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

January 26, 2015

Electronic Devices

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

1. EVENT

Location:	Wichita Falls, Texas
Date:	October 4, 2014
Aircraft:	Bell 206L1+
Registration:	N335AE
Operator:	Air Evac EMS, Inc
NTSB Number:	CEN15FA003

On October 4, 2014, about 0155 central daylight time, N335AE, a Bell 206L1+, was destroyed by post-impact fire after it impacted terrain while on approach to the United Regional Hospital helipad, in Wichita Falls, Texas. The commercial pilot was seriously injured and the patient, flight nurse, and paramedic sustained fatal injuries. The helicopter was registered to and operated by Air Evac EMS, Inc, O'Fallon, Missouri. A company visual flight rules flight plan was filed for the patient transfer flight that departed Jackson County Hospital, near Waurika, Oklahoma, about 0133. Visual meteorological conditions prevailed for the air medical flight conducted under the provisions of 14 *Code of Federal Regulations* Part 135.

2. DETAILS OF DEVICE INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following devices:

Device 1:	Garmin GPSMAP 396
Device 1 Serial Number:	Unknown
Device 2:	SkyTrac ISAT-100
Device 2 Serial Number:	Unknown

2.1. Differences Between Device Data Parameters

Section 2.4 of this report compares various data points between the Garmin GPSMAP 396 and the SkyTrack ISAT-100 datasets. Similar data points contain different values between datasets, including time, speed, and position. Sections 2.2 and 2.3 present the data as recorded by each device, without any correction.

2.2. Garmin GPSMAP 396 Device Description

The Garmin GPSMAP 396 is a battery-powered portable 12-channel GPS receiver with a 256-color TFT LCD display screen. The unit includes a built-in Jeppesen database and is capable of receiving XM satellite radio for flight information including NEXTRAD radar, lightning, METARs, TAFs, and TFRs. The unit stores date, route-of-flight, and flight-time information for up to 50 flights. A flight record is triggered when groundspeed exceeds 30 knots and altitude exceeds 500 feet, and ends when groundspeed drops below 30 knots for 10 minutes or more. A detailed tracklog—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 tracklog as a function of time or distance moved, depending on how the unit has been configured. Once the current tracklog memory becomes full, new information either overwrites the oldest information or recording stops, depending on how the unit is configured. The current tracklog can be saved to long-term memory and 15 saved tracklogs can be maintained in addition to the current tracklog. Tracklog storage may be activated or de-activated at user discretion. All recorded data is stored in non-volatile[1] memory. The unit contains hardware and software permitting the download of recorded waypoint, route, and tracklog information to a PC via a built-in serial port using the NMEA 0183 version 2.0 protocol. The unit can also communicate with external devices such as a computer using 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.

2.2.1. Garmin GPSMAP 396 Data Recovery

Upon arrival at the NTSB Vehicle Recorder Division, an exterior examination revealed the device had sustained severe heat damage, as shown in figure 1. The charred and melted encasement was removed, revealing the partially intact Garmin GPSMAP 396 unit, as shown in figure 2. Figure 3 shows the exterior enclosure of the device removed, revealing a rectangular, foil-protected area (annotated with a red arrow). The foil protection was removed, revealing the intact, non-volatile memory chip; figure 4 shows the non-volatile memory chip under the pencil eraser and annotated.

The AMD A1600B12VD non-volatile memory chip was removed from the printed circuit board (PCB) using a hot air re-work station. Figure 5 shows a microscopic view of the front of the chip on the PCB, and the 6x8 ball grid array (BGA) on the back of the chip after removal from the PCB. The BGA was reworked and a raw-data binary readout of the chip was obtained using a Xeltek SP-3000u EEPROM programmer. Recorded tracklog data was identified and converted to engineering units using an in-house software program.

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

Figure 1. Charred encasement containing Garmin GPSMAP 396.

Figure 2. Partially intact Garmin GPSMAP 396.

Figure 3. Internal foil-protected area of Garmin GPSMAP 396.

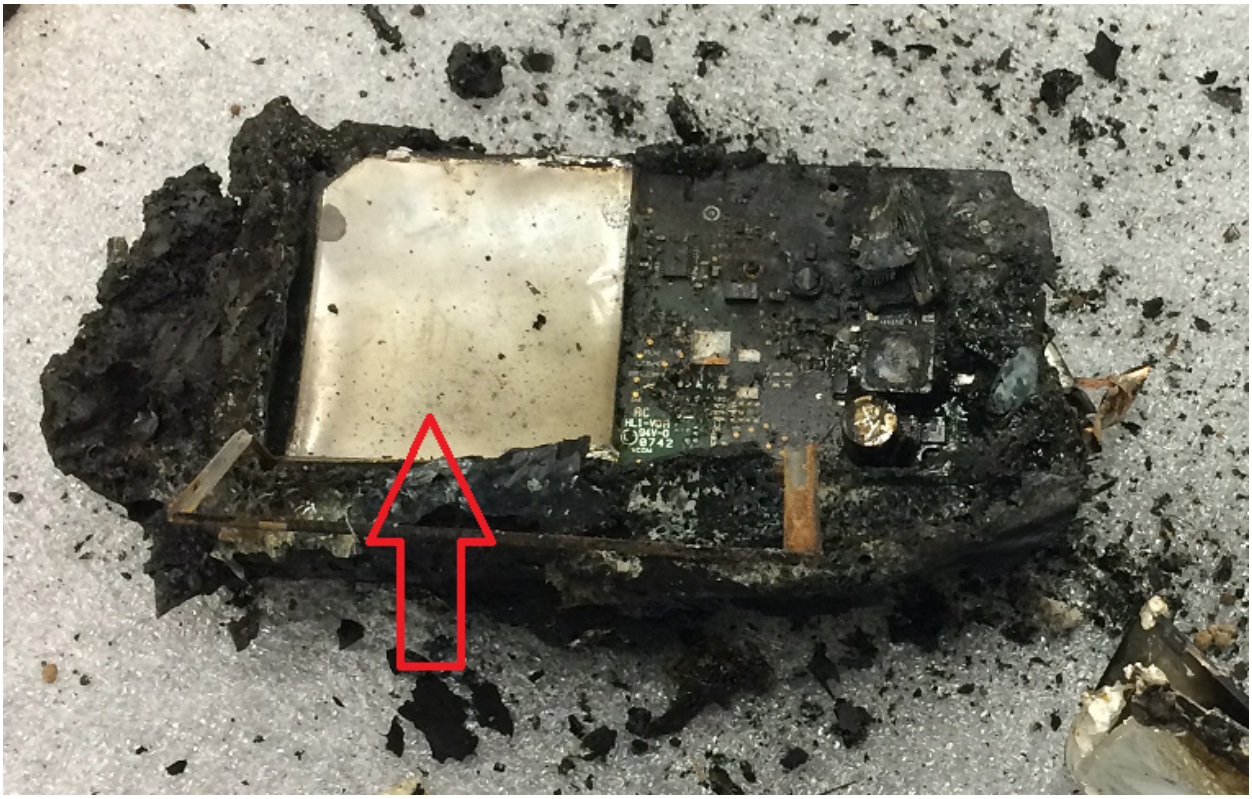


Figure 4. Intact non-volatile memory chip in Garmin GPSMAP 396.

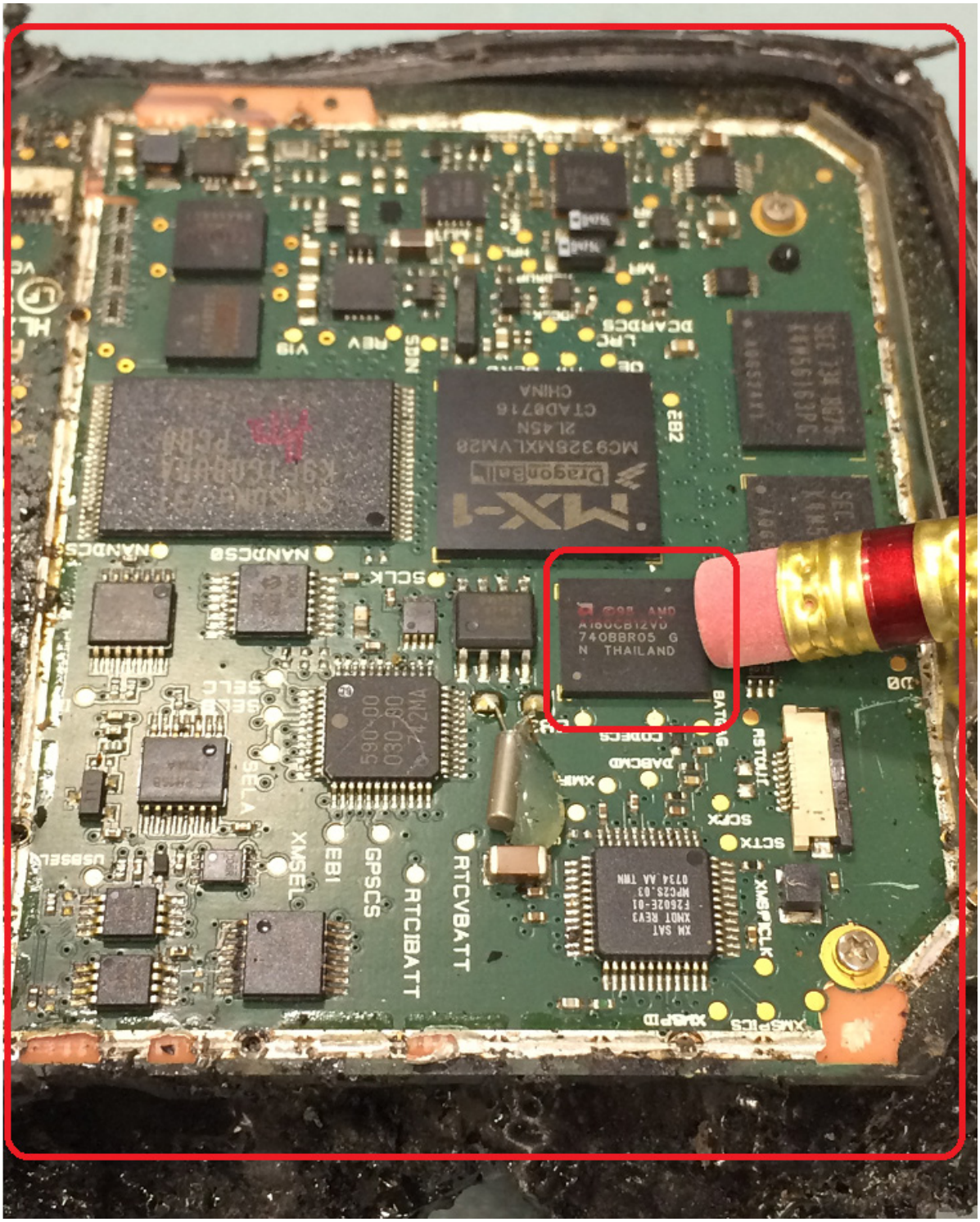
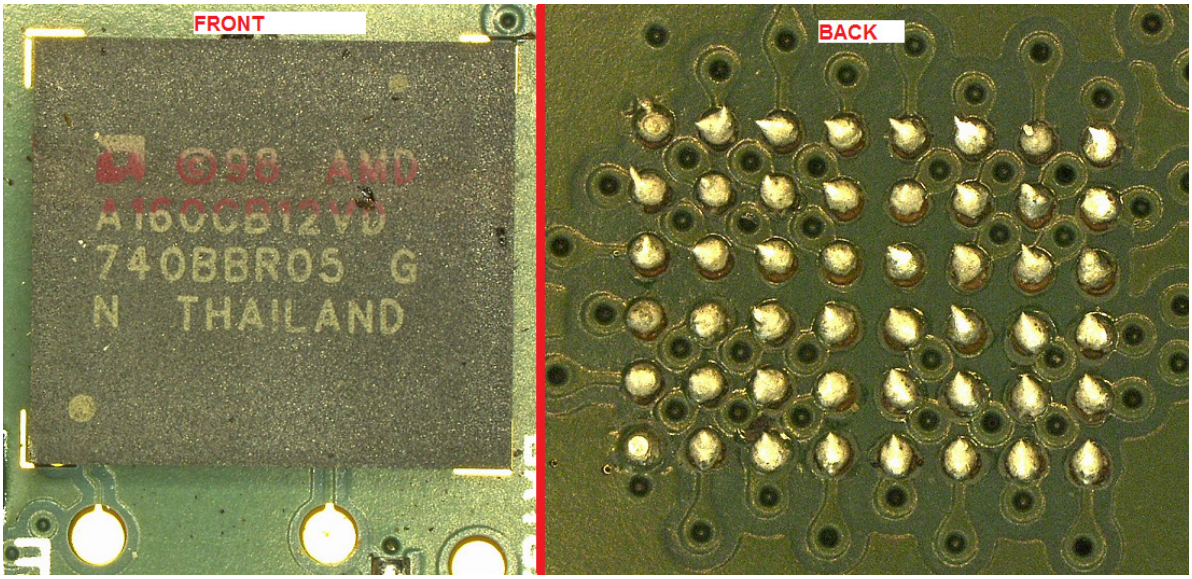


