NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Ashburn, Virginia 20147

May 22, 2014

Trajectory Study

ERA13FA253

John Clark

ACCIDENT

Location: Johnstown, NY
Date: May 24, 2013
Time: 2110 GMT,
Aircraft: Piper PA34-200T, N31743
NTSB: ERA13FA253
IIC: A Diaz

SUMMARY

On May 24, 2013, at 2110 GMT, a Piper PA34-200T airplane broke up inflight following a rapid loss of altitude and resulting increase in airspeed. The airplane was destroyed upon ground contact. The pilot and two passengers were killed in the accident and there were no reported ground injuries.

Instrument meteorological conditions prevailed along the route of flight. The airplane flew generally to the northwest at 8,300 feet mean sea level (MSL) at 130 knots calibrated airspeed (KCAS[1]). The airplane was expected to turn to the west, but instead turned to the north. Within about one minute the airplane entered a 400-degree descending turn to the left. The airplane descended about 3,700 feet in 36 seconds, accelerated to about 240 KCAS or 255 KTAS and broke up.

An airplane performance history was developed using airplane characteristics, atmospheric data, and recorded radar data. The information is presented in a Radar Performance Study. A breakup scenario was developed that would produce the wreckage scatter as found and was consistent with the performance study.

[1] The conditions were established using recorded radar data and airplane performance data. The data are presented in the Radar Performance Study.

DISCUSSION

TRAJECTORY PROGRAM

A simple trajectory program was created using FORTRAN to calculate the ballistic trajectories of parts that separated from the airplane. The intent is to use the trajectories to define the initiation point of the breakup and the flight characteristics of the airplane at breakup.

The ballistic trajectory of each part is determined by a set of initial conditions at separation and calculating a ballistic flight path that results from gravity, drag and upper air winds. The end point of each trajectory is then "moved" to the point where the part was found.

In an ideal situation, the trajectories of each part could be well defined and each would start at a singular point in space and end at the point on earth where the part was found. However, there are too many variables to determine a precise trajectory for each part. Fortunately, the data is sufficiently accurate to determine that some sets of initial conditions are possible or even likely, where other sets of initial conditions are unlikely.

The estimated drag characteristic of each part is presented as CdS. A flat plate drag coefficient of 1.0 is used in conjunction with the cross sectional area of the part. For example, if a part cross section is $S1=1.3\ ft^2$, CdS=1.3. If a part is likely tumbling, the CdS = (S1+S2)*.635 where S1 and S2 are the cross sectional areas of two sides of an object. Drop tests and wind tunnel test data may improve the accuracy of the CdS estimates.[2]

[2] A flat plate drag Cd=1.28 may be used if the object has sharp edges, is flat, and the flat side perpendicular to the air flow.

INITIAL CONDITIONS

A set of initial conditions at the point of breakup is defined using available information. In this case, the positions, speeds and flight path angles were obtained from the Radar Performance Study.

Condition 1:
Altitude: 4,600 feet msl
Speed: 240 KCAS
Flight path angle: -48 0 degrees
Ground track: 340 degrees true

