Aviation Investigation Final Report

Location:	Folsom, California	**Accident Number:**	WPR16LA019
Date & Time:	October 24, 2015, 16:33 Local	**Registration:**	N911WL
Aircraft:	AMERICAN EUROCOPTER LLC AS350B3	**Aircraft Damage:**	Substantial
Defining Event:	Loss of control in flight	**Injuries:**	3 None
Flight Conducted Under:	Public aircraft		

Analysis

The purpose of the public helicopter flight was to perform a patrol mission with a tactical flight officer onboard, while the flight instructor also trained the pilot under instruction (PUI), who had recently been hired by the sheriff's department. The plan was to perform a routine patrol mission to introduce the PUI to the operation of the helicopter's systems, then practice autorotations, which the PUI had not previously performed in the accident helicopter make and model.

After the patrol, they practiced a series of uneventful autorotations over flat areas. They then conducted an autorotation to a pinnacle in the middle of a peninsula. The flight instructor was flying the helicopter throughout the maneuver; during the power recovery phase of the autorotation, he applied engine power by moving the throttle twist grip from the idle to the flight position as the helicopter passed through 100 ft. The engine did not respond as he expected, and, unable to reach the pinnacle, he maneuvered the helicopter to a forced landing on downsloping terrain. The helicopter landed hard and tipped forward, resulting in substantial damage to the tailboom and aft fuselage structure. Postaccident examination of the engine and airframe did not reveal any anomalies that would have precluded normal operation, and the engine met its nominal performance parameters during a subsequent test run.

The helicopter's flight manual recommended that autorotation training be conducted within gliding distance of a suitable running landing area. The flight instructor's choice of a raised landing area, which was surrounded by soft and rocky downsloping terrain, did not represent a suitable area for such practice. Additionally, the slope did not allow a sufficient maneuvering envelope for the appropriate control inputs required to safely control the helicopter in the event of a delayed engine response or loss of engine power. Also, although physically close to a town, the location was relatively remote, because accessing the site by road would have required a long on- and off-road drive by first response vehicles around the lake. Therefore, the chosen location placed the crew in additional danger should a more serious accident have occurred.

About 3 months before the accident, the helicopter manufacturer issued a safety information notice

regarding the high exposure to accidents and incidents during simulated engine-off landing training. The notice issued a series of procedural updates, including a recommendation that minimal crew be onboard, and that power recoveries should be initiated as the helicopter passed through 200 ft above ground level (agl) rather than 70 ft agl, as recommended in the flight manual. The notice reiterated the need to be prepared to conduct an engine-off landing if power recovery was unsuccessful, along with the reminder that a higher gross weight increases the risk of a hard landing. Therefore, the flight instructor's choice of a power recovery initiation altitude (100 ft) lower than recommended left him with a reduced margin for recovery when the anomaly occurred. Further, the decision to keep the tactical flight officer onboard during the autorotation portion of the training represented an unnecessary risk both to him and the mission. The helicopter was loaded near its maximum gross weight, increasing the risk of a hard landing.

The flight instructor did not hold a valid medical certificate at the time of the accident due to a recent Type 1 diabetes diagnosis. However, as a public operation, the sheriff's department was responsible for oversight of its own operation and allowed the instructor to fly with another pilot present. The instructor was not exhibiting any symptoms of the condition, and there was no evidence to suggest his diagnosis contributed to the outcome of the accident.

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 perform simulated engine failure training in accordance with manufacturer guidance, including his improper recovery from the maneuver, which resulted in an overshoot of the intended landing zone when the engine did not respond as expected; his selection of an unsuitable landing area; and his decision to perform the maneuver near the helicopter's maximum gross weight, which resulted in a hard landing.

Findings

Personnel issues	Delayed action - Instructor/check pilot
Not determined	(general) - Unknown/Not determined
Personnel issues	Decision making/judgment - Instructor/check pilot
Personnel issues	Incorrect action selection - Instructor/check pilot
Environmental issues	Sloped/uneven terrain - Decision related to condition
Environmental issues	Sloped/uneven terrain - Contributed to outcome

Factual Information

History of Flight

Autorotation	Miscellaneous/other
Landing-flare/touchdown	Loss of control in flight (Defining event)
Landing-flare/touchdown	Hard landing

On October 24, 2015, at 1633 Pacific daylight time, an American Eurocopter AS350B3 helicopter, N911WL, landed hard during a practice autorotation near Folsom, California. The flight instructor, pilot undergoing instruction (PUI), and tactical flight officer (TFO) were not injured; the helicopter sustained substantial damage. The helicopter was registered to Placer County, and operated by the Placer County Sheriff's Department, as a public aircraft flight. Visual meteorological conditions prevailed, and a company flight plan had been filed. The instructional flight departed Mc Clellan Airfield, Sacramento, California, at 1618.