Figure 5. Front and back of non-volatile memory chip.



2.2.2. Garmin GPSMAP 396 Data Description

The data extracted included 127 recording sessions (14,352 data points) with time expressed as Coordinated Universal Time (UTC). The data was from September 9, 2014, through October 4, 2014, UTC. The accident flight was the last session recorded, from 6:22:44 UTC to 6:55:26 UTC on October 4, 2014. Only the accident flight data is presented in this report.

2.2.3. Garmin GPSMAP 396 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: Garmin GPSMAP 396 Data Parameters

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

Note: MSL means altitude above mean sea level

2.2.4. Garmin GPSMAP 396 Overlays and Corresponding Tabular Data

Figures 6 through 10 were generated using data extracted from the Garmin GPSMAP 396 and overlaid using Google Earth. The weather and lighting depicted in Google Earth are not necessarily representative of the weather and lighting conditions experienced by the accident flight.

Figures 6 and 7 show an overview of the accident flight overlaid on an aviation sectional chart and satellite imagery, respectively. The recording began at 6:22:44 UTC at Waurika and ended at 6:55:26 UTC at Wichita Falls.

Figure 8 shows the departure of the helicopter from Waurika. The points prior to 6:33:14 UTC are not annotated; these prior points may represent movement of the helicopter or position inaccuracies while the helicopter was stationary. After 6:33:14 UTC, the helicopter climbed and accelerated toward the north before turning southwest.

Figure 9 shows the arrival of helicopter at Wichita Falls. At about 6:51:35 UTC, the helicopter began to turn towards the northwest, similar to a left downwind arrival to the landing zone.

Figure 10 shows the last few points of the recording. By 6:54:45 UTC, the helicopter was tracking southeast at a calculated groundspeed of 11 kts. After 6:55:17 UTC, the recorded points show a course reversal and varied groundspeeds. It is possible the GPS positions were inaccurate towards the end of the recording, depending upon the attitude of the helicopter. Furthermore, since groundspeeds are derived from distance travelled between two points, the calculated groundspeeds during sharp turns may be inaccurate due to the low sampling rate of track points and possible inaccuracies of the GPS position.

Tabular data used to generate figures 6 through 10 are included as attachment 1 in electronic comma-delimited (.CSV) format.

Figure 6. Accident flight overview, as recorded by Garmin GPSMAP 396, overlaid on aviation sectional chart.

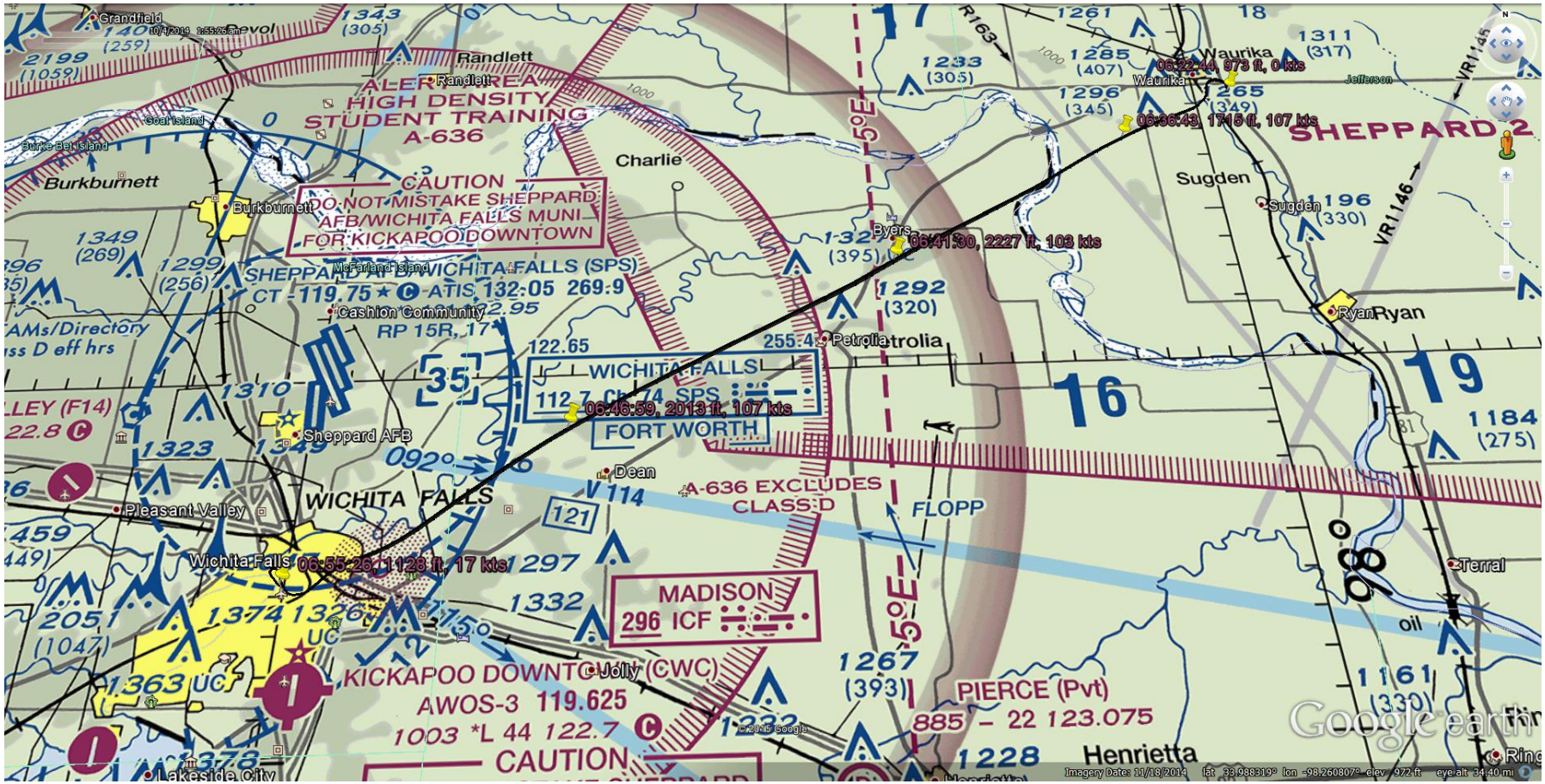


Figure 7. Accident flight overview, as recorded by Garmin GPSMAP 396, overlaid on satellite imagery.

