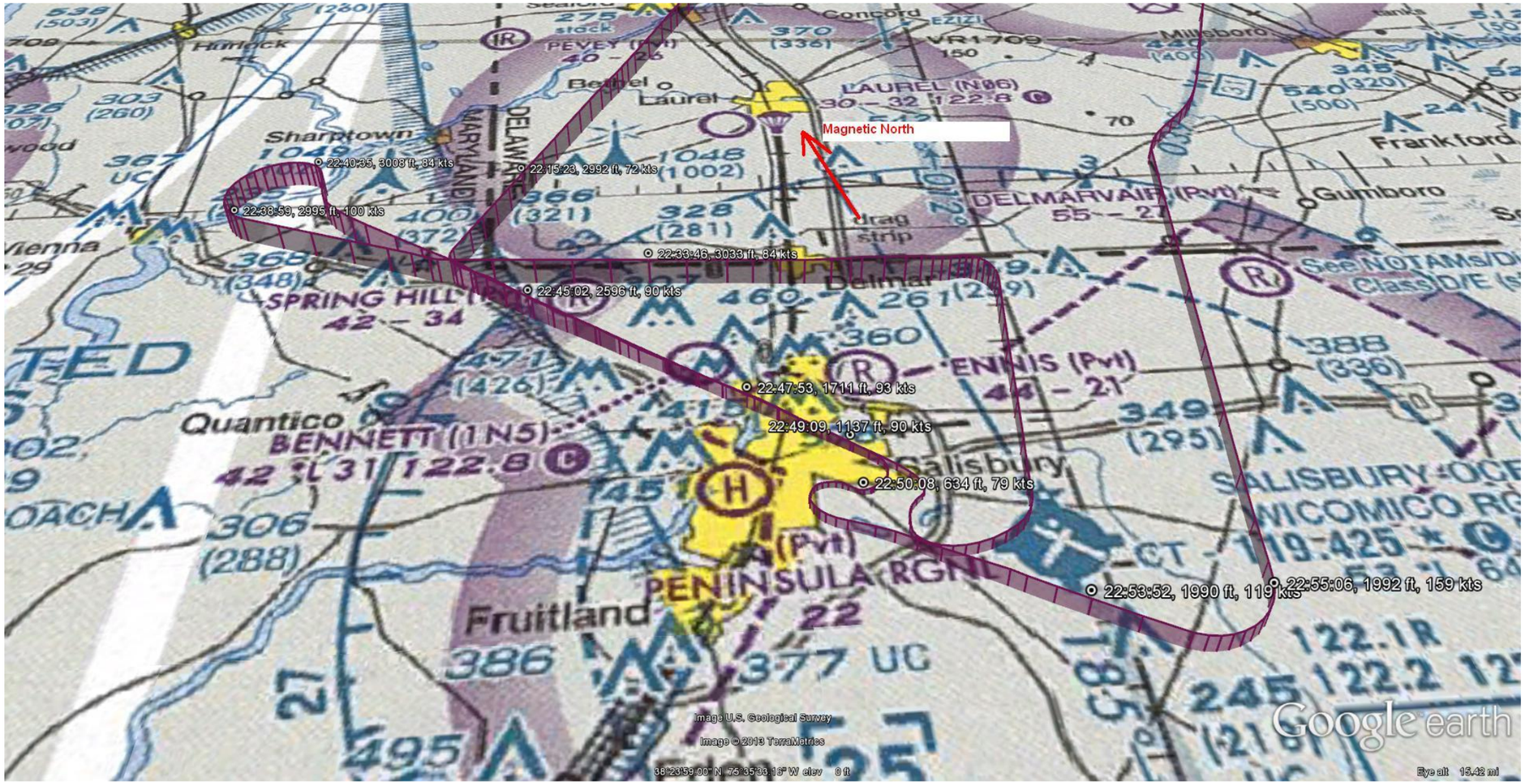


**Figure 9. Google Earth overlay of all points during the second missed approach at SBY.