OVERVIEW OF AREA

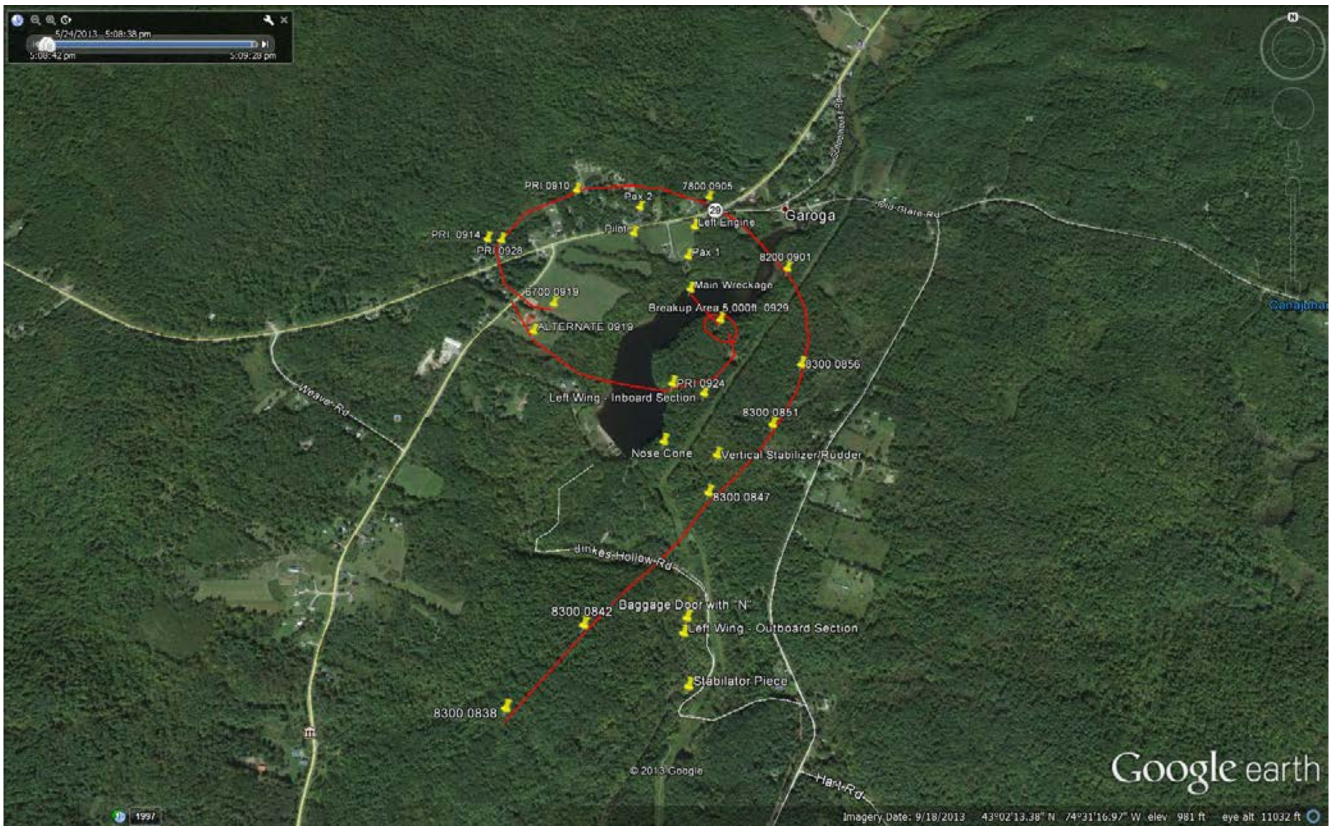

Figure 1 – Radar data and location of objects

BALLASTIC DATA FOR EACH PART

The location and ballistic data for objects are presented below. The smaller parts were measured and weighed.

OBJECT	CDS	WEIGHT	N(nm)	E(nm)	
FUSELAGE	140.0	2500.0	0.000	0.000	#fuselage
LEFT ENGINE	12.0	400.0	0.120	0.007	#left engine
LEFT WING TIP	9.0	7.0	-0.610	-0.017	#left wing tip w=10 to 20 CDs==6 to 8
PIECE OF STAB	1.0	0.5	-0.690	-0.009	#small piece of stab CDs=.6 to 1
PASSENGER 2	6.0	240.0	0.167	-0.090	
PASSENGER 1	5.8	140.0	0.060	-0.004	
PILOT	6.7	240.0	0.112	-0.100	
NOSE CONE	4.0	15.0	-0.296	-0.047	#nose cone
LEFT WING SECTION	18.0	70.0	-0.209	0.019	#left wing section W=50 to 60 CDs=17 to 27
VERT STAB + RUDDER	19.0	50.0	-0.318	0.038	#vert stab and rudder W=30 to 40 CDs=19 to 30
LEFT STAB	15.0	10.0	-0.560	-0.009	#left stabilator and piece from right CDs=15 to 9
BAGGAGE DOOR	9.0	6.0	-0.580	-0.011	#door CDs= 4 to 6

WINDS ALOFT

ALT (ft msl)	DIR (T)	VEL (KT)	TEMP(F)
260.0	291.0	4.0	47.0
280.0	347.0	4.0	48.0
360.0	279.0	6.0	45.0
640.0	296.0	9.0	44.0
940.0	313.0	7.0	43.0
1230.0	341.0	7.0	42.0
1620.0	340.0	12.0	40.0
1750.0	335.0	13.0	40.0
1900.0	19.0	13.0	39.0
2050.0	9.0	12.0	38.0
2240.0	20.0	10.0	38.0
2500.0	39.0	8.0	37.0
3020.0	22.0	10.0	35.0
3350.0	10.0	13.0	34.0
3530.0	20.0	17.0	33.0
4130.0	5.0	19.0	32.0
4780.0	356.0	17.0	30.0
5320.0	348.0	15.0	29.0
6500.0	355.0	13.0	27.0
7340.0	110.0	9.0	36.0
8430.0	157.0	9.0	33.0
9510.0	195.0	9.0	31.0

RESULTS

This study shows that the airplane likely broke up about 4,600 while tracking about 340 degrees, descending about 45 degrees downward, and flying about 240 KCAS or 255 KTAS. The more dense objects moved more northerly as they descended while the less dense objects moved more southerly as they drifted with the wind. The flight conditions at the breakup were consistent with the Radar Performance Study. The positions of the calculated initiation points are tightly grouped, as shown in Figures 2 and 3.