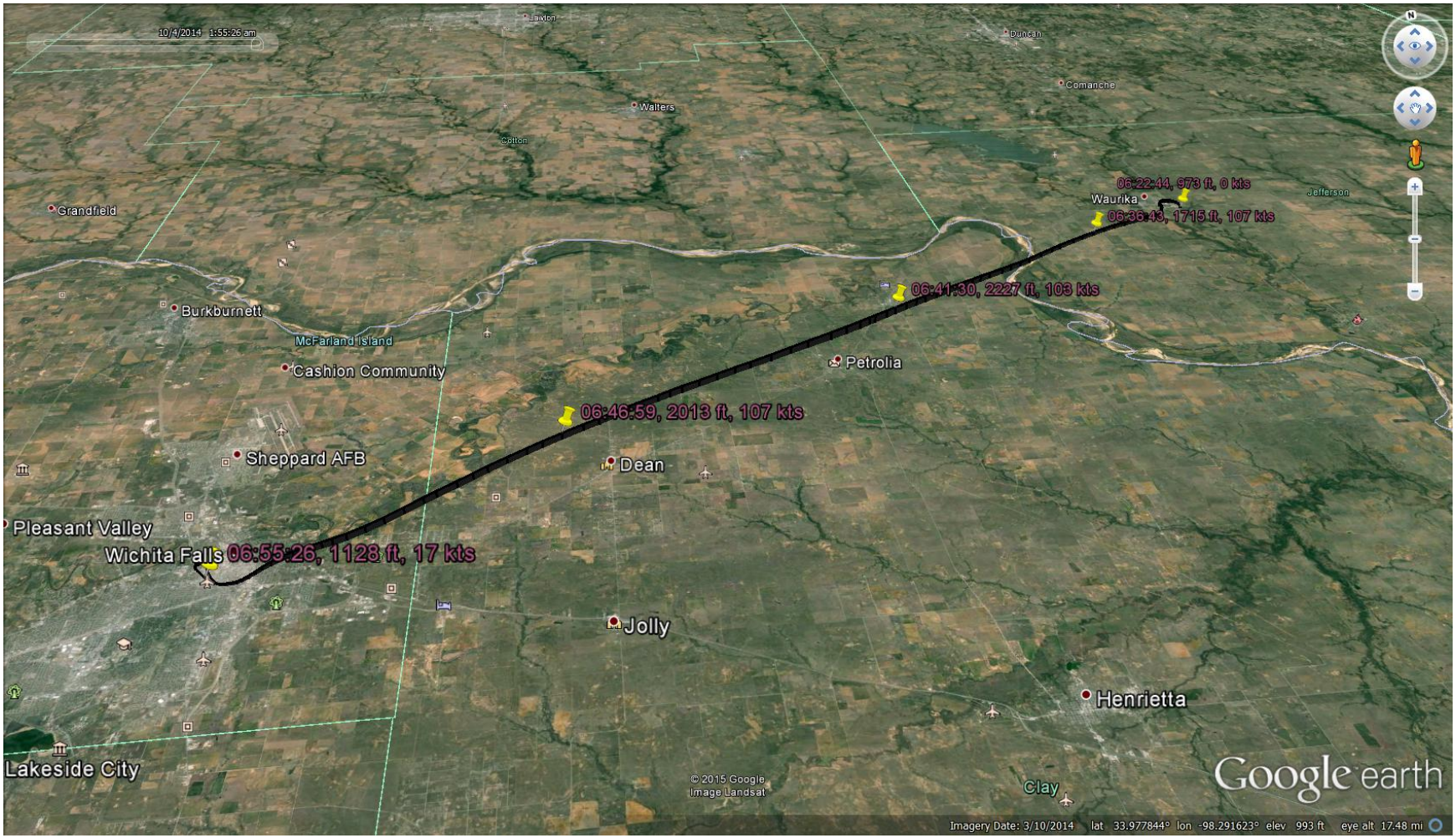
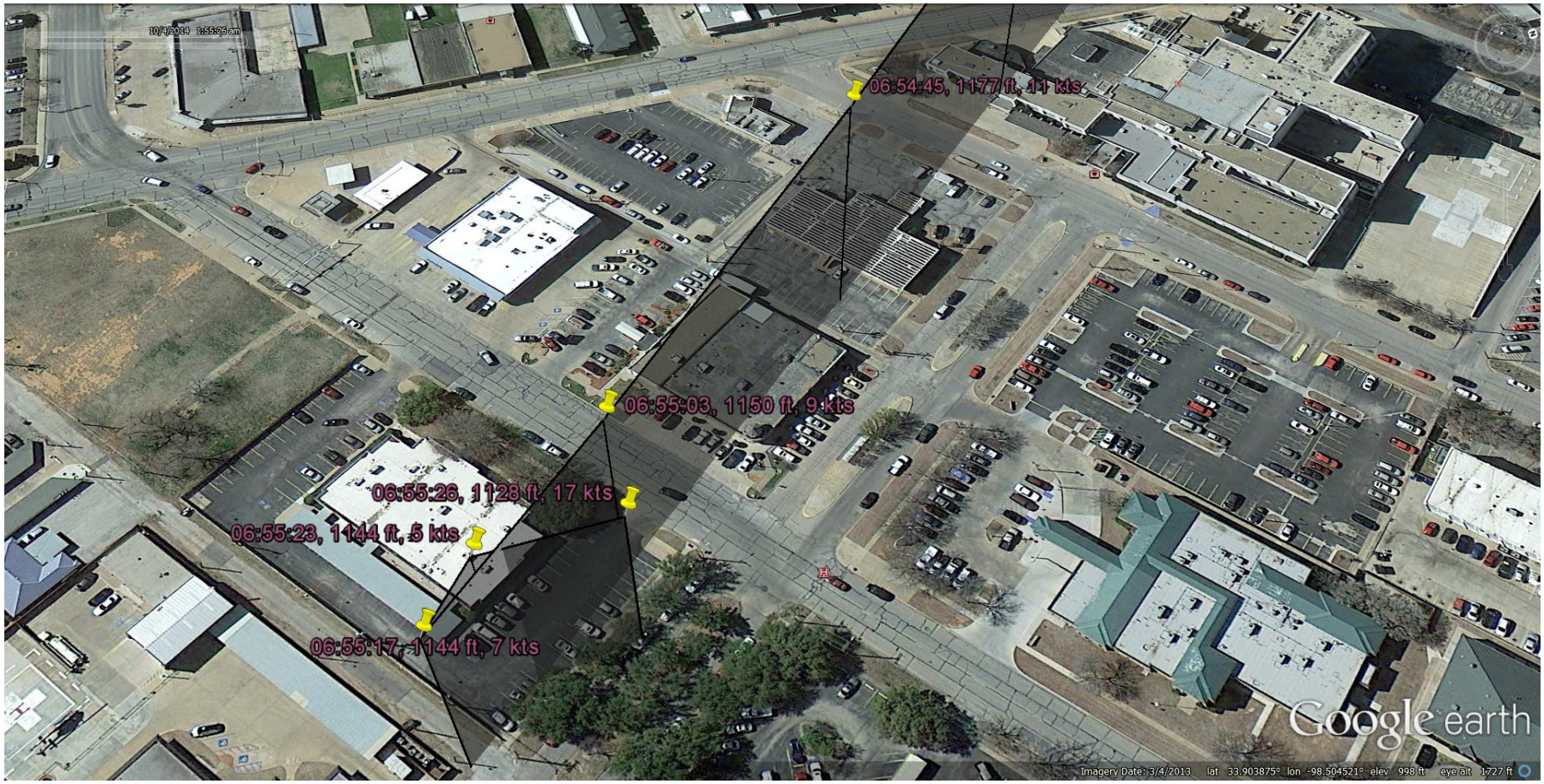


Figure 8. Departure from Waurika, Oklahoma, as recorded by Garmin GPSMAP 396.

Figure 9. Arrival at Wichita Falls, Texas, as recorded by Garmin GPSMAP 396.

Figure 10. End of Recording at Wichita Falls, Texas, as recorded by Garmin GPSMAP 396.



2.3. SkyTrac ISAT-100 Device Description

The SkyTrac ISAT-100 is flight tracking and satellite communication device. Using GPS position information and Iridium satellite communications, the device enables flight following, voice, text, and data transfer with ground stations.

Non-volatile memory on the internal LP3500 processor board contains a record of track history sampled every 5 seconds. This data may be recovered using the SkyTrac ISAT-100 Data Extraction Kit (part number 110-100-01).

2.3.1. SkyTrac ISAT-100 Data Recovery

Upon arrival at the NTSB Vehicle Recorder Division, an exterior examination revealed the device had sustained significant heat damage, as shown in figure 11. The unit was disassembled, as shown in figure 12. The LP3500 board was found intact, as shown in figure 13. The SkyTrac unit was sent to the Transportation Safety Board of Canada (TSB) for readout.

Figure 11. SkyTrac ISAT-100.

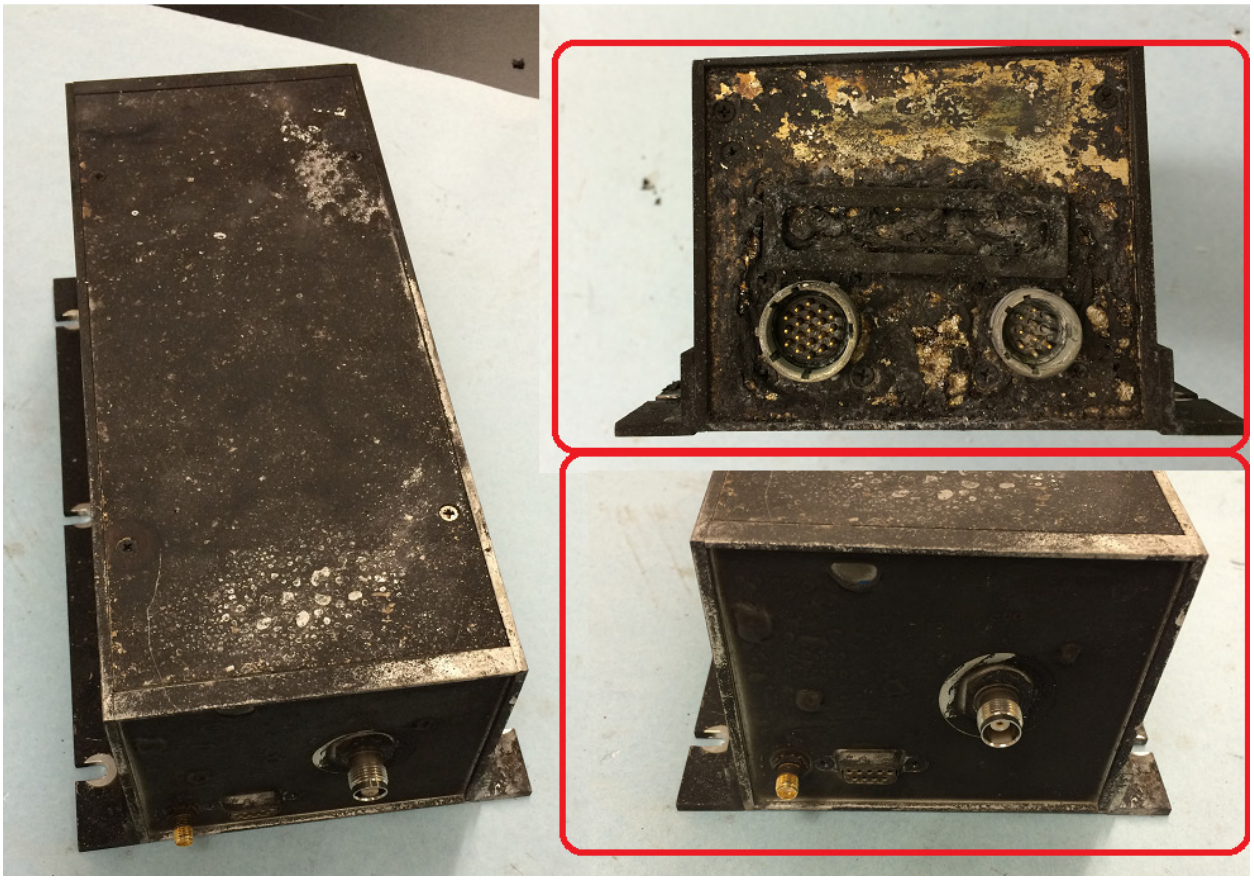


Figure 12. SkyTrac ISAT-100 disassembled.