**

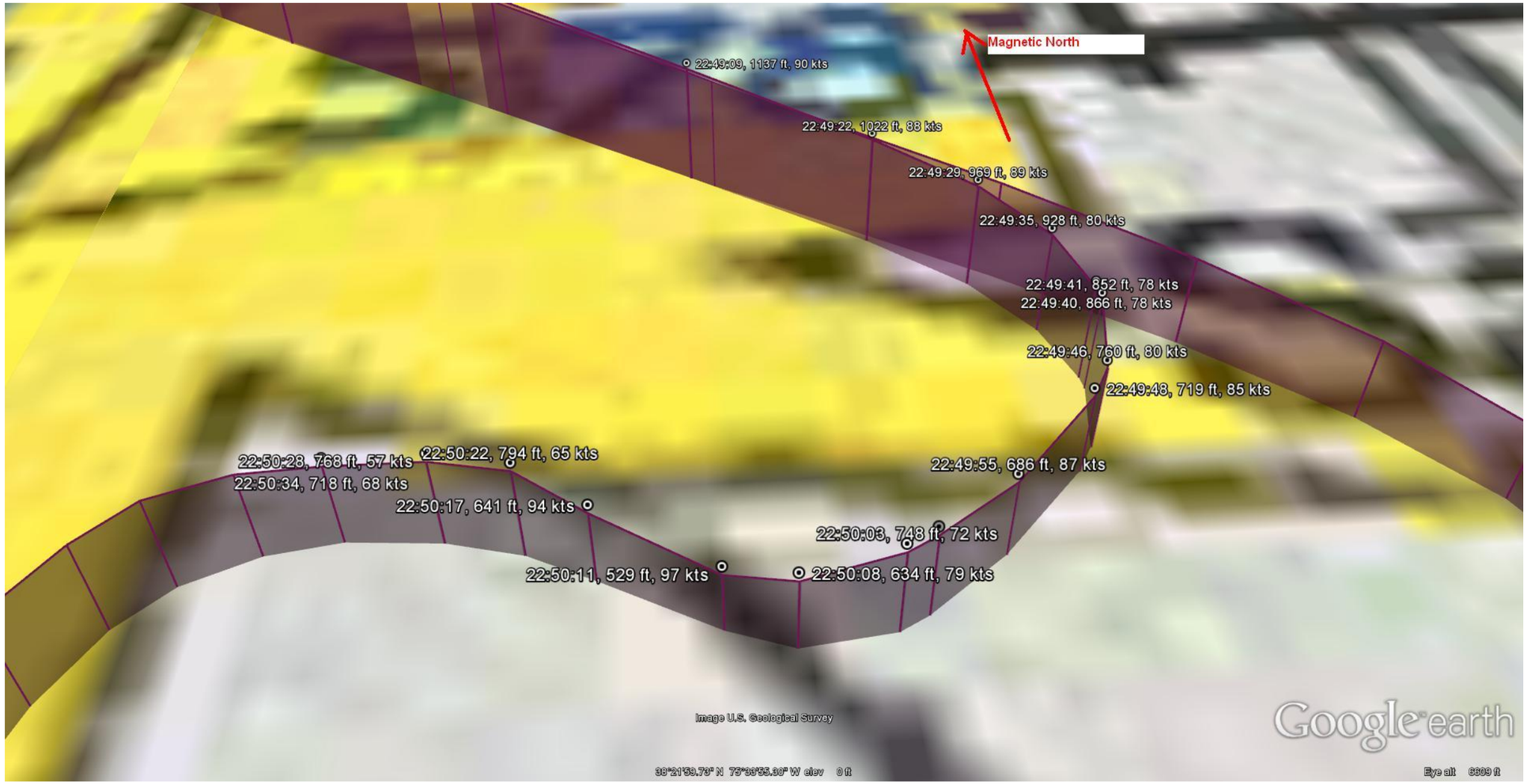


**Figure 10. Google Earth overlay of all points during the missed approach at GED.**

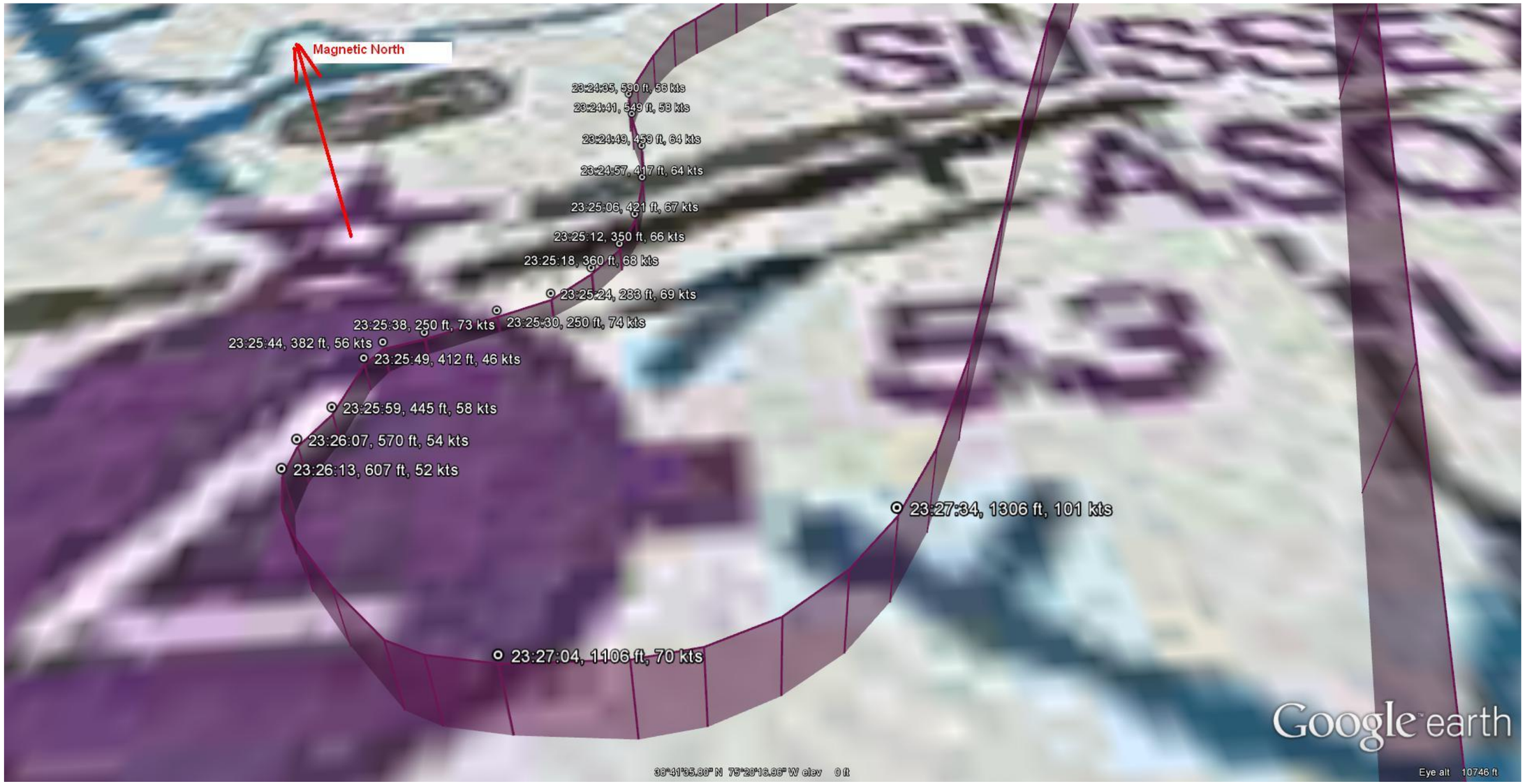