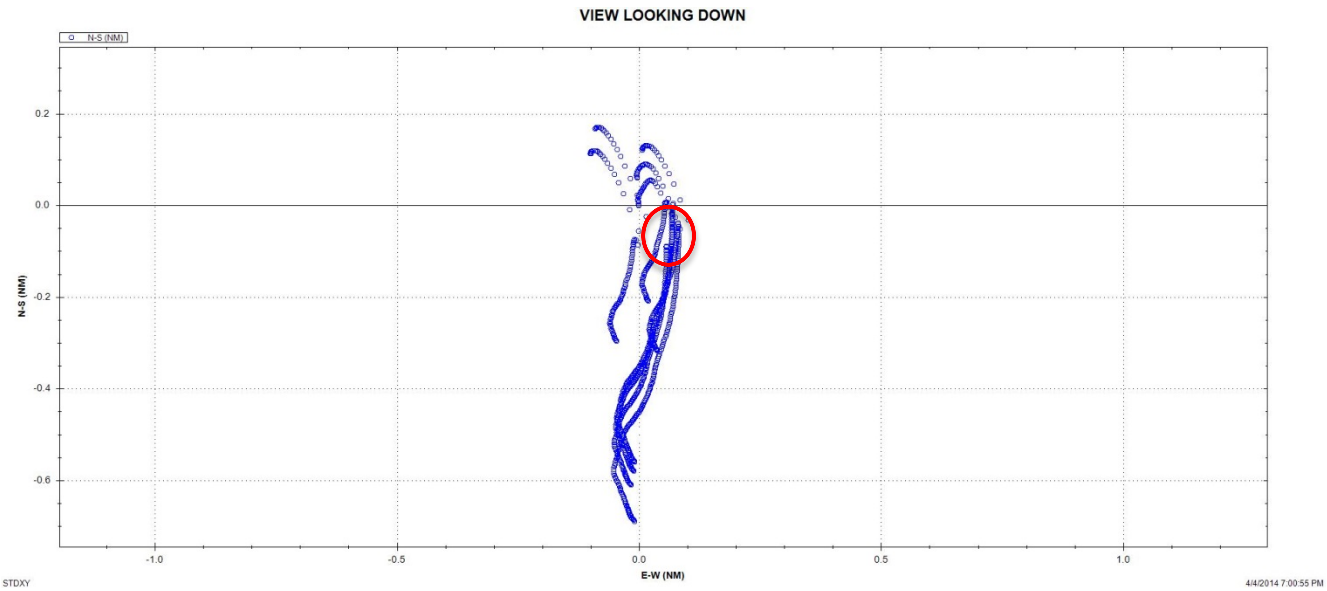

Figure 2 - Track of individual objects when viewd from above.