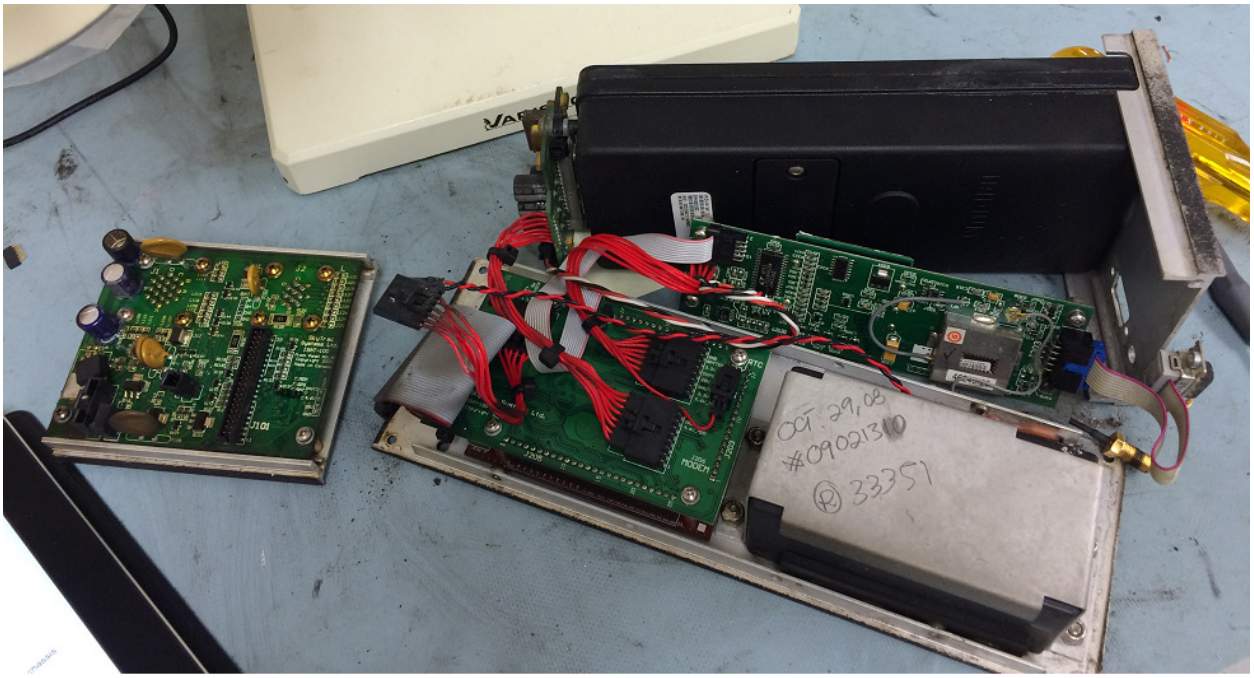
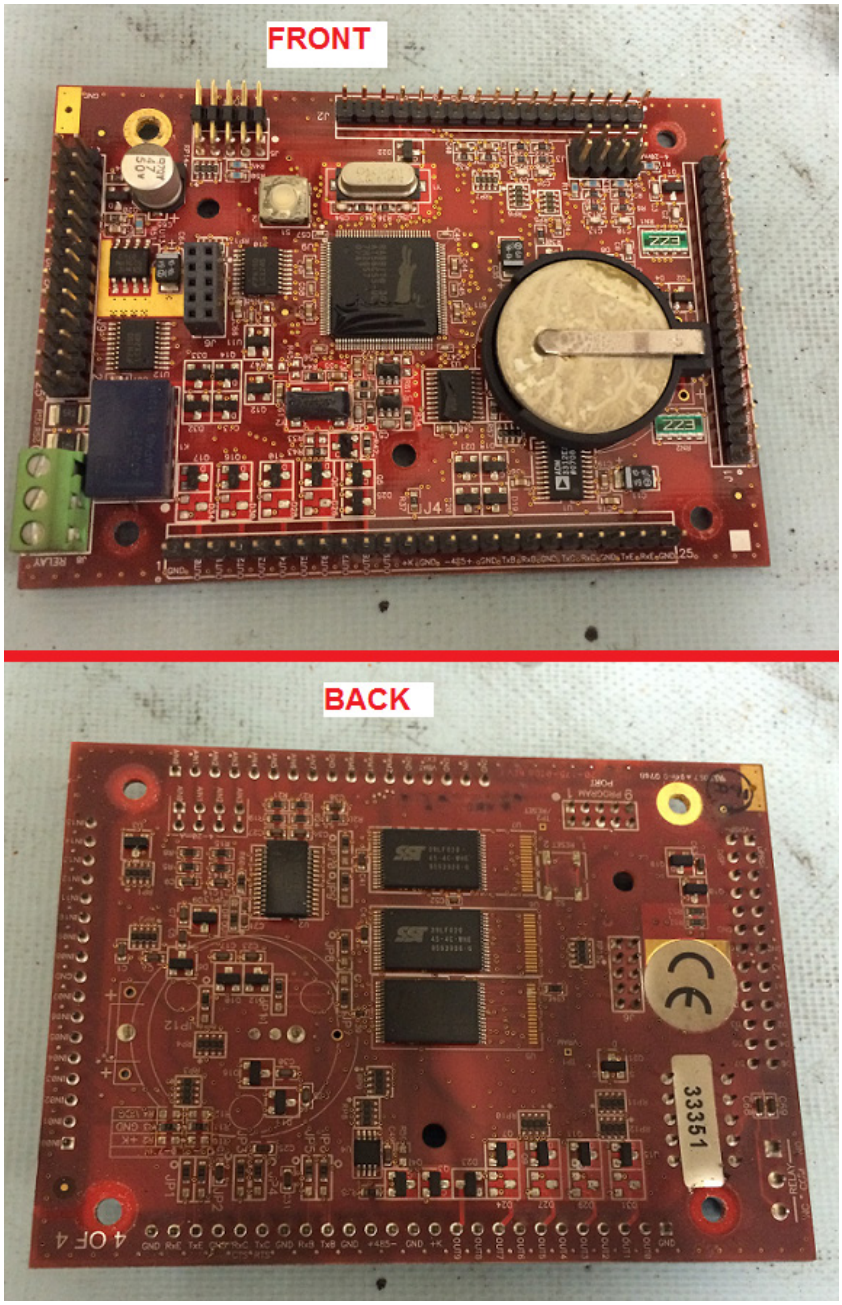


Figure 13. SkyTrac ISAT-100 LP3500 board.



2.3.2. SkyTrac ISAT-100 Data Description

The unit contained 1,872 data points recorded at a sample rate of once every 5 seconds, recorded in UTC. The data was recorded between the October 3, 2014, and October 4, 2014 UTC. The accident was recorded starting at 6:35:48 UTC and ended at 6:55:14 UTC.

2.3.3. SkyTrac ISAT-100 Data Parameters Provided

Table 2 describes data parameters provided by the SkyTrac ISAT-100. Groundspeed and track were contained in the data download from the LP3500.

Table 2: SkyTrac ISAT-100 Data Parameters

Parameter Name	Parameter Description
Date	Date for recorded data point (MM/DD/YYYY)
Time	Time (EDT) for recorded data point (HH:MM:SS)
Latitude	Recorded Latitude (degrees)
Longitude	Recorded Longitude (degrees)
Altitude	Recorded GPS Altitude ((ft), MSL)
Velocity	SkyTrac Computed Groundspeed (kts)
Track	SkyTrac Computed Course (degrees)
HDOP	Horizontal Dilution of Precision[2] (ratio)
VDOP	Vertical Dilution of Precision (ratio)

Note: Altitude and velocity were downloaded in metric units and converted to kts and ft.

2.3.4. SkyTrac ISAT-100 Plots and Corresponding Tabular Data

Figures 14 through 17 were generated using data extracted from the SkyTrac ISAT-100 and overlaid using Google Earth. The weather and lighting depicted in Google Earth are not necessarily representative of the weather and lighting conditions experienced by the accident flight.

Figures 14 through 16 show data similar to the Garmin GPSMAP 396, discussed in section 2.2; however, the recording starts about 2.3 nm southeast of Waurika.

Figure 17 shows the end of the recording at Wichita Falls. The last two points of the recorded track deviate right (southwest) of the final approach course.

As with the Garmin GPSMAP 396, it is possible the GPS positions were inaccurate towards the end of the recording, depending upon the attitude of the helicopter. Furthermore, since groundspeeds are derived from distance travelled, the calculated groundspeeds during sharp turns may be inaccurate.

Tabular data used to generate figures 14 through 17 are included as attachment 2 in CSV format.

[2] For more information on Dilution of Precision, see R. B. Langley, "Dilution of Precision," *GPS World,* May, 1999.

Figure 14. SkyTrac ISAT-100 accident flight, overview.

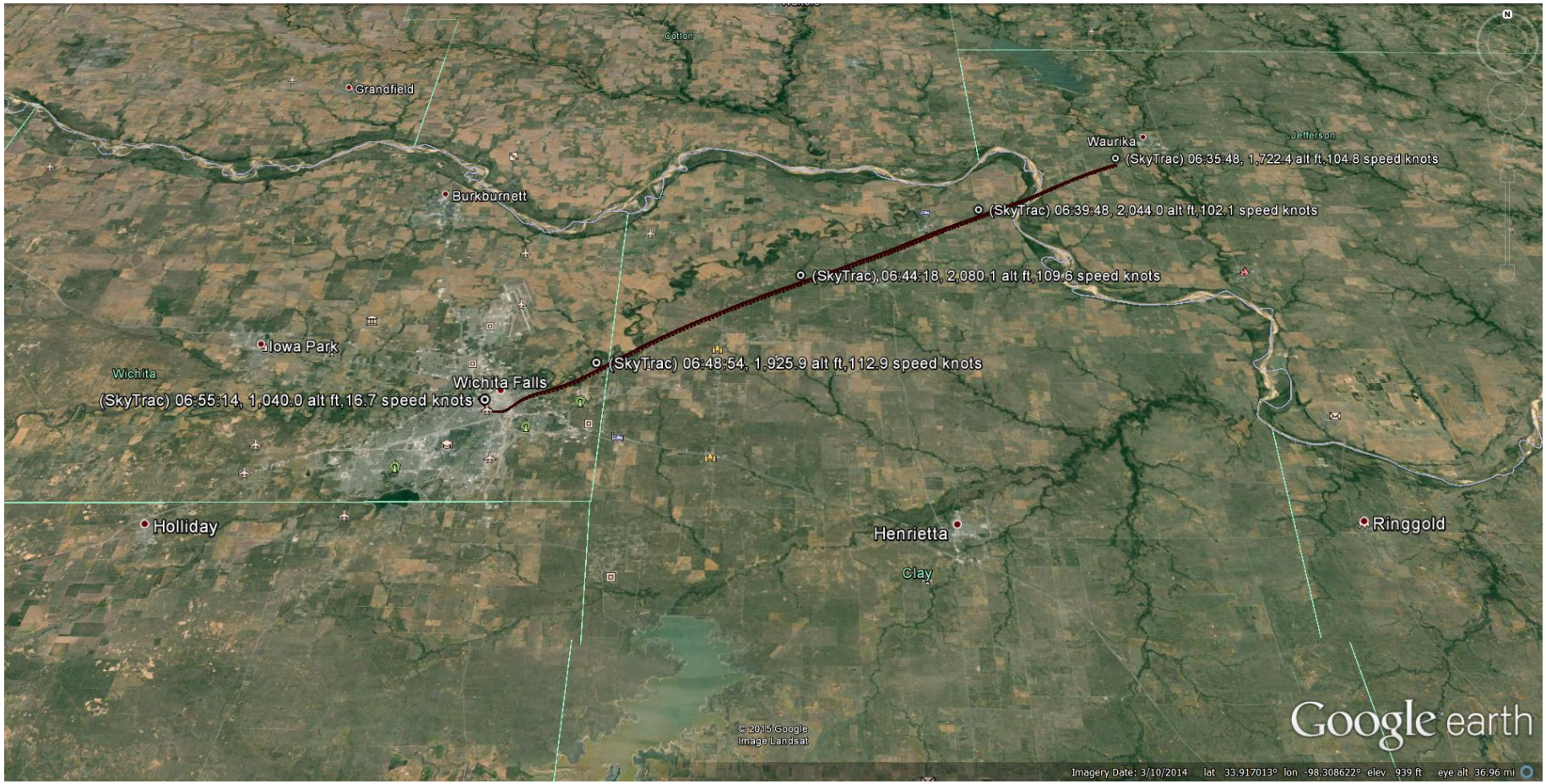


Figure 15. SkyTrac ISAT-100 accident flight, start of recording.

Figure 16. SkyTrac ISAT-100 accident flight, arrival at Wichita Falls.