The purpose of the flight was to perform patrol missions, in addition to providing training for the PUI, who had recently been hired by the Sheriff's department. This was his first patrol training flight, and he was seated in the front left seat, with the flight instructor in the front right, and the TFO in the rear jump seat. The plan was to introduce the PUI to the helicopters systems while on patrol, and then perform a series of straight-in, 180°, and "enhanced" autorotation's. The flight instructor stated that an enhanced autorotation is a maneuver where a point is picked for an emergency landing, and the pilot is tasked with landing the helicopter at that point using whatever maneuvers are necessary.

The crew departed from their base at Auburn Municipal Airport, Auburn, California about 1230, and initially performed routine patrol work. Once completed, they then transitioned to a series of autorotation's with power recoveries in a flat field, all of which were uneventful. They then landed at Mc Clellan Airfield, and serviced the helicopter with about 120 gallons of fuel. After departure, they flew to a peninsula on the northern shore of the Folsom Lake Reservoir with the intention of performing more enhanced autorotation training. The peninsula, which according to the flight instructor was an area for training approved by the department, was normally partially submerged in water but due to drought conditions, was fully exposed.

They reported surveying the area and beginning the maneuver at 2,500 ft mean sea level (about 2,100 ft above the lake surface). The flight instructor stated that he was the pilot-in-command, and that the PUI was "shadowing" the controls.

They surveyed the area and then performed an enhanced autorotation with a power recovery to the dry lakebed. The flight instructor stated that during this maneuver the PUI appeared overwhelmed. They then set up for another approach to the peninsula, and the flight instructor told him to just track rotor RPM and not to worry about foot pedal control, or aircraft attitude, as he demonstrated that rotor RPM could be controlled with both the cyclic and collective.

The flight instructor reported that at about 1,000 ft agl, he felt the PUI was inadvertently hindering the

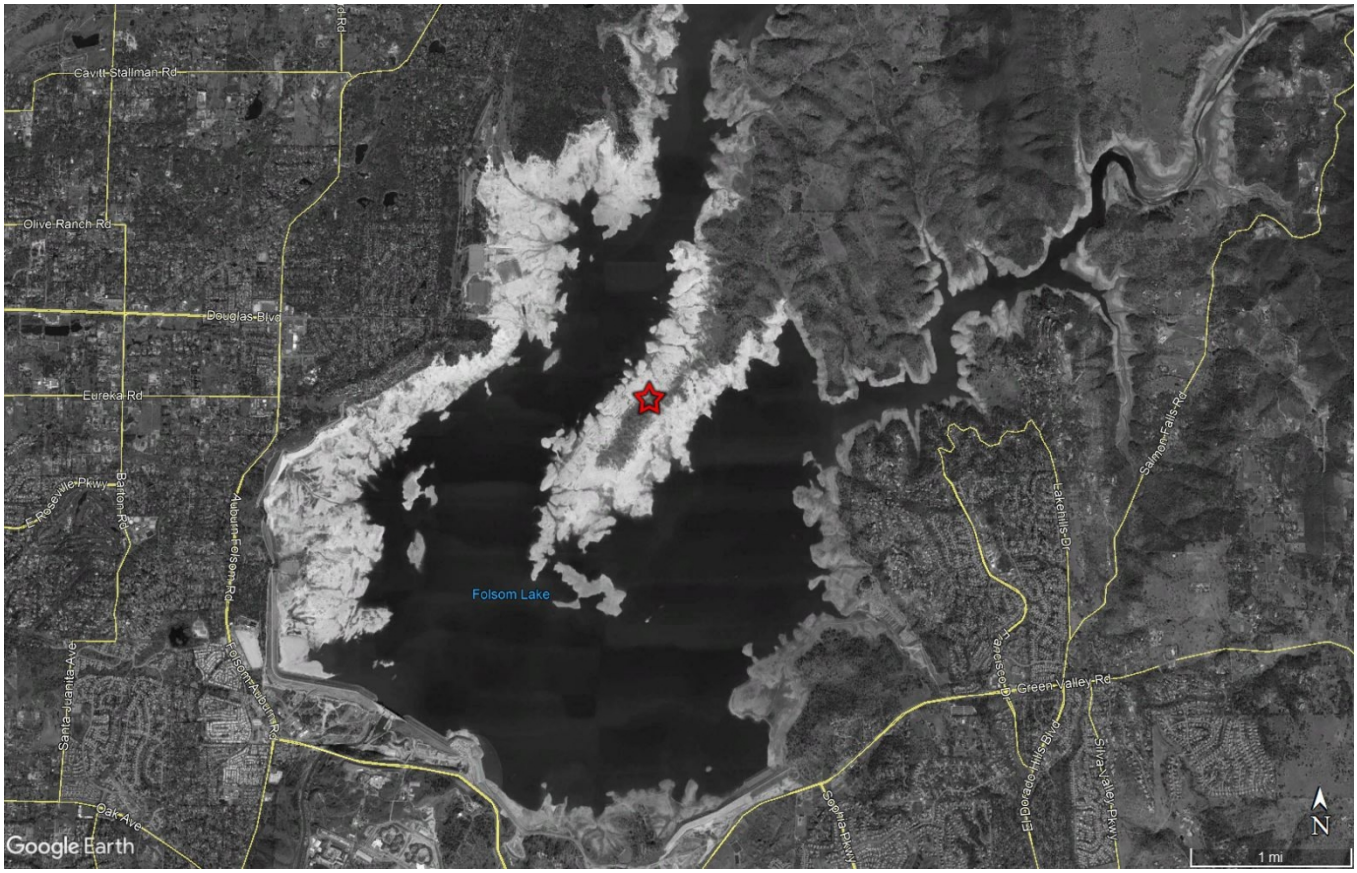
controls, and he reached over and moved the PUI's hands away from the controls. The flight instructor stated that he was not concerned, and in his experience, this was not unusual while providing training.

