Aviation Investigation Final Report

Location:	Brinnon, Washington	**Accident Number:**	WPR17FA215
Date & Time:	September 29, 2017, 22:13 Local	**Registration:**	N9549W
Aircraft:	Piper PA 28-140	**Aircraft Damage:**	Destroyed
Defining Event:	Controlled flight into terr/obj (CFIT)	**Injuries:**	1 Fatal, 1 Serious
Flight Conducted Under:	Part 91: General aviation - Instructional		

Analysis

The flight instructor and student pilot were conducting the student's first night flight: a cross-country visual flight rules flight to two other airports which concluded with a return to their home airport. Review of the student's flight planning documents, which included the penciled flight route on a Sectional Aeronautical chart and a hand-filled paper flight planning form, revealed that the student had planned to conduct the entire flight at an altitude of 3,500 ft msl. The student's plotted course for the last leg of the flight, which was drawn directly from the departure airport to the destination, passed over a peak with a charted elevation of 3,440 ft. While in the airplane, and prior to engine start, the student and instructor reviewed the planned flight and current weather. The first leg was flown using air traffic control (ATC) flight following services. This northeast-bound leg was flown at 4,500 ft, an altitude that was contrary to the FAA hemispheric rule (easterly flights should be flown at odd-thousand ft altitudes and westerly flights should be flown at even-thousand ft altitudes); ATC did not assign or question this altitude selection. The second leg was westbound and did not use ATC flight-following; the leg was flown at 3,500 ft, again contrary to the FAA hemispheric rule. The final, southbound accident leg was also flown at 3,500 ft; this altitude selection was erroneous for two reasons. First, it was contrary to the hemispheric rule, but more significantly, the student pilot's plotted course line on the Sectional chart passed directly over a peak that was charted as having an elevation of 3,440 ft. The airplane impacted the terrain immediately prior to that peak at an elevation about 3,075 ft mean sea level (msl). Examination of the airplane and engine did not reveal any pre-impact mechanical deficiencies or failures that would have precluded continued normal operation.

Review of flight track and data from onboard personal electronic devices (PEDs) was consistent with a controlled flight into terrain (CFIT) event. Further review of the flight planning form showed an airport listed as a waypoint for the accident leg; the airport was located just east of the direct route between the departure and destination. If the pilots had chosen to navigate first toward this airport then to the destination rather than flying direct, the flight would have avoided the mountainous terrain. Additionally, the student's planned altitudes did not comply with Federal Aviation Administration regulations regarding cruise flight altitudes. The investigation was unable to determine why neither the student nor the flight instructor detected the erroneous planned and flown altitude. Although the student's work schedule in the days leading up to the accident may have been conducive to the development of fatigue and, subsequently, his error in planning, there was insufficient evidence to determine the presence or role of fatigue. Further, as pilot-in-command, the instructor should have reviewed the flight planning documents and detected these errors.

Both the student pilot and the flight instructor owned multiple portable electronic devices (PEDs) equipped with flight planning and operating software capable of displaying geo-referenced flight and terrain information. As part of his training regimen, the flight instructor did not let the student use any PEDs during flight; however, the student stated that the flight instructor would typically use his PEDs to monitor or augment the flight while they were airborne.

Whether the flight instructor was using his PEDs during the accident flight could not be determined; however, he had sufficient time, tools, and knowledge to detect the flight's improper altitude and proximity to terrain with or without the use of PEDs, and why he failed to do so and instead allowed the flight to remain on that track at that altitude could not be determined.

CFIT prevention is primarily dependent on pilots' complete and accurate situational awareness, which can be aided by many safety tools and measures. Despite the fact that the flight instructor held the knowledge, tools, and responsibility to ensure proper and safe conduct of the flight, particularly with regard to appropriate altitude selection, the circumstances of the accident indicate that neither he nor the student possessed complete and accurate situational awareness, most critically for the accident leg, which resulted in the CFIT event.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:
The flight instructor's failure to completely and properly evaluate the student pilot's incorrectly- planned flight, and his failure to use all available resources to maintain situation awareness during the flight, which resulted in controlled flight into terrain.