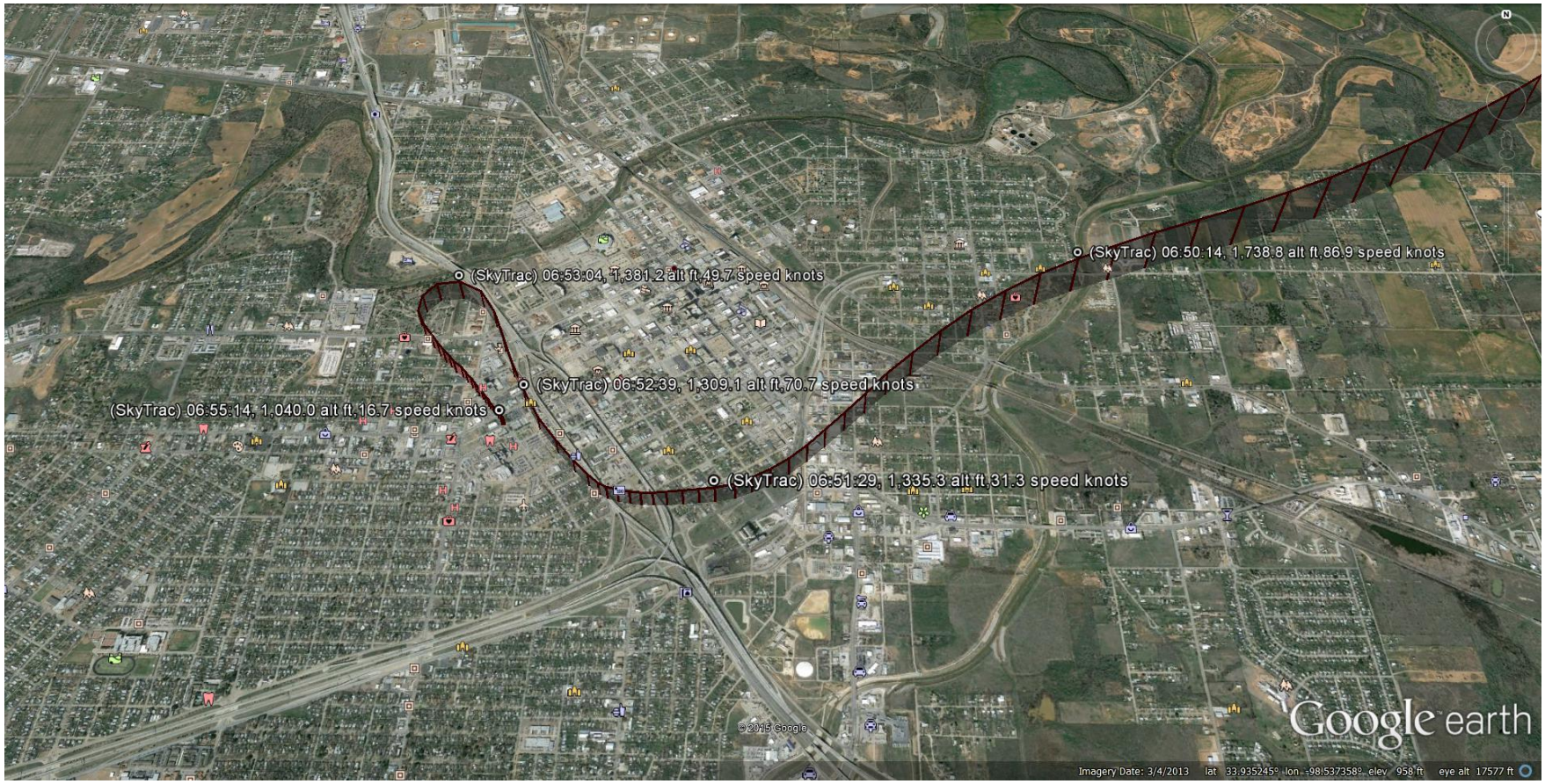


Figure 17. SkyTrac ISAT-100 accident flight, end of recording.

2.4. Garmin GPSMAP 396 and SkyTrac ISAT-100 Data Comparison

Figures 18 through 21 compare the Garmin GPSMAP 396 (Garmin) and the SkyTrac ISAT-100 (SkyTrac) datasets using Google Earth overlays. The SkyTrac datset is shown in green with white text annotated “SkyTrac;” the Garmin dataset is shown in red with magenta text.

Figure 18 shows an overview of both datasets. SkyTrac started recording about 13 minutes after Garmin, and both units stopped recording about the same time and place.

Figure 19 shows a select portion of enroute datapoints from both datasets. Two sets of points are shown, both sets with the same UTC time recorded by each device. Both sets of points were about 2,600 ft apart for the same recorded UTC time; however, the tracks of both datasets overlapped across time. This behavior is similar to a difference between the recorded UTC time by each device.

Figure 20 shows another select portion of enroute datapoints from both datasets with two sets of points shown. In this case, points were selected which were at nearly the same position. In both cases, Garmin recorded time was 13 seconds after SkyTrac recorded time.

Figure 21 shows both datasets at the end of the recording. During the downwind and base portions of the recording, the tracks generally overlap; however, during the end of the recording on final approach, the positions of the two datasets noticeably diverge.

Figure 18. Comparison of Garmin GPSMAP 396 and SkyTrac ISAT-100, entire accident flight.

Figure 19. Comparison of Garmin GPSMAP 396 and SkyTrac ISAT-100, enroute.

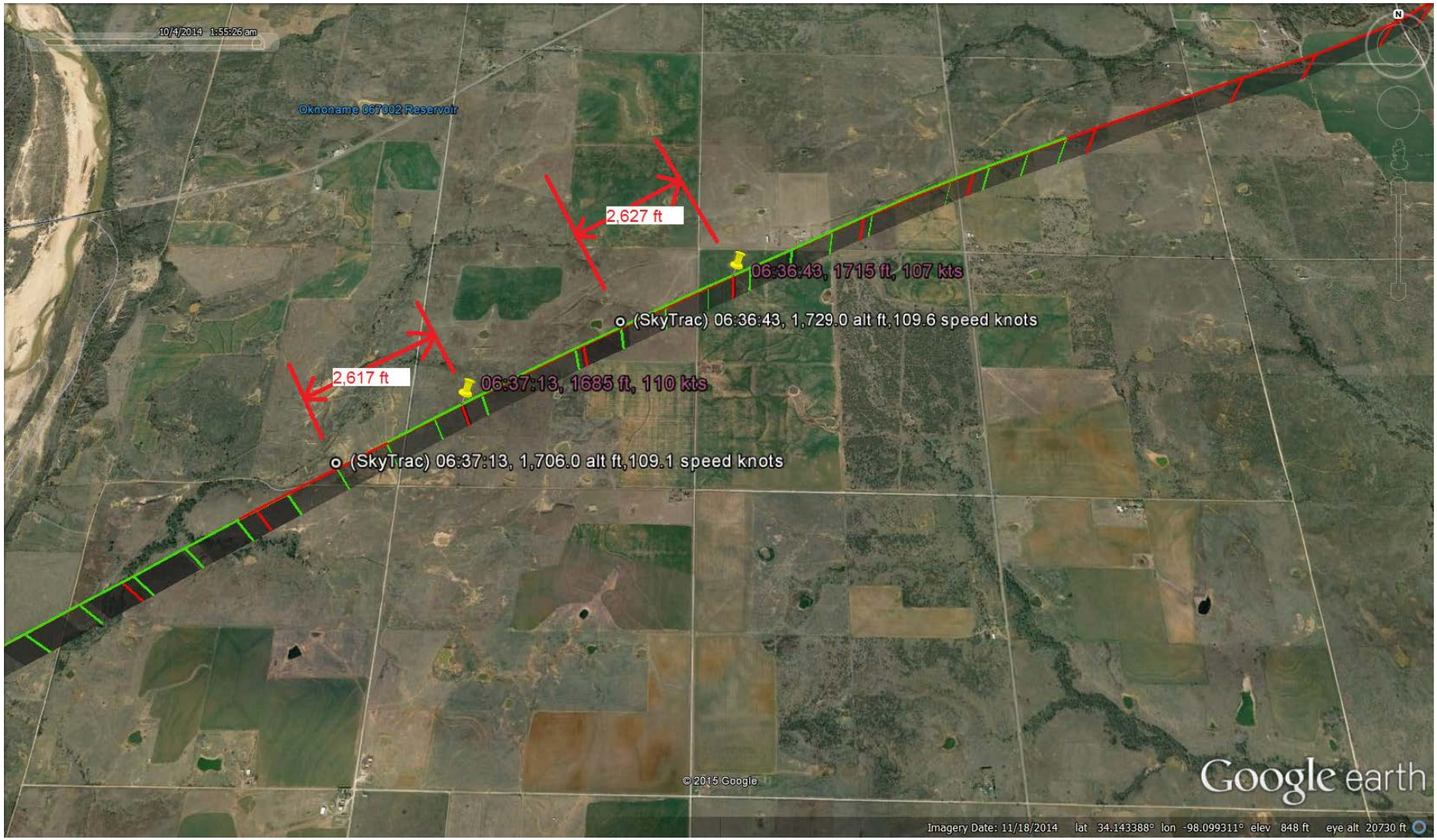


Figure 20. Comparison of Garmin GPSMAP 396 and SkyTrac ISAT-100, position same, different times.

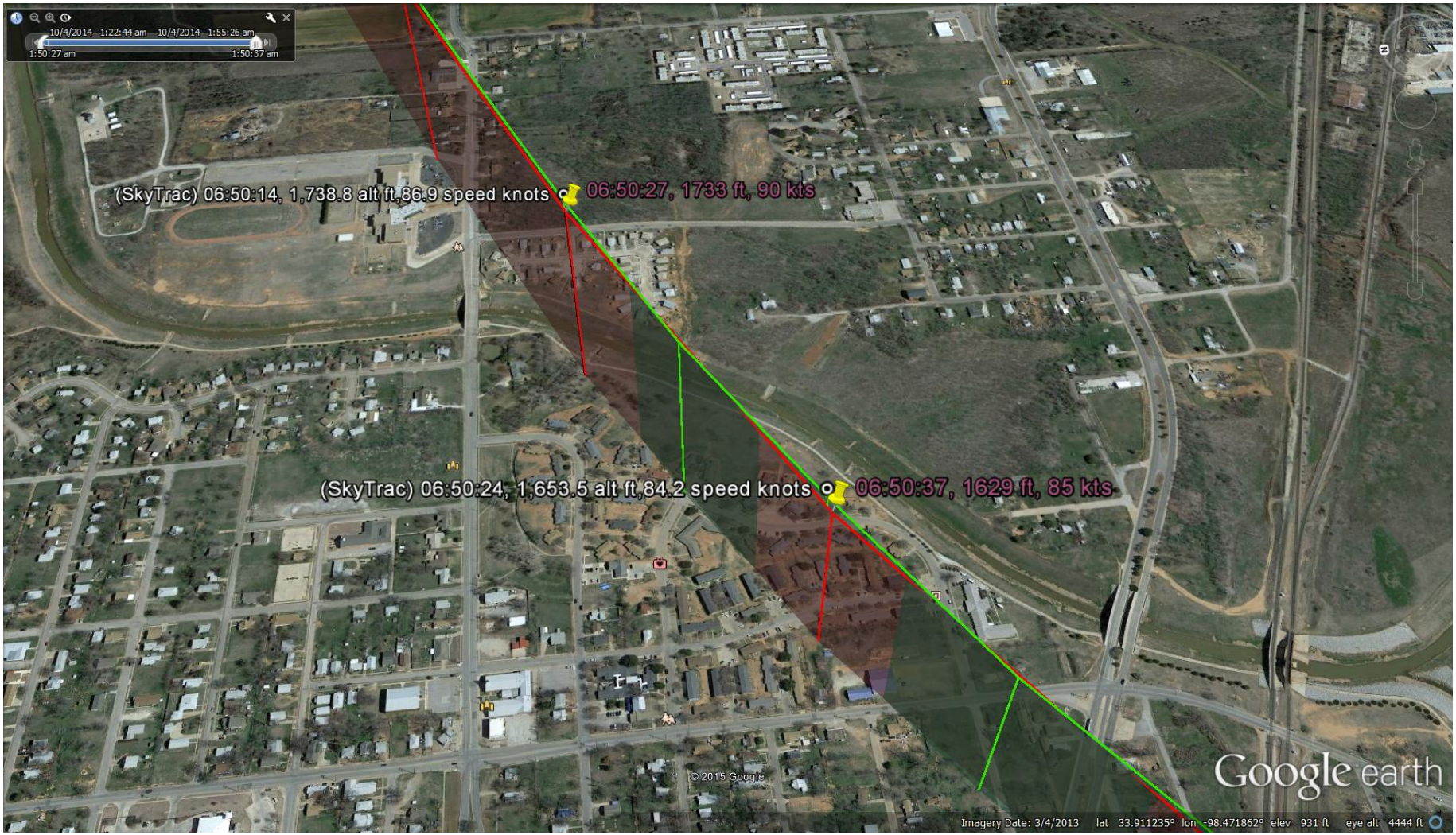


Figure 21. Comparison of Garmin GPSMAP 396 and SkyTrac ISAT-100, end of recording.