The rotor RPM remained within limits during the remainder of the descent, and as they approached 100 ft agl, the flight instructor verbalized his intentions to perform a power recovery, and began by turning the throttle twist grip control from idle to flight, while simultaneously initiating the flare. As the flare progressed he did not hear the engine fully regain its speed, and he checked the instruments, observing that the engine and rotor RPM needles were still "split". They were between 10 and 25 ft from the ground and he prepared for a full touchdown landing, but by now the helicopter had moved forward to an area of down-sloping terrain. He did not want to land in an unusual attitude, so aimed to touch down flat on the skids relative to the slope. He then pulled the collective control hard just before impact to cushion the landing. By now the engine had recovered to full operating speed and he immediately applied collective control lifting the helicopter back off the ground. He then maneuvered the helicopter for landing about 100 ft forward.

After landing, he exited the helicopter and discovered that the aft airframe was wrinkled, and the tailboom had bent downwards at its intersection with the aft bulkhead. He was surprised the helicopter had sustained this damage because while the landing was hard, it did not feel hard enough to cause structural damage. He recounted having performed many autorotation's before, all without anomalies, and that this time the engine sound did not match his throttle control inputs.

The flight instructor reported that during the autorotation he was focused on audio and visual external clues as he had done in the past, rather than examining the instruments during the descent. He did not hear any audible alerts during the flight, did not notice any lights on the annunciator panel, and all gauges were "in the green".

The PUI recounted similar observations, and stated that the flight instructor initially asked him if he would like to perform the final autorotation, but he was not happy doing so. They agreed that the flight instructor would fly the autorotation, and he would shadow the controls. During the descent the PUI kept his right hand on his lap, and lightly held the collective with his left hand. At one point when he was watching the Nr gauge, the cyclic brushed against his hand, and the flight instructor asked what he was doing. The flight instructor then physically moved his right hand onto his lap, but at no point was there any interference with the flight controls. They then made a final right turn towards the landing zone, and as they approached 100 ft agl, the flight instructor stated that he was applying throttle, and the PUI felt the twist grip move in his hands. The PUI then released his hand completely from the twist grip, and as they approached the hilltop which was the landing spot, the flight instructor initiated the flare. The PUI stated that it was at this point that he had a "seat of the pants" sensation that something was wrong. The flight instructor verbalized to that effect, and the PUI felt that he should be getting a sense that power was being applied, but he was not. They were about 20 ft agl as the terrain fell away, and he started to hear a change in engine tone, but the helicopter then began to rapidly sink. He saw the flight instructor then quickly pull up on the collective, and he was relieved as this seemed to be the appropriate maneuverer. The helicopter then landed hard, and started tipping forward as the engine sound continued to change. He became concerned that the helicopter may roll forward, but instead it lifted back up into the air under what now appeared to be power. He did not recall any audible warnings or annunciator panel lights during the descent.