Findings

Personnel issues	Flight planning/navigation - Instructor/check pilot
Personnel issues	Identification/recognition - Instructor/check pilot
Personnel issues	Use of available resources - Instructor/check pilot
Personnel issues	Situational awareness - Instructor/check pilot
Personnel issues	Flight planning/navigation - Student/instructed pilot
Environmental issues	Dark - Effect on operation

Factual Information

History of Flight

Prior to flight	Preflight or dispatch event
Enroute-cruise	Controlled flight into terr/obj (CFIT) (Defining event)

On September 29, 2017, about 2213 Pacific daylight time, a Piper PA-28-140, N9549W, was destroyed when it impacted trees and terrain near Brinnon, Washington (WA) during a night cross-country flight. The student pilot was seriously injured, and the flight instructor was fatally injured. The airplane was owned and operated by the Shelton Flight flying club as a Title 14 *Code of Federal Regulations* Part 91 instructional flight. Night visual meteorological conditions prevailed in the vicinity of the accident site about the time of the accident. The airplane had departed Jefferson County International Airport (0S9), Port Townsend, Washington, and was destined for its base and origination point of Sanderson Field Airport (SHN), Shelton, Washington when the accident occurred.

The pilot who flew the airplane immediately prior to the accident pilots stated that he flew the airplane for about an hour, and that the airplane operated normally, with no irregularities or problems. That pilot topped off the fuel tanks, and then turned the airplane over to the accident pilots about 2015.

The flight was the student pilot's first night flight, and was to consist of three legs, with full-stop landings at each of the two intermediate airports. The accident pilots did not file a flight plan for any of the legs but were in radio communication with air traffic control (ATC) for the first leg and the first part of the second leg.

The trip originated when the airplane departed SHN about 2050. The pilots requested and received visual flight rules (VFR) flight following services by ATC, with a stated destination of Snohomish County Airport (Paine Field, PAE), Everett, Washington. The airplane conducted a full stop landing at PAE about 2130, and then departed PAE for 0S9. About 2135, the pilot acknowledged a communications facility switch from PAE ATCT, but did not establish contact with the next facility; no further ATC communications to or from the airplane were recorded.

The airplane landed at 0S9 about 2156, and then departed on a direct course towards SHN. Although the pilots were not in communication with ATC during this leg, the flight was captured by Federal Aviation Administration (FAA) ground-based radar. The last radar return from the airplane was obtained at 2212:23 and depicted the airplane as slightly north of the accident location, and at an indicated radar altitude of 3,250 ft. About 2238, the student pilot telephoned 911 to summon help; this was the first notification that the airplane was missing or had crashed.

First responders reached the wreckage about 0500 the next morning, and the student pilot was airlifted from the scene by a US Navy helicopter a few hours later. Investigation and recovery personnel accessed the accident site 2 days after the accident. The wreckage was situated on a heavily wooded slope in the Olympic National Forest at an elevation about 3,075 ft mean sea level (msl).

Student pilot Information

Certificate:	Student	**Age:**	35,Male
Airplane Rating(s):	None	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Lap only
Instrument Rating(s):	None	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 3 Without waivers/limitations	**Last FAA Medical Exam:**	September 1, 2015
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	44 hours (Total, all aircraft), 43 hours (Total, this make and model)		

Flight instructor Information

Certificate:	Airline transport; Flight instructor	**Age:**	69,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):		**Restraint Used:**	Lap only
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane single-engine	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	December 8, 2016
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	(Estimated) 27000 hours (Total, all aircraft)		

Flight Instructor

The flight instructor was a retired airline pilot with multiple type ratings. Insurance application information indicated that he had a total flight experience of over 27,000 hours, including more than 2,000 hours in fixed-gear, single-engine airplanes. His most recent FAA second-class medical certificate was issued in December 2016. No records of either his flight instruction or PA-28 experience could be determined. No information was located to indicate that the flight instructor instructed at any flight training schools.

Student Pilot

The student pilot obtained his FAA third-class medical certificate in September 2015. He had logged 44.5 hours of flight time, not including the accident flight, in his personal logbook. His first flight was in December 2016, and all his flights except one were conducted in the accident airplane.