NTSB CEN1 Attachment 1 to Electronic Devices Specialist's Factual Report
Operator: A Inc.
Vehicle ID/Registration: N335AE
Source of d s/n unknown
Date of Event: 10/4/2014
Location: W TX
DATA

Date UTC	Time UTC	Latitude Deg	Longitude Deg	GPS Alt Ft	Groundspe Kt	True Track Deg
########	6:22:44	34.15711	-97.9789	973	0	0
########	6:25:56	34.15708	-97.979	937	0	243.3
########	6:26:31	34.15709	-97.979	950	0	51.2
########	6:27:01	34.15712	-97.979	945	0	10.1
########	6:27:20	34.15711	-97.979	947	0	132.9
########	6:27:33	34.1571	-97.979	953	0	198.3
########	6:27:59	34.15708	-97.979	972	0	128.6
########	6:28:34	34.15708	-97.979	970	0	253.2
########	6:29:00	34.15709	-97.9787	1062	2	88.1
########	6:29:17	34.15707	-97.9787	1040	0	213.1
########	6:29:46	34.15716	-97.9793	639	3	282
########	6:31:13	34.15714	-97.979	973	1	95.3
########	6:32:59	34.15714	-97.979	970	0	0
########	6:33:14	34.15718	-97.979	977	1	317.9
########	6:33:26	34.15752	-97.979	1005	6	359.1
########	6:33:27	34.15756	-97.979	1008	9	1.7
########	6:33:33	34.15788	-97.9789	1024	12	10
########	6:33:41	34.15858	-97.9787	1057	19	14.1
########	6:33:47	34.15944	-97.9786	1090	31	9
########	6:33:55	34.16113	-97.9787	1188	46	356.6
########	6:33:58	34.16183	-97.979	1235	54	338.7
########	6:34:04	34.16304	-97.9803	1328	59	318.1
########	6:34:06	34.16337	-97.9809	1358	64	303.7
########	6:34:13	34.16419	-97.9834	1434	69	291.5
########	6:34:18	34.1643	-97.9856	1472	77	273.6
########	6:34:23	34.16381	-97.9878	1498	82	255
########	6:34:27	34.16289	-97.9894	1514	86	235
########	6:34:31	34.16158	-97.9906	1527	89	216.9
########	6:34:36	34.1596	-97.9914	1541	91	200.4
########	6:34:43	34.15659	-97.992	1552	94	189.4
########	6:34:49	34.15394	-97.9929	1551	99	194.7
########	6:34:55	34.15144	-97.9945	1536	102	208.7
########	6:35:06	34.14754	-97.999	1519	106	223.6
########	6:35:13	34.14561	-98.0025	1522	108	236.4
########	6:35:25	34.14296	-98.0089	1577	106	243.2
########	6:35:36	34.14092	-98.0146	1650	101	246.7
########	6:35:57	34.13698	-98.0255	1694	101	246.4
########	6:36:13	34.13379	-98.0341	1700	105	245.8

########	6:36:27	34.13068	-98.0415	1700	106	243.1
########	6:36:43	34.12684	-98.0499	1715	107	241.1
########	6:37:00	34.12266	-98.0589	1680	109	240.7
########	6:37:13	34.11924	-98.0658	1685	110	239
########	6:37:34	34.11354	-98.0765	1732	108	237.3
########	6:37:47	34.10997	-98.0829	1740	107	236.2
########	6:38:04	34.10532	-98.0913	1754	106	236.1
########	6:38:23	34.10004	-98.1006	1768	107	235.8
########	6:38:36	34.09661	-98.1071	1800	105	237.2
########	6:38:50	34.0932	-98.114	1858	102	239.2
########	6:39:03	34.09007	-98.1202	1894	101	238.9
########	6:39:22	34.08572	-98.1292	1983	98	239.7
########	6:39:35	34.08272	-98.1354	2016	98	239.5
########	6:39:47	34.0799	-98.1412	2016	101	239.9
########	6:40:03	34.07617	-98.1492	2027	102	240.5
########	6:40:19	34.0724	-98.157	2068	101	239.8
########	6:40:35	34.06867	-98.1649	2125	101	240.2
########	6:40:50	34.06517	-98.1722	2150	101	240
########	6:41:02	34.06233	-98.178	2183	101	239.4
########	6:41:15	34.05912	-98.1843	2199	102	238.5
########	6:41:30	34.0553	-98.1916	2227	103	237.6
########	6:41:41	34.05252	-98.197	2254	103	237.9
########	6:41:56	34.04868	-98.2041	2293	102	237.2
########	6:42:03	34.04685	-98.2075	2315	102	236.4
########	6:42:15	34.04377	-98.2134	2307	105	238.1
########	6:42:30	34.03997	-98.2213	2281	109	239.7
########	6:42:47	34.03573	-98.2305	2244	111	240.9
########	6:43:11	34.02984	-98.2437	2195	112	241.8
########	6:43:28	34.02557	-98.2532	2131	114	241.6
########	6:43:47	34.02069	-98.264	2071	116	241.3
########	6:44:06	34.01593	-98.2747	2036	114	241.7
########	6:44:21	34.01228	-98.2829	2061	111	241.9
########	6:44:39	34.00782	-98.2925	2079	109	240.7
########	6:44:56	34.00372	-98.3015	2071	108	241.2
########	6:45:12	33.99986	-98.3101	2095	109	241.5
########	6:45:23	33.99714	-98.3159	2071	110	240.9
########	6:45:34	33.99433	-98.3219	2035	112	240.4
########	6:45:52	33.9897	-98.3317	2022	112	240.3
########	6:45:59	33.98787	-98.3356	2016	114	240.4
########	6:46:09	33.98512	-98.3411	1998	115	238.7
########	6:46:26	33.98048	-98.3498	2002	109	237.4
########	6:46:40	33.97684	-98.357	2017	107	238.5
########	6:46:59	33.97179	-98.3666	2013	107	237.7
########	6:47:16	33.96703	-98.3753	2006	110	236.6
########	6:47:29	33.9632	-98.3819	1997	111	235
########	6:47:46	33.95813	-98.3903	2002	109	234
########	6:48:02	33.95329	-98.3983	2002	111	233.7

########	6:48:14	33.94944	-98.4041	2003	111	231.7
########	6:48:27	33.94521	-98.4105	1997	113	231.4
########	6:48:43	33.94012	-98.4186	1984	113	232.7
########	6:48:53	33.93685	-98.4235	1979	113	231.2
########	6:49:08	33.93184	-98.4308	1959	114	230.6
########	6:49:23	33.92697	-98.4381	1942	111	231
########	6:49:37	33.92282	-98.445	1940	109	234
########	6:49:50	33.91938	-98.4517	1942	109	238.5
########	6:49:59	33.91731	-98.4567	1932	111	243.5
########	6:50:06	33.91603	-98.4606	1902	106	248.1
########	6:50:17	33.91424	-98.4663	1814	100	249.5
########	6:50:27	33.91263	-98.471	1733	90	247.2
########	6:50:37	33.91078	-98.4751	1629	85	242
########	6:50:46	33.90876	-98.4785	1539	82	234
########	6:50:55	33.90666	-98.4812	1480	75	227.4
########	6:51:04	33.90478	-98.4834	1426	62	223.4
########	6:51:15	33.90282	-98.4856	1396	53	223.8
########	6:51:25	33.90152	-98.4875	1371	43	229.7
########	6:51:35	33.90071	-98.4893	1347	37	241.5
########	6:51:36	33.90065	-98.4895	1346	36	246
########	6:51:48	33.90032	-98.4915	1328	32	259.2
########	6:52:02	33.90021	-98.4937	1314	27	266.4
########	6:52:15	33.90037	-98.4952	1301	21	277.5
########	6:52:27	33.9008	-98.4964	1295	20	293.3
########	6:52:34	33.90146	-98.4973	1300	30	312.9
########	6:52:40	33.90249	-98.4983	1300	49	319.1
########	6:52:47	33.90419	-98.4998	1317	64	324.6
########	6:52:55	33.90653	-98.5012	1327	71	333.2
########	6:53:07	33.9102	-98.503	1363	71	338
########	6:53:10	33.91096	-98.5035	1380	63	330.4
########	6:53:15	33.91174	-98.5047	1396	55	308.1
########	6:53:19	33.91182	-98.5058	1393	48	275.1
########	6:53:23	33.91147	-98.5066	1387	42	243
########	6:53:28	33.91069	-98.5071	1363	37	206.1
########	6:53:34	33.90972	-98.5069	1338	36	171.7
########	6:53:37	33.9093	-98.5066	1334	34	151.6
########	6:53:48	33.90819	-98.5056	1308	27	143.5
########	6:54:01	33.90736	-98.5047	1267	19	137.3
########	6:54:15	33.90648	-98.5039	1246	17	141.3
########	6:54:28	33.90587	-98.5032	1215	13	139.8
########	6:54:45	33.90524	-98.5026	1177	11	139.4
########	6:55:03	33.90464	-98.502	1150	9	140.1
########	6:55:17	33.90431	-98.5017	1144	7	140.9
########	6:55:23	33.9044	-98.5018	1144	5	312.1
########	6:55:26	33.90463	-98.5018	1128	17	351.7