Accident Location

The accident site was composed of rolling hills, covered in dry grass, and interspersed with rocks. The intended landing zone was on a pinnacle, about 100 ft from where the helicopter came to rest. The terrain from the top of the pinnacle to the resting location was on a downward slope of about 4°, and the site was at an elevation of about 455 ft above sea level. The site was about 2 miles across the lake from the City of Folsom, however, the closest access via automobile from Folsom would have required a drive of about 27 miles on paved and unpaved roads, followed by an off-road drive of about 1 mile.

The helicopter was recovered from the accident site the following day under the supervision of the Sheriff's department, and the accident was reported to the National Transportation Safety Board three days later.

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	44,Male
Airplane Rating(s):	None	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	4-point
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	Yes
Instructor Rating(s):	Helicopter	**Toxicology Performed:**	No
Medical Certification:	Class 2 None	**Last FAA Medical Exam:**	October 22, 2015
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	September 17, 2015
Flight Time:	5580 hours (Total, all aircraft), 1658 hours (Total, this make and model), 5328 hours (Pilot In Command, all aircraft), 64 hours (Last 90 days, all aircraft), 20 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

Pilot Information

Certificate:	Commercial; Military	**Age:**	45,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane; Helicopter	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	March 16, 2015
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	October 3, 2015
Flight Time:	1491.1 hours (Total, all aircraft), 12.1 hours (Total, this make and model), 801.2 hours (Pilot In Command, all aircraft), 15.3 hours (Last 90 days, all aircraft), 12.1 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

Flight Instructor

The flight instructor had been a member of the air support unit since 2000; he was the chief, and only helicopter pilot for the Sheriff's department. He attended ground, flight, and recurrency training at the Airbus training facility four times since 2009, the most recent occurring in May 2014. The remainder of his currency training and checkrides he received from a variety of other law enforcement agencies typically twice per year, with his last flight review taking place with an officer from the Sacramento Police Department on September 17, 2015.

He held a commercial pilot certificate and a flight instructor certificate, both with ratings for helicopter, and reported a total flight time of 5,580 hours in helicopters, 1,658 of which were in the AS350B3.

Pilot Undergoing Instruction

The PUI held a commercial pilot certificate with ratings for airplane single engine land, helicopter, instrument airplane, and instrument helicopter. He also held a type rating for Sikorsky S-65 (CH-53) helicopter. He reported a total flight time of 1,341.8 hours, with the majority of that time occurring in

the CH-53 helicopter, and 12.2 hours in the AS350 series.

The accident flight was the first time he had received autorotation training in the AS350 type.

Aircraft and Owner/Operator Information

Aircraft Make:	AMERICAN EUROCOPTER LLC	**Registration:**	N911WL
Model/Series:	AS350B3	**Aircraft Category:**	Helicopter
Year of Manufacture:	2008	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	4587
Landing Gear Type:	High skid	**Seats:**	3
Date/Type of Last Inspection:	October 9, 2015 Continuous airworthiness	**Certified Max Gross Wt.:**	5225 lbs
Time Since Last Inspection:	9 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	1451.1 Hrs as of last inspection	**Engine Manufacturer:**	Turbomeca
ELT:	C126 installed, not activated	**Engine Model/Series:**	2B1
Registered Owner:	PLACER COUNTY PUBLIC FINANCING AUTHORITY	**Rated Power:**	871 Horsepower
Operator:	Placer County Sheriff's Department	**Operating Certificate(s) Held:**	None

The helicopter, callsign Falcon 30, was manufactured in 2008 and equipped with a Turbomeca Arriel 2B1 engine. The helicopter was maintained under a continuous airworthiness program, and the last inspection occurred on October 9, 2015, 9.3 flight hours prior to the accident.