Aircraft and Owner/Operator Information

Aircraft Make:	Piper	**Registration:**	N9549W
Model/Series:	PA 28-140 140	**Aircraft Category:**	Airplane
Year of Manufacture:	1967	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	28-22981
Landing Gear Type:	Tricycle	**Seats:**	4
Date/Type of Last Inspection:	September 17, 2017 Annual	**Certified Max Gross Wt.:**	
Time Since Last Inspection:	34 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	5495 Hrs at time of accident	**Engine Manufacturer:**	LYCOMING
ELT:	Installed	**Engine Model/Series:**	O-320 SERIES
Registered Owner:	On file	**Rated Power:**	0 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

FAA information indicated that the airplane was manufactured in 1967, and was purchased by Shelton Flight in August 2015. Maintenance records indicated that the airplane was equipped with a Lycoming O-320-E2A series engine. The engine was overhauled and installed in the accident airplane in October 1994, at which time the airplane tachometer registered 4,791.0 hours. The most recent annual inspection was completed in September 2017, at which time the airplane tachometer registered 5,461.9 hours.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Unknown	**Condition of Light:**	Night
Observation Facility, Elevation:	0S9,110 ft msl	**Distance from Accident Site:**	18 Nautical Miles
Observation Time:	21:55 Local	**Direction from Accident Site:**	360°
Lowest Cloud Condition:	Few / 3600 ft AGL	**Visibility**	9 miles
Lowest Ceiling:	Overcast / 4200 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots / None	**Turbulence Type Forecast/Actual:**	Unknown / Unknown
Wind Direction:	140°	**Turbulence Severity Forecast/Actual:**	Unknown / Unknown
Altimeter Setting:	30.04 inches Hg	**Temperature/Dew Point:**	13°C / 11°C
Precipitation and Obscuration:	N/A - None - Unknown precipitation		
Departure Point:	Port Townsend, WA (0S9)	**Type of Flight Plan Filed:**	None
Destination:	Shelton, WA (SHN)	**Type of Clearance:**	None
Departure Time:	21:59 Local	**Type of Airspace:**	

The SHN 2053 automated weather observation included winds from 250° at 6 knots, visibility 10 miles, clear skies, temperature 13° C, dew point 11° C, and an altimeter setting of 30.02 inches of mercury. At 2300, the approximate time that the flight would have returned to SHN, the skies remained clear, the wind speed had increased, and temperatures had decreased slightly.

Bremerton National Airport (PWT), Bremerton, Washington was located slightly east of the direct route between SHN and PAE. The PWT 2056 automated weather observation included calm winds, visibility 10 miles, clear skies, temperature 8° C, dew point 7° C, and an altimeter setting of 30.05 inches of mercury. The 2239 observation indicated scattered clouds at 1,800 ft and a broken ceiling at 6,000 ft.

The PAE 2053 automated weather observation included winds from 010° at 6 knots, visibility 10 miles, broken ceiling at 3,600 ft, overcast ceiling at 4,600 ft, temperature 13° C, dew point 8° C, and an altimeter setting of 30.05 inches of mercury. At 2153 the ceiling was overcast at 3,700 ft, and at 2253 the ceiling was overcast at 4,400 ft.

The 0S9 2035 automated weather observation included calm winds, visibility 10 miles, overcast ceiling at 4,000 ft, temperature 13° C, dew point 10° C, and an altimeter setting of 30.03 inches of mercury. By 2055 the ceiling had lowered to 3,800 ft, and by 2115 was at 3,600 ft. The 2135 observation included a broken ceiling at 3,600 ft and overcast ceiling at 4,100 ft. At 2155, which was about the time that the airplane was at 0S9, the observation included few clouds at 3,600 ft, and an overcast ceiling at 4,200 ft.

Wreckage and Impact Information

Crew Injuries:	1 Fatal, 1 Serious	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal, 1 Serious	**Latitude, Longitude:**	47.761112,-122.936386

On-Scene

The accident location was about 1/4 mile south of the last radar return, and coincident with a direct track from 0S9 to SHN. Site elevation was about 3,075 ft. A partial swath of topped or damaged trees, presumed to have been made by the airplane, was observed. The swath had an approximate alignment of 110°, and a descent angle of about 30°. Most trees appeared to be Douglas Fir, with trunks up to about 18 inches in diameter, and heights of 75 ft or more.