**Figure 11. Google Earth overlay of the end of the flight.**

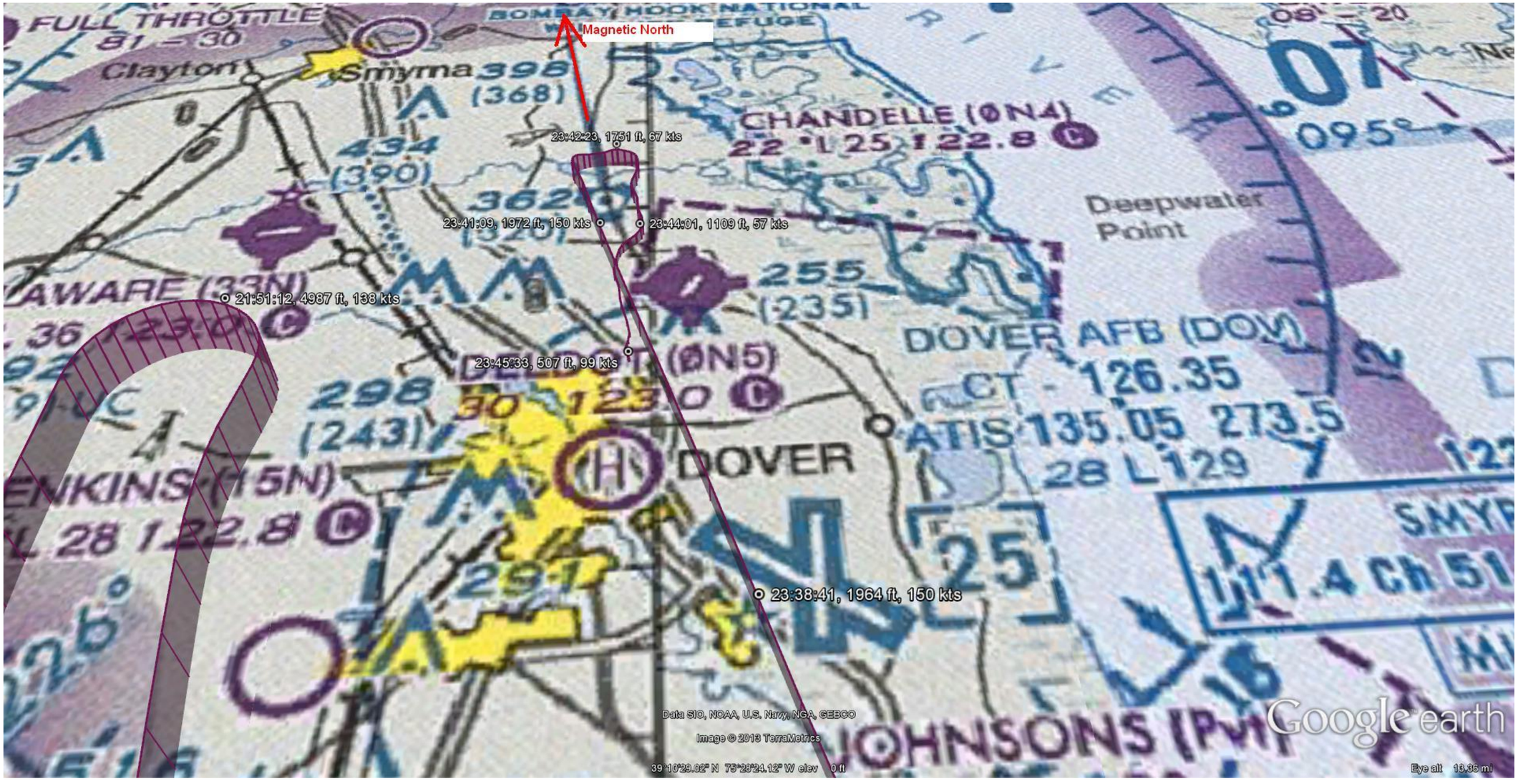


**Figure 12. Google Earth overlay of most points during the initial phase of the final descent.**

**Figure 13. Google Earth overlay of the last recorded points.**