NTSB CEN1 Attachment 2 to Electronic Devices Specialist's Factual Report
Operator: A Inc.
Vehicle ID/Registration: N335AE
Source of d s/n unknown
Date of Event: 10/4/2014
Location: W TX
DATA

date EDT	time EDT	latitude deg	longitude deg	altitude ft	velocity kts	track deg	hdop ratio	vdop ratio	
########	6:35:48	34.13622	-98.0276	1722.441	104.7516	245.6	0.9	1.3	
########	6:35:53	34.13522	-98.0303	1719.16	105.2916	245.5	0.9	1.3	
########	6:35:58	34.13421	-98.033	1719.16	105.8315	245.6	0.9	1.3	
########	6:36:03	34.13317	-98.0357	1719.16	105.2916	244.5	0.9	1.3	
########	6:36:08	34.1321	-98.0383	1725.722	105.2916	243	0.9	1.3	
########	6:36:13	34.13094	-98.0409	1725.722	106.3715	241.5	0.9	1.3	
########	6:36:18	34.12974	-98.0436	1722.441	107.4514	241	0.9	1.3	
########	6:36:23	34.12853	-98.0462	1722.441	107.4514	241.1	0.9	1.3	
########	6:36:28	34.12734	-98.0488	1729.003	106.3715	241.4	0.9	1.3	
########	6:36:33	34.12615	-98.0515	1732.283	106.9114	241.1	0.9	1.3	
########	6:36:38	34.12493	-98.0541	1735.564	107.9914	240.5	0.9	1.3	
########	6:36:43	34.12368	-98.0567	1729.003	109.6112	240.5	0.9	1.3	
########	6:36:48	34.12243	-98.0594	1712.598	110.6911	240.8	0.9	1.3	
########	6:36:53	34.12115	-98.062	1699.475	111.2311	239	0.9	1.3	
########	6:36:58	34.1198	-98.0647	1699.475	109.0713	238.3	0.9	1.3	
########	6:37:03	34.11846	-98.0673	1702.756	109.0713	237.8	0.9	1.3	
########	6:37:08	34.1171	-98.0699	1706.037	109.0713	237.4	0.9	1.3	
########	6:37:13	34.11573	-98.0724	1706.037	109.0713	237.5	0.9	1.3	
########	6:37:18	34.11437	-98.0749	1715.879	106.9114	236.5	0.9	1.3	
########	6:37:23	34.11301	-98.0774	1732.283	106.3715	236.8	0.9	1.3	
########	6:37:28	34.11163	-98.0799	1738.845	106.9114	235.9	0.9	1.3	
########	6:37:33	34.11025	-98.0824	1742.126	106.3715	236.5	0.9	1.3	
########	6:37:38	34.10889	-98.0849	1751.969	105.8315	236.1	0.9	1.3	
########	6:37:43	34.10752	-98.0873	1761.811	105.8315	236.3	0.9	1.3	
########	6:37:48	34.10618	-98.0898	1768.373	105.8315	236.5	0.9	1.3	
########	6:37:53	34.10476	-98.0923	1768.373	106.9114	234.8	0.9	1.3	
########	6:37:58	34.10334	-98.0946	1768.373	106.9114	235.4	0.9	1.3	
########	6:38:03	34.10194	-98.0971	1774.934	106.3715	236	0.9	1.3	
########	6:38:08	34.10058	-98.0996	1778.215	105.8315	237.1	0.9	1.3	
########	6:38:13	34.09925	-98.1021	1784.777	105.8315	236.6	0.9	1.3	
########	6:38:18	34.09792	-98.1046	1788.058	104.7516	238	0.9	1.3	
########	6:38:23	34.09663	-98.107	1804.462	103.6717	237.5	0.9	1.3	
########	6:38:28	34.09536	-98.1095	1817.585	103.1317	239	0.9	1.3	
########	6:38:33	34.09415	-98.112	1833.99	101.5119	240	0.9	1.3	
########	6:38:38	34.09298	-98.1144	1856.955	100.432	239.4	0.9	1.3	
########	6:38:43	34.09179	-98.1168	1879.921	100.9719	239	0.9	1.3	
########	6:38:48	34.09058	-98.1192	1896.325	99.89201	239.5	0.9	1.3	
########	6:38:53	34.08941	-98.1216	1919.291	98.81209	239.5	0.9	1.3	

########	6:38:58	34.08826	-98.1241	1942.257	98.27214	239.8	0.9	1.3
########	6:39:03	34.08712	-98.1264	1965.223	97.19222	239.9	0.9	1.3
########	6:39:08	34.08599	-98.1287	1988.189	97.19222	239.9	0.9	1.3
########	6:39:13	34.08485	-98.1311	2004.593	98.27214	240	0.9	1.3
########	6:39:18	34.0837	-98.1335	2014.436	98.81209	239.3	0.9	1.3
########	6:39:23	34.08253	-98.1358	2027.559	99.35205	239.4	0.9	1.3
########	6:39:28	34.08134	-98.1382	2034.121	101.5119	239.5	0.9	1.3
########	6:39:33	34.08016	-98.1407	2030.84	101.5119	240.8	0.9	1.3
########	6:39:38	34.07902	-98.1432	2037.402	101.5119	241	0.9	1.3
########	6:39:43	34.07787	-98.1457	2040.682	102.5918	241	0.9	1.3
########	6:39:48	34.0767	-98.1482	2043.963	102.0518	240.5	0.9	1.3
########	6:39:53	34.07554	-98.1507	2053.806	101.5119	240	0.9	1.3
########	6:39:58	34.07436	-98.1531	2066.929	100.9719	240	0.9	1.3
########	6:40:03	34.07319	-98.1556	2080.052	100.9719	239.9	0.9	1.3
########	6:40:08	34.072	-98.158	2093.176	100.9719	239.4	0.9	1.3
########	6:40:13	34.07079	-98.1604	2099.738	102.0518	239.3	0.9	1.3
########	6:40:18	34.06963	-98.1629	2112.861	100.9719	241.4	0.9	1.3
########	6:40:23	34.0685	-98.1653	2129.265	100.432	240.6	0.9	1.3
########	6:40:28	34.06734	-98.1678	2145.669	100.432	240.1	0.9	1.3
########	6:40:33	34.06618	-98.1702	2158.793	100.9719	240	0.9	1.3
########	6:40:38	34.06501	-98.1726	2171.916	100.432	239.9	0.9	1.3
########	6:40:43	34.06384	-98.1751	2185.039	100.9719	239.5	0.9	1.3
########	6:40:48	34.06264	-98.1775	2198.163	100.432	239.6	0.9	1.3
########	6:40:53	34.06144	-98.18	2211.286	102.5918	238.8	0.9	1.3
########	6:40:58	34.0602	-98.1824	2214.567	102.0518	238.8	0.9	1.3
########	6:41:03	34.05895	-98.1848	2230.971	101.5119	237.8	0.9	1.3
########	6:41:08	34.05769	-98.1872	2247.375	102.0518	237.5	0.9	1.3
########	6:41:13	34.0564	-98.1896	2260.499	102.5918	237.8	0.9	1.3
########	6:41:18	34.05512	-98.1921	2263.78	103.6717	238	0.9	1.3
########	6:41:23	34.05386	-98.1946	2267.06	103.6717	238.4	0.9	1.3
########	6:41:28	34.05259	-98.1969	2276.903	102.5918	237.3	0.9	1.3
########	6:41:33	34.05131	-98.1994	2296.588	102.0518	237.4	0.9	1.3
########	6:41:38	34.05004	-98.2018	2312.992	101.5119	238.1	0.9	1.3
########	6:41:43	34.04876	-98.2041	2329.396	102.0518	236.1	0.9	1.3
########	6:41:48	34.04745	-98.2065	2349.081	101.5119	236.6	0.9	1.3
########	6:41:53	34.04615	-98.2089	2358.924	103.6717	237.3	0.9	1.3
########	6:41:58	34.04485	-98.2114	2355.643	105.2916	238.1	0.9	1.3
########	6:42:03	34.04357	-98.2139	2349.081	106.3715	239	0.9	1.3
########	6:42:08	34.04227	-98.2165	2335.958	108.5313	239	0.9	1.3
########	6:42:13	34.04099	-98.2192	2326.115	109.0713	240.3	0.9	1.3
########	6:42:18	34.03974	-98.2218	2312.992	110.1512	240.5	0.9	1.3
########	6:42:23	34.03851	-98.2245	2303.15	110.1512	241	0.9	1.3
########	6:42:28	34.03725	-98.2271	2296.588	110.6911	240.8	0.9	1.3
########	6:42:33	34.036	-98.2299	2283.465	111.2311	241.1	0.9	1.3
########	6:42:38	34.03475	-98.2326	2270.341	111.7711	241	0.9	1.3
########	6:42:43	34.0335	-98.2354	2257.218	111.7711	241.1	0.9	1.3
########	6:42:48	34.03226	-98.2381	2247.375	111.7711	242	0.9	1.3

########	6:42:53	34.03106	-98.2409	2237.533	112.311	242.6	0.9	1.3
########	6:42:58	34.02987	-98.2437	2227.69	112.311	242.8	0.9	1.3
########	6:43:03	34.02865	-98.2465	2214.567	113.3909	242	0.9	1.3
########	6:43:08	34.0274	-98.2492	2198.163	114.4708	241.8	0.9	1.3
########	6:43:13	34.02613	-98.252	2181.759	114.4708	241	0.9	1.3
########	6:43:18	34.02483	-98.2549	2158.793	116.0907	241	0.9	1.3
########	6:43:23	34.02354	-98.2577	2135.827	116.0907	241.3	0.9	1.3
########	6:43:28	34.02224	-98.2605	2116.142	115.5508	241	0.9	1.3
########	6:43:33	34.02096	-98.2634	2103.018	114.4708	242	0.9	1.3
########	6:43:38	34.01972	-98.2662	2093.176	113.9309	242.3	0.9	1.3
########	6:43:43	34.01847	-98.269	2080.052	114.4708	241.3	0.9	1.3
########	6:43:48	34.01719	-98.2718	2066.929	113.9309	241.6	0.9	1.3
########	6:43:53	34.01595	-98.2746	2060.367	113.3909	242.1	0.9	1.3
########	6:43:58	34.01475	-98.2774	2057.087	112.311	242.5	0.9	1.3
########	6:44:03	34.01353	-98.2802	2060.367	110.6911	241.5	0.9	1.3
########	6:44:08	34.01231	-98.2829	2070.21	109.6112	241.5	0.9	1.3
########	6:44:13	34.01109	-98.2856	2076.772	109.6112	241	0.9	1.3
########	6:44:18	34.00983	-98.2882	2080.052	109.6112	240.5	0.9	1.3
########	6:44:23	34.00858	-98.2909	2086.614	107.9914	240.6	0.9	1.3
########	6:44:28	34.00738	-98.2935	2099.738	107.4514	241	0.9	1.3
########	6:44:33	34.00617	-98.2961	2112.861	106.9114	241.1	0.9	1.3
########	6:44:38	34.00498	-98.2987	2119.423	108.5313	241.4	0.9	1.3
########	6:44:43	34.00376	-98.3014	2109.58	110.6911	241.8	0.9	1.3
########	6:44:48	34.00257	-98.3042	2099.738	109.6112	242.3	0.9	1.3
########	6:44:53	34.00138	-98.3069	2103.018	108.5313	241.6	0.9	1.3
########	6:44:58	34.00018	-98.3095	2112.861	107.9914	241.1	0.9	1.3
########	6:45:03	33.99894	-98.3121	2122.703	108.5313	240.5	0.9	1.3
########	6:45:08	33.99769	-98.3148	2116.142	110.6911	240.8	0.9	1.3
########	6:45:13	33.99644	-98.3175	2099.738	111.7711	240.9	0.9	1.3
########	6:45:18	33.99516	-98.3202	2083.333	113.3909	240	0.9	1.3
########	6:45:23	33.99384	-98.323	2063.648	112.851	240.3	0.9	1.3
########	6:45:28	33.99255	-98.3257	2053.806	112.851	240.4	0.9	1.3
########	6:45:33	33.99126	-98.3285	2043.963	111.7711	241	0.9	1.3
########	6:45:38	33.99001	-98.3312	2047.244	110.6911	240.4	0.9	1.3
########	6:45:43	33.98872	-98.3338	2043.963	111.7711	239.6	0.9	1.3
########	6:45:48	33.98739	-98.3365	2020.997	113.9309	239.1	0.9	1.3
########	6:45:53	33.986	-98.3393	1998.031	113.3909	238	0.9	1.3
########	6:45:58	33.9846	-98.3419	1988.189	112.311	237.5	0.9	1.3
########	6:46:03	33.98322	-98.3445	1988.189	110.6911	237.9	0.9	1.3
########	6:46:08	33.98186	-98.3471	1991.47	109.6112	238	0.9	1.3
########	6:46:13	33.98051	-98.3497	1994.751	108.5313	237.6	0.9	1.3
########	6:46:18	33.97918	-98.3523	1998.031	107.9914	238.6	0.9	1.3
########	6:46:23	33.9779	-98.3548	2004.593	107.4514	239.5	0.9	1.3
########	6:46:28	33.97662	-98.3574	2017.717	106.3715	238.4	0.9	1.3
########	6:46:33	33.97532	-98.36	2027.559	106.9114	238	0.9	1.3
########	6:46:38	33.97399	-98.3625	2030.84	107.4514	237.5	0.9	1.3
########	6:46:43	33.97265	-98.365	2027.559	109.0713	237.1	0.9	1.3