The fuselage came to rest upright, on an approximate heading of 180°, at about a 30° airplane nose down angle; the aft end was supported by vegetation. The engine remained attached to the fuselage, and the propeller remained attached to the engine. The propeller and engine were partially embedded in the soil. The cockpit volume was compromised by crushing in the aft direction. Both fuel tanks were breached, and no fuel was observed at the time of the site examination. Both wings and the left horizontal stabilizer were fracture-separated from the fuselage. All aerodynamic and flight control surfaces appeared to be present at the accident site. The key remained in the ignition switch, which was set to the "BOTH" position. The cockpit fuel selector valve handle was found set to the right fuel tank. The tachometer registered 5,495.38 hours. The 121.5 Mhz emergency locator transmitter (ELT) was found still attached to its antenna cable, and the switch was found in the "AUTO" (armed) position. The wreckage was recovered to a secure facility for subsequent detailed examination.

Post-Recovery

All major portions of the airplane and all flight control surfaces were identified in the recovered wreckage. Flight control continuity was confirmed to the extent possible, given the condition of the wreckage. The flaps were in the retracted position at impact. The pitch trim components suggested that the stabilator was set to neutral to slightly airplane nose up at impact, but damage precluded positive determination. No pre-impact anomalies or mechanical deficiencies of the airframe were observed that would have precluded continued normal operation.

The engine was partially damaged by impact. No evidence of any pre-impact internal failures of the engine was observed. Both magnetos were intact and produced sparks at all towers when rotated by hand. All spark plugs displayed normal in-service appearance and condition. Engine valve and drive train continuity was confirmed by hand rotation of the engine. All cylinders appeared normal during borescope examination.

The carburetor was partially fractured but remained attached to the engine. Both the throttle and mixture controls remained attached to the carburetor. The carburetor was disassembled, and the metal floats exhibited hydraulic crushing on their outboard sides. The carburetor fuel inlet screen was found free of debris. The engine driven fuel pump produced pressure when operated by hand. The vacuum pump was disassembled, and the rotor and vanes were found intact. No pre-impact anomalies or mechanical deficiencies of the engine that would have precluded continued normal operation and flight were observed.

Additional Information

Student Pilot's Background and Schedule

The student pilot became interested in flying when he was teaching at the aforementioned skydiving school and asked the accident flight instructor to be his primary flight instructor. It was not determined what curriculum or program guidance, if any, the flight instructor used to instruct the student pilot. According to one of the skydiving school owners, the accident flight instructor and pilot frequently used tables at the skydiving facility to conduct their lessons and flight planning. According to the FAA Aviation Instructor Handbook, low-noise level, distraction-free rooms or spaces, particularly those equipped with instructional aids, positively contribute to learning quality.

The student was a service member in the U.S. Army at the time of the accident. He stated that he worked his regular Army shift of 0430 to 1200 each day from Tuesday, September 26 through Friday September 29 (the day of the accident). On Tuesday, he worked at the skydiving school from 1300 to 1700. On Wednesday, he met with the accident flight instructor to review the planned flight from 1300 to 1400, and then worked at the skydiving school from 1400 to 1700. On Thursday, he worked at the skydiving school from 1300 to 1700, and then played baseball from 1930 to 2230.

On the day of the accident, he worked his normal Army shift, and then napped at home from about 1300 to 1700. He arrived at SHN about 1950, and he and the flight instructor took possession of the airplane about 2015. One account by the student pilot stated that they reviewed the flight plan again in the airplane, but another account stated that he did not remember much before the accident.

Hemispheric Rule

Title 14 *CFR* paragraph 91.159 specifies the cruising altitudes to be used as a function of direction of flight, and this guidance is typically referred to as the "hemispheric rule." Hemispheric rule flight altitudes are predicated on magnetic course (MC), which is the true course adjusted for magnetic variation. For MC values from 0° (360°) to 179°, odd thousand-foot altitudes are to be used, and for MC values from 180° to 359°, even thousand-foot altitudes are to be used. For VFR flights, such as the accident flight, 500 ft are to be added to each altitude. The hemispheric rule only applies to flights at altitudes greater than 3,000 ft above ground level (agl).