The helicopter was equipped with the Airbus Helicopters maximum gross weight increase kit, which consisted of high skid landing gear, and a dual hydraulic system. The kit gave it a maximum internal gross weight of 5,225 pounds (compared to the standard configuration gross weight of 4,960 pounds). According to the flight instructor, the helicopter weighed 5,166 pounds at the time of the accident.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KMCC,77 ft msl	**Distance from Accident Site:**	13 Nautical Miles
Observation Time:	23:35 Local	**Direction from Accident Site:**	252°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	4 knots / None	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	280°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.94 inches Hg	**Temperature/Dew Point:**	27°C / 6°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	SACRAMENTO, CA (MCC)	**Type of Flight Plan Filed:**	Company VFR
Destination:	AUBURN, CA (AUN)	**Type of Clearance:**	None
Departure Time:	16:18 Local	**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	3 None	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	3 None	**Latitude, Longitude:**	38.735832,-121.126663

Medical and Pathological Information

Flight Instructor

At the time of the accident, the flight instructor's second-class medical certificate was suspended due to a diagnosis of Type 1 diabetes. FAA records indicated that at that time a review was underway to determine his eligibility for a special issuance medical certificate.

According to the Air Unit Commander, the department was aware of the flight instructor's medical status, and they had made it a requirement that he show them his glucose levels throughout the day. Because he was not exhibiting symptoms, the decision was made to only allow the flight instructor to

continue to fly the helicopter when a "safety pilot" was also on board. He also stated that they had been in contact with the local FAA Flight Standards District Office and had advised them of his status. He was subsequently issued a third-class medical certificate in August 2017.

Based on the accounts of the helicopter's occupants, he was awake and alert both during and after the accident flight and was able to self-extricate himself from the helicopter.

Tests and Research

Engine Operation

The engine is controlled by the pilot through a guarded (ON/OFF) mode selector switch on the overhead instrument panel, and a twist grip on the collective pitch lever, with two modes, FLIGHT and IDLE. The entire system is electronically controlled by a dual-channel FADEC (Full Authority Digital Engine Control), which controls a dual stepper motor driving the engines main fuel metering valve. Should the FADEC encounter a major failure, engine operation is automatically maintained through a backup ancillary control unit (EBCAU), which controls a separate backup metering valve.

According to the "Autorotation Training Landing Procedures" section of the helicopter's flight manual, during the power recovery phase of an autorotation, the pilot should move the twist grip from IDLE to FLIGHT, which commands the FADEC to operate the engine at flight power. The electrical control logic in the twist grip mechanism is designed such that flight power is commanded as soon as the twist grip moves out of the IDLE detent (releasing the "forced-idle" microswitch), even before it enters the FLIGHT detent.

Airbus Helicopters had released an alert service bulletin (ASB), and emergency alert service bulletin (EASB) related to the electrical operation and logic of the twist grip.

EASB 05.00.61 Revision 2, issued on August 13, 2013 recommended both a functional check of the microswitches that govern IDLE and FLIGHT modes, along with the addition of a varnish to ensure the microswitches remain water-tight. The EASB was in response to a previous serious incident, where corrosion in a wet and salt-laden environment had caused the deterioration of the switch contacts and resulted in an unintentional command of the engine to IDLE power. Revision 3 was released on June 15, 2015 and included an additional step to ensure a water tight seal of the microswitch connectors. The service bulletin required a repetitive inspection every 12 months or 660 flight hours (whichever came first) for aircraft not operating in salt-laden environments.

Airframe maintenance records indicated that EASB 05.00.61 Revision 2 was last completed on August 16, 2013. No records were recovered indicating that Revision 3 had been complied with, or that a repetitive inspection of Revision 2 was performed.

ASB 80.00.09 Revision 1, issued on August 13, 2013, required the modification of the electrical connections between a microswitch, relay, and diode within the twist grip's circuitry. The modifications were introduced as a fail-safe, such that should the two stacked microswitches which control FLIGHT

mode not engage, the engine would still be commanded to flight power as soon as the twist grip was moved out of its IDLE detent (releasing the "forced-idle" microswitch). The bulletin did not have any recurrent in-service requirements.

Airframe maintenance records indicated that ASB 80.00.09 Revision 1 was completed on January 31, 2014.

In a post-accident examination, the functional and logical operation of the twist grip, along with compliance of both bulletins to their documented revision levels was confirmed. No corrosion to any of the microswitches or their contacts was observed.

Engine Examination

The engine and digital engine control unit (DECU) was removed from the helicopter and transported to the facilities of Turbomeca for examination. The complete examination report is contained within the public docket.