########	6:46:48	33.97126	-98.3676	2017.717	109.6112	237.4	0.9	1.3
########	6:46:53	33.96989	-98.3702	2011.155	109.6112	237.4	0.9	1.3
########	6:46:58	33.9685	-98.3727	2011.155	109.0713	236	0.9	1.3
########	6:47:03	33.96706	-98.3752	2011.155	110.1512	235.5	0.9	1.3
########	6:47:08	33.9656	-98.3778	1994.751	111.7711	235.6	0.9	1.3
########	6:47:13	33.96413	-98.3803	1984.908	110.6911	234.9	0.9	1.3
########	6:47:18	33.96264	-98.3828	1988.189	109.6112	233.9	0.9	1.3
########	6:47:23	33.96114	-98.3853	1998.031	109.0713	234.1	0.9	1.3
########	6:47:28	33.95966	-98.3878	2001.312	109.6112	234.3	0.9	1.3
########	6:47:34	33.95786	-98.3908	2001.312	110.1512	234.1	0.9	1.3
########	6:47:39	33.95638	-98.3933	1998.031	110.6911	235	0.9	1.3
########	6:47:44	33.95489	-98.3958	1998.031	110.1512	233.5	0.9	1.3
########	6:47:49	33.95333	-98.3982	2001.312	110.1512	231.9	0.9	1.3
########	6:47:54	33.95173	-98.4006	2001.312	110.6911	231.6	0.9	1.3
########	6:47:59	33.95013	-98.4031	1998.031	111.7711	231.5	0.9	1.3
########	6:48:04	33.94851	-98.4055	1994.751	111.2311	231.1	0.9	1.3
########	6:48:09	33.94688	-98.4079	1991.47	111.2311	230.9	0.9	1.3
########	6:48:14	33.94521	-98.4103	1984.908	112.311	231	0.9	1.3
########	6:48:19	33.9436	-98.4128	1978.346	111.7711	232	0.9	1.3
########	6:48:24	33.94201	-98.4153	1971.785	112.311	232.6	0.9	1.3
########	6:48:29	33.94044	-98.4178	1965.223	112.851	232.8	1.1	1.3
########	6:48:34	33.93884	-98.4203	1955.381	112.311	231.1	0.9	1.3
########	6:48:39	33.93719	-98.4227	1948.819	112.311	230.5	0.9	1.3
########	6:48:44	33.93552	-98.4251	1942.257	112.851	230	0.9	1.2
########	6:48:49	33.93385	-98.4275	1935.696	112.851	230.5	0.9	1.2
########	6:48:54	33.93218	-98.4299	1925.853	112.851	230.5	0.9	1.2
########	6:48:59	33.93052	-98.4323	1916.01	112.851	230.5	0.9	1.2
########	6:49:04	33.92887	-98.4348	1912.73	112.311	231.6	0.9	1.2
########	6:49:09	33.92728	-98.4373	1909.449	111.7711	232.9	0.9	1.2
########	6:49:14	33.92574	-98.4397	1912.73	110.6911	233.9	0.9	1.2
########	6:49:19	33.92425	-98.4422	1916.01	110.1512	234.8	0.9	1.2
########	6:49:24	33.92283	-98.4448	1922.572	109.6112	236.8	0.9	1.2
########	6:49:29	33.92147	-98.4474	1929.134	109.6112	238.4	0.9	1.2
########	6:49:34	33.92016	-98.45	1935.696	109.6112	239.4	0.9	1.2
########	6:49:39	33.91891	-98.4527	1935.696	109.6112	241.5	0.9	1.2
########	6:49:44	33.91775	-98.4554	1929.134	107.9914	243.8	0.9	1.2
########	6:49:49	33.91673	-98.4581	1906.168	107.9914	246.9	0.9	1.2
########	6:49:54	33.91582	-98.4609	1873.36	105.2916	249.1	1.2	1.8
########	6:49:59	33.915	-98.4636	1837.27	102.0518	250.1	0.9	1.2
########	6:50:04	33.91421	-98.4662	1804.462	95.0324	249.5	1.2	1.8
########	6:50:09	33.91343	-98.4685	1771.654	90.17279	247.5	0.9	1.2
########	6:50:14	33.91264	-98.4708	1738.845	86.93305	246	0.9	1.2
########	6:50:19	33.91177	-98.473	1699.475	85.31317	242.9	0.9	1.2
########	6:50:24	33.9108	-98.475	1653.543	84.23326	239.1	0.9	1.2
########	6:50:29	33.90974	-98.477	1604.331	82.61339	234.5	0.9	1.2
########	6:50:34	33.90856	-98.4787	1555.118	79.37365	229.1	0.9	1.2
########	6:50:39	33.90736	-98.4803	1512.467	73.43413	227.8	0.9	1.2

########	6:50:44	33.90626	-98.4817	1479.659	65.33477	225.5	0.9	1.2
########	6:50:49	33.90519	-98.4829	1446.85	59.93521	222.5	1.1	1.2
########	6:50:54	33.90421	-98.484	1420.604	55.07559	223.1	0.9	1.2
########	6:50:59	33.90331	-98.485	1404.199	51.2959	224.4	0.9	1.2
########	6:51:04	33.90253	-98.4859	1387.795	46.43629	227.3	0.9	1.2
########	6:51:09	33.90186	-98.4869	1374.672	42.65659	230.8	0.9	1.2
########	6:51:14	33.90133	-98.4878	1368.11	38.33693	237.8	0.9	1.2
########	6:51:19	33.90092	-98.4887	1358.268	35.63715	243.5	1.2	1.8
########	6:51:24	33.90061	-98.4895	1345.144	32.93736	250.6	0.9	1.2
########	6:51:29	33.90043	-98.4905	1335.302	31.31749	260.3	0.9	1.2
########	6:51:34	33.90037	-98.4913	1328.74	30.77754	265	0.9	1.2
########	6:51:39	33.90031	-98.4921	1322.178	29.15767	264.5	1.2	1.8
########	6:51:44	33.90026	-98.4929	1312.336	26.45788	265.3	1.2	1.8
########	6:51:49	33.90023	-98.4936	1302.493	23.21814	269.3	1.2	1.8
########	6:51:54	33.90025	-98.4942	1295.932	20.51836	272.3	1.2	1.8
########	6:51:59	33.90031	-98.4947	1289.37	20.51836	280.6	1.2	1.8
########	6:52:04	33.90041	-98.4953	1286.089	21.05832	283.3	1.2	1.8
########	6:52:09	33.90055	-98.4959	1282.808	18.89849	290.6	1.2	1.8
########	6:52:14	33.90076	-98.4963	1276.247	20.51836	305.6	0.9	1.2
########	6:52:19	33.90118	-98.4969	1276.247	31.85745	312.6	0.9	1.2
########	6:52:24	33.90188	-98.4977	1279.528	48.59611	319	1.2	1.8
########	6:52:29	33.90289	-98.4986	1286.089	61.01512	321.6	0.9	1.2
########	6:52:34	33.90412	-98.4997	1295.932	66.41469	327.5	1.2	1.7
########	6:52:39	33.90554	-98.5006	1309.055	70.73434	333.8	1.2	1.7
########	6:52:44	33.90708	-98.5015	1318.898	72.89417	336.1	1.2	1.7
########	6:52:49	33.90865	-98.5022	1328.74	70.73434	338.3	1.2	1.7
########	6:52:54	33.91016	-98.503	1341.864	66.41469	337	1.2	1.7
########	6:52:59	33.91137	-98.5039	1364.829	57.23542	315	1.2	1.7
########	6:53:04	33.91193	-98.5052	1381.234	49.67603	281	0.9	1.2
########	6:53:09	33.91175	-98.5064	1387.795	41.03672	243	0.9	1.2
########	6:53:14	33.91102	-98.5071	1377.953	37.25702	201.6	1.4	2.3
########	6:53:19	33.91015	-98.5071	1354.987	35.09719	170.1	1.4	2.3
########	6:53:24	33.90939	-98.5067	1338.583	32.93736	147.6	1.4	2.3
########	6:53:29	33.90878	-98.5061	1328.74	28.07775	143.4	1	1.4
########	6:53:34	33.9083	-98.5057	1318.898	22.67819	141.5	1	1.5
########	6:53:39	33.90794	-98.5053	1302.493	18.89849	138.3	1	1.5
########	6:53:44	33.90762	-98.505	1286.089	18.35853	136.3	1	1.5
########	6:53:49	33.90731	-98.5047	1272.966	17.27862	135.5	1	1.5
########	6:53:54	33.90704	-98.5042	1256.562	17.27862	135.6	0.9	1.3
########	6:53:59	33.90673	-98.5039	1246.719	16.73866	140.5	1	1.5
########	6:54:04	33.90644	-98.5036	1236.877	14.57883	140.6	1	1.5
########	6:54:09	33.9062	-98.5034	1223.753	12.41901	140.1	0.9	1.3
########	6:54:14	33.90598	-98.5032	1210.63	11.87905	139.1	1	1.5
########	6:54:19	33.90577	-98.503	1204.068	11.33909	145.5	1.4	2.3
########	6:54:24	33.90556	-98.5028	1197.507	10.25918	141.4	1	1.5
########	6:54:29	33.90539	-98.5026	1187.664	9.179266	136.6	1	1.5
########	6:54:34	33.90522	-98.5025	1177.822	9.719222	142.4	0.9	1.3

########	6:54:39	33.90504	-98.5023	1167.979	9.719222	139.8	1	1.5
########	6:54:44	33.90487	-98.5021	1158.136	8.639309	143.1	1	1.4
########	6:54:49	33.90472	-98.502	1151.575	8.099352	139.6	1	1.4
########	6:54:54	33.90458	-98.5018	1145.013	7.559395	138.4	1	1.4
########	6:54:59	33.90446	-98.5017	1141.732	6.479482	139	1.2	2
########	6:55:04	33.90435	-98.5016	1138.451	5.399568	155	1	1.3
########	6:55:09	33.90434	-98.5017	1131.89	15.65875	302.3	2.8	3.3
########	6:55:14	33.9047	-98.5019	1040.026	16.73866	326.3	1.5	3.1