Sectional Chart Maximum Elevation Figures

Sectional Aeronautical charts are divided into quadrants, which are areas bounded by ticked lines of 30 minutes of latitude and longitude. Each quadrant contains a Maximum Elevation Figure (MEF). According to the FAA's Aeronautical Chart User's Guide, the MEF represents the highest elevation within a quadrant, including terrain and other obstacles (towers, trees, etc.). MEF figures are rounded up to the nearest 100 ft value, and the last two digits of the number are not shown. Thus, a quadrant with an obstacle of 4,437 ft would have an MEF of 45.

Student Pilot's Flight Planning

Both the student and flight instructor owned multiple personal electronic devices (PEDs) that could be used for flight planning and as navigation aids during flight; these included three tablets (such as iPads with the Foreflight software), and one Appareo Stratus GPS device. The student stated that the flight instructor did not let him use any PEDs during flight; the flight instructor's intent was to prevent the student pilot from becoming reliant on those devices until he was proficient using more traditional, non-electronic means such as paper flight plan sheets, paper charts, ground reference points (landmarks), and ground tracks. The flight instructor would typically use his PEDs to monitor or augment the flight while they were airborne.

According to the student, he and the flight instructor had spoken a few weeks prior to the accident regarding the night flight. The originally discussed route of flight was SHN to PLU (Pierce County Airport - Thun Field, Puyallup, Washington) to PAE to 0S9 to SHN. The two met 2 days before the accident flight, in order to review the student's flight plan. That plan was for the route SHN-PAE-0S9-SHN; the student pilot forgot to include PLU in his flight planning. The flight plan was complete except for winds aloft information. The flight instructor reportedly told the student that the student pilot's proffered plan looked good. The investigation did not determine the medium (PED, paper, or both) that was used for this review, and did not determine what, if any, altitude discussions took place.

The student reported that he was familiar with the planned flight and had flown it or similar routes previously. According to his logbook, the student had flown to 0S9 three other times, including once from 0S9 to SHN, a week before the accident. The student pilot's specific route(s) for that airport pair were not known, but he stated that he "always" used an altitude of 5,500 ft so that the flight "would clear the mountains."

PEDs on Accident Flight

According to the student, as part of their preflight preparations at SHN that evening, the flight instructor used the student mobile phone as a 'hot-spot' for his Stratus device to enable them to access the most current weather information. For the flight itself, the flight instructor used his iPad mini with Foreflight to monitor the flight's progress. The Appareo Stratus communicates wirelessly with the iPad/Foreflight unit to present altitude, navigation, weather, and traffic information. "Geo-referencing" the term used to describe when such information is graphically depicted in relation to a map or aerial photo image was the primary display mode for the iPad/Foreflight combination and included terrain display and warning capability. Neither the iPad's specific operating/display mode nor any accident fight or flight track information was recorded by the iPad, but the Stratus did retain flight and flight track information, and that data was successfully recovered for the investigation.

Student Pilot's Accident Flight Plan

During a post-accident examination, a paper Seattle Sectional Aeronautical chart and a commercial preprinted tabular flight plan form with handwritten entries were found in the cockpit. Their condition (open/unfolded, torn, scuffed, and stained) was consistent with them being used by the pilot at the time of the accident. According to these documents, the student pilot had planned a flight for the route SHN-PAE-0S9-SHN.

The chart contained penciled lines depicting the direct track routes for the three flight legs. The tabular flight plan contained handwritten entries for the same route, but with three enroute landmarks inserted between SHN and PAE, and one landmark ("PWT") inserted between 0S9 and SHN. The entries included altitude, wind, track/course, distance, and time information for each of the trip legs. The form did not have a column for magnetic course.

Review of the checkpoint locations on the Sectional chart revealed that the checkpoints generally were abeam of, instead of directly on, the track lines between the origin and destination airports. Although most checkpoints were offset from the direct airport-to-airport tracks, the student-entered track/course information on the tabular form were of a constant value for each origin-destination airport pair. In other words, the student's tabular planned flight was a series of direct airport-to-airport legs (SHN-PAE-0S9-SHN) that were the same as the tracks drawn on the Sectional chart, and did not include any track/course information to or from any of the checkpoints.