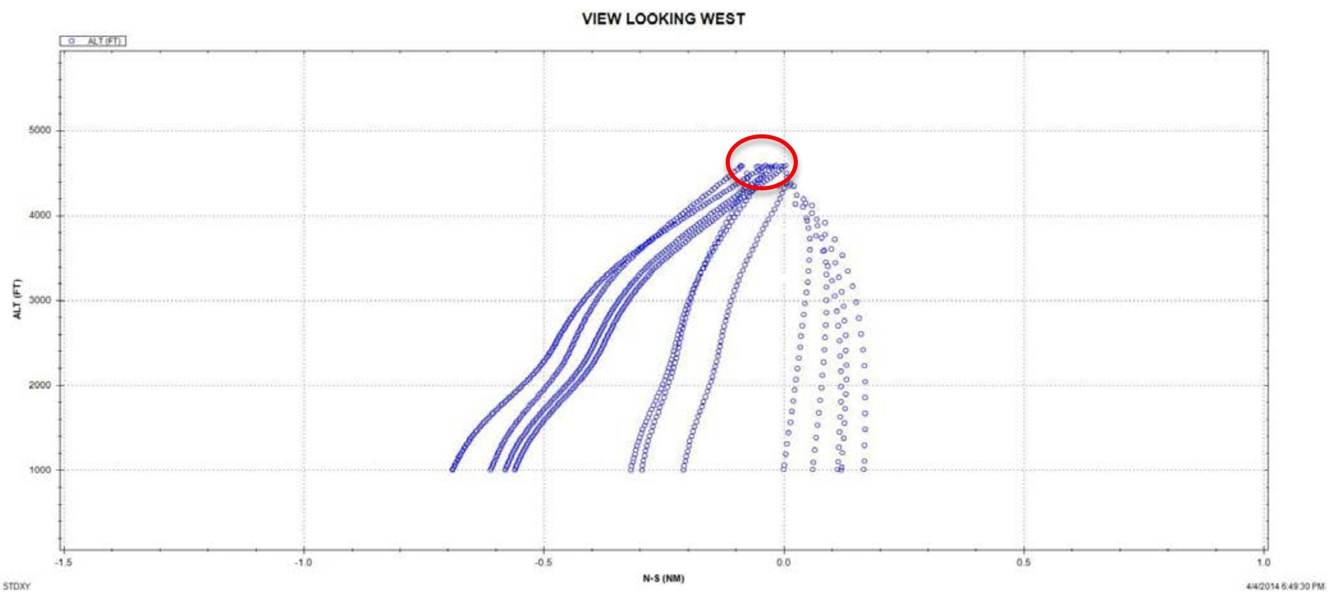

Figure 3 - track of individual parts when viewed from the east.

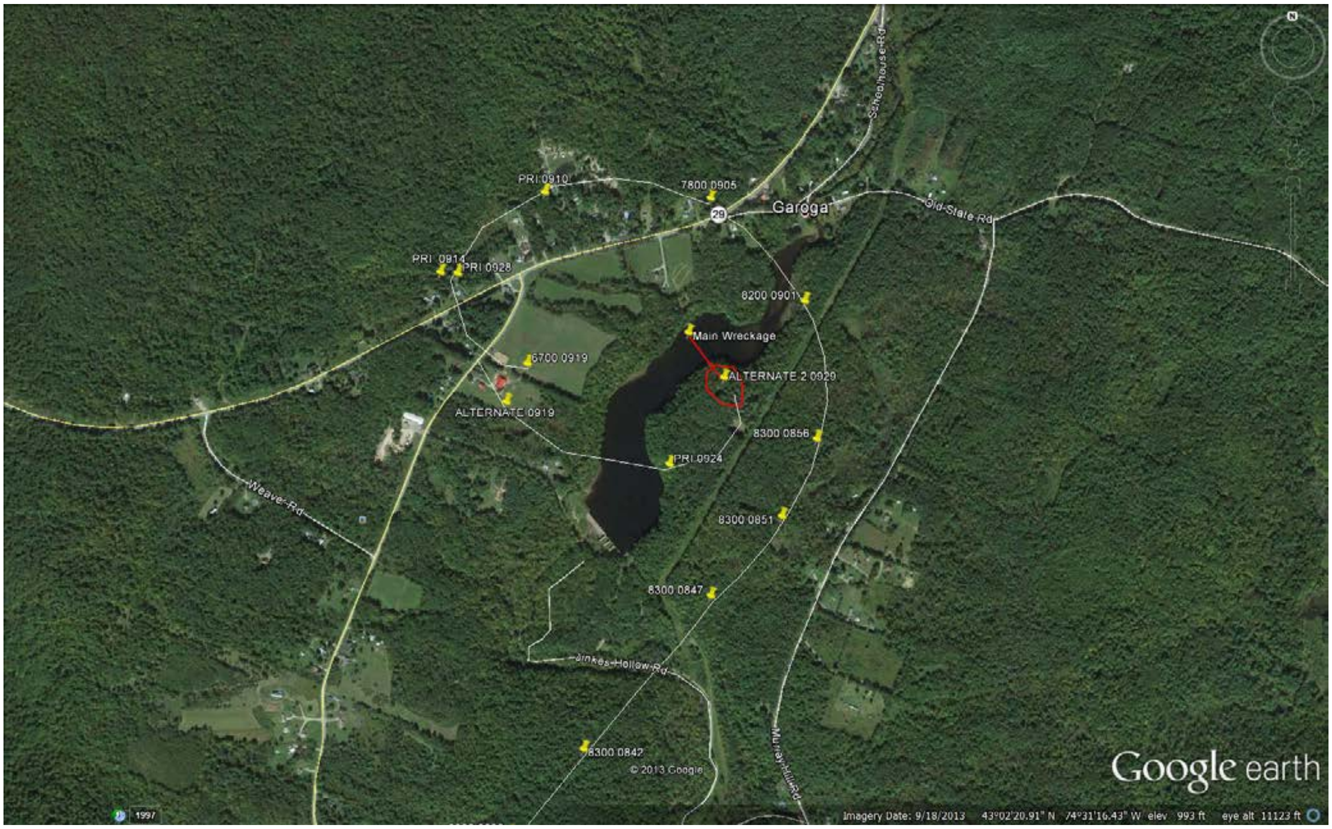

Figure 4 – The red circle shows the likely breakup area. The data is consistent with a breakup near 5,000 feet.

John Clark
Senior Technical Advisor
Office of Aviation Safety