The elevation of 0S9 was 110 ft, and the elevation of SHN was 272 ft. The track line for the last planned (and accident) leg direct from 0S9 to SHN that the student pilot had drawn on the Sectional chart crossed a region of mountainous terrain. A charted peak of 3,440 ft was directly on that track line, and charted peaks of over 4,000 ft were about 5 miles to the west of that track line. The Maximum Elevation

Figure (MEF) for that quadrant was 4,800 ft. The accident location was on the track line from 0S9 to SHN, less than 1 mile before the 3,440 ft peak.

Student Pilot's Planned Flight Altitudes

As part of the effort to determine the student pilot's altitude selection methodology, some of his entries into his flight-planning form were compared to NTSB-generated values for the same trip legs.(See Table located in Docket)

During a post-accident interview, the student pilot did not recall when he entered the altitudes on his flight plan form. Most of the underlying terrain on the student pilot's planned legs had elevations less than 500 ft, meaning that generally, the 3,500 ft altitude would have put the airplane above 3,000 ft agl, and that the flight would be required to comply with the hemispheric rule.

Aside from circumnavigating the globe, it is geometrically impossible to conduct any flight at a constant altitude above 3,000 ft agl that returns to the airport of origin and also complies with the hemispheric rule. The student pilot had entered the same 3,500 ft altitude for all three of the trip legs.

Recovered Stratus Data

An Appareo Stratus PRX V2 device that belonged to the flight instructor was found in the wreckage. The device is a self-contained battery-powered unit with an internal Attitude and Heading Reference System (AHRS), GPS/WAAS receiver and Automatic Dependent Surveillance - Broadcast (ADS-B) receiver. The device communicates wirelessly with compatible devices, such as the flight instructor's iPad, to display all acquired information. In addition, the device records GPS position and AHRS information internally in its non-volatile memory at approximately 5 data records per second (5 Hz). The device was sent to the NTSB Vehicle Recorders Laboratory in Washington D.C, for a successful download of data from all three legs of the accident flight.

The following flight event timeline was developed from the recovered Stratus data.

- 2035:43 Status powered ON
- 2044:04 Begin taxi SHN
- 2045:31 Arrive run up area SHN
- 2050:10 Exit run up area SHN
- 2050:55 Start T/O roll SHN 23. ATC flight following for this leg
- 2128:20 Touchdown PAE runway 34L
- 2129:56 Stop PAE
- 2133:29 Start T/O roll PAE runway 34L. No ATC flight following this leg
- 2153:17 Touchdown 0S9 runway 9
- 2154:39 Stop 0S9
- 2158:25 Take 0S9 runway 27

- 2158:46 Start T/O roll 0S9 runway 27. No ATC contact for this leg
- 2212:48 Last data point. Accident

The data indicated that for the last leg of the flight, the airplane departed from 0S9 via runway 27 about 2159, began a left turn of about 160° to the southeast, then turned to a southerly course directly toward SHN. About 6 minutes after takeoff, the airplane stopped its climb at about 3,500 ft, but exhibited several altitude excursions of about 500 ft over the next 3 minutes. The airplane leveled off about 2208 at an altitude about 3,300 ft, still proceeding approximately directly towards SHN.

The last minute of recorded data consisted of two altitude excursions, with a net overall altitude decrease of about 200 ft. The final data point had a time tag of 2212:48, and a GPS altitude of 3,094 ft.

Stratus-derived groundspeeds recovered from the device were consistent with the published performance of the airplane. Refer to the public docket for this accident for detailed information.

Flight Instructor Responsibilities

Title 14 *CFR* paragraph 91.3 states that the pilot-in-command (PIC) of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft." Title 14 *CFR* paragraph 91.103 states that "Each pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight."

Controlled Flight into Terrain (CFIT) Accidents

The FAA states that controlled flight into terrain (CFIT) "occurs when an airworthy aircraft is flown, under the control of a qualified pilot, into terrain … with inadequate awareness on the part of the pilot of the impending collision." In April 2003, the FAA published Advisory Circular (AC) 61-134, "General Aviation Controlled Flight Into Terrain Awareness." The AC highlights the inherent risk that CFIT poses for general aviation pilots.

The AC defined "situational awareness" as the pilot's knowledge "of what is happening around the aircraft at all times in both the vertical and horizontal planes. This includes the ability to project the near-term status and position of the aircraft in relation to other aircraft, terrain, and other potential hazards."

The AC stated that, "in visual meteorological conditions, the pilot in command (PIC) is responsible for terrain and obstacle clearance (See and Avoid)…" and identified several CFIT risks, including:

- Loss of situational awareness
- Breakdown in good aeronautical decision making
- Failure to comply with appropriate regulations
- Failure to comply with minimum safe altitudes

The AC also cited excerpts from the FAA Aeronautical Information Manual (AIM), which listed frequent pilot-involved causal factors for general aviation accidents, and stated that many of those same factors applied to CFIT accidents. These factors included:

- Inadequate preflight preparation and/or planning
- Failure to see and avoid objects or obstructions
- Improper in-flight decisions or planning

The AC further stated that:

"VFR flight operations may be conducted at night in mountainous terrain with the application of sound judgment and common sense. Proper pre-flight planning, giving ample consideration to winds and weather, knowledge of the terrain and pilot experience in mountain flying are prerequisites for safety of flight. Continuous visual contact with the surface and obstructions is a major concern and flight operations under an overcast or in the vicinity of clouds should be approached with extreme caution."

Preventing Similar Accidents

Controlled Flight Into Terrain in Nighttime Visual Conditions (SA-013)

The Problem

Controlled flight into terrain (CFIT) by both instrument flight rules (IFR)-rated and visual flight rules (VFR) pilots operating under visual flight conditions at night in remote areas have occurred, in many of these cases, when the pilots were in contact with air traffic controllers at the time of the accident and receiving radar service. The pilots and controllers involved all appear to have been unaware that the aircraft were in danger. Increased altitude awareness and better preflight planning would likely prevent these types of accidents.

What can you do?

- CFIT accidents are best avoided through proper preflight planning.
- Terrain familiarization is critical to safe visual operations at night. Use sectional charts or other topographic references to ensure that your altitude will safely clear terrain and obstructions all along your route.
- In remote areas, especially in overcast or moonless conditions, be aware that darkness may render visual avoidance of high terrain nearly impossible and that the absence of ground lights may result in loss of horizon reference.
- When planning a nighttime VFR flight, follow IFR practices such as climbing on a known safe course until well above surrounding terrain. Choose a cruising altitude that provides terrain separation similar to IFR flights (2,000 feet above ground level in mountainous areas and 1,000 feet above the ground in other areas.)
- When receiving radar services, do not depend on air traffic controllers to warn you of terrain hazards. Although controllers will try to warn pilots if they notice a hazardous situation, they may not always be able to recognize that a particular VFR aircraft is dangerously close to terrain.
- When issued a heading along with an instruction to "maintain VFR," be aware that the heading may not provide adequate terrain clearance. If you have any doubt about your ability to visually avoid terrain and obstacles, advise ATC immediately and take action to reach a safe altitude if necessary.
- ATC radar software can provide limited prediction and warning of terrain hazards, but the warning system is configured to protect IFR flights and is normally suppressed for VFR aircraft. Controllers can activate the warning system for VFR flights upon pilot request, but it may produce numerous false alarms for aircraft operating below the minimum instrument altitude—especially in en route center airspace.
- For improved night vision, the FAA recommends the use of supplemental oxygen for flights above 5,000 feet.
- If you fly at night, especially in remote or unlit areas, consider whether a global positioning system-based terrain awareness unit would improve your safety of flight.

See https://www.ntsb.gov/Advocacy/safety-alerts/Documents/SA-013.pdf for additional resources

The NTSB presents this information to prevent recurrence of similar accidents. Note that this should not be considered guidance from the regulator, nor does this supersede existing FAA Regulations (FARs).

Administrative Information

Investigator In Charge (IIC):	Huhn, Michael
Additional Participating Persons:	Rod Ziegler; FAA SEA FSDO; Renton, WA Christopher Melchior; FAA SEA FSDO; Renton, WA Troy Helgeson; Lycoming Engines; Williamsport, PA Charles Little; Piper Aircraft; Vero Beach, FL
Original Publish Date:	December 16, 2019
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=96115