No external mechanical anomalies were noted to the engine, which was then installed in a test cell. The engine started normally, and preliminary acceptance tests revealed no irregularities. A series of tests were then performed at varying engine speeds and loads; and the engine performed to nominal specifications throughout. At the conclusion of the test run the EBCAU unit was tested, and it performed appropriately.

The DECU was examined and tested utilizing a Turbomeca Loading and Test Bench. Historical data from the system occurrence log was downloaded and no faults attributed to the accident flight were observed. The most recent error occurred 18,872 system cycles prior. A DECU self-test was then initiated, and the unit passed.

Mapping System

The helicopter was equipped with an Aerocomputer Ultichart UC-5100 tactical mapping system. The unit integrated onboard cameras, infrared sensors, and other aircraft systems to collect video and geo-reference information in real time during flight. The unit was sent to the NTSB Office of Research and Engineering for data extraction. The data from the accident flight was recovered and analyzed and revealed a flight track that closely matched the pilot's statements.

Organizational and Management Information

The air support unit was composed of a unit commander, chief pilot, and contract mechanic. A tactical flight officer, rescue specialist, and system operator also reported to the unit commander, but performed other duties within the Sheriff's department. The division operated the accident helicopter and a single twin-engine fixed wing airplane.

The air support unit used the helicopter in two different configurations; either as a two-person crew for

general law enforcement patrols, or a minimum three-person crew for technical rescue operations.

The chief (accident) pilot was beginning to make plans for retirement, and the PUI was due to be one of his replacements. The unit commander had retired in 2011, and had returned to lead the division 4 months before the accident, as a retired annuitant.

The air support unit utilized an operations manual, and at the time of the accident, was in the process of implementing a safety management system (SMS). The operations manual included aircrew training standards for simulated engine failure at altitude, including a recommendation that each forced landing simulation should be planned to continue to the ground if necessary. The manual did not provide guidance regarding at what altitude to apply throttle during the recovery, nor did it provide guidance for aircraft configuration, practice areas, or onboard crew limits during training operations.

Additional Information

Public Aircraft Operations

FAA Advisory Circular 00-1.1A, dated February 12, 2014, provides guidance for determining whether government aircraft operations are public or civil aircraft operations, as well as defining the responsibilities of the various operational and regulatory parties.

According to the circular, the FAA generally has limited oversight, and no regulatory authority of public aircraft operations, although such operations must continue to comply with the regulations applicable to all aircraft operating in the national airspace system.

The circular goes on to state that the government entity conducting the public aircraft operation is responsible for oversight of the operation, including aircraft airworthiness and any operational requirements.

Simulated Engine-Off Training

The most current AS350B3 Flight Manual Supplement, "Autorotation Training Landing Procedure", updated in May 2009, stated that autorotation training shall be conducted within gliding distance of a suitable running landing area, and that the power recovery phase should be initiated at an altitude of 70 ft above ground level. It also stated that as the helicopter approaches an altitude of 20/25 ft agl, forward cyclic input should be applied to give the helicopter a slightly nose-up (<10°) attitude.

Airbus Helicopters Safety Information Notice 2896-S-00, dated July 7, 2015, and applicable to the AS350 series, included recommendations for simulated engine-off landing training.

The notice stated, "Current helicopter accident / incident statistics indicate that the greatest exposure to accidents or incidents is during simulated engine-off landing (EOL). The purpose of this Safety Information Notice is to raise the level of awareness of Flight instructors involved in simulated EOL training and to stress on key points."

The notice included recommendations that minimal crew be onboard during training, and that a power recovery be initiated as the helicopter passed through 200 ft agl, rather than the 70 ft recommended in the flight manual.

Furthermore the "Tips for airman" section stated, in part:

- keep in mind that a higher All Up Weight increases the risk of NR overspeed and hard landing

- be prepared to conduct engine-off landing if power recovery is unsuccessful

- aft cyclic input during the ground slide will do nothing at all except chop off the tail boom

- for go-around maneuvers, anticipate the decision process.

Administrative Information

Investigator In Charge (IIC):	Simpson, Eliott
Additional Participating Persons:	Richard T Dilbeck; Federal Aviation Administration FSDO; Sacramento, CA Bernard Boudaille; Bureau d'Enquêtes et d'Analyses; Lyon, France Dave Harris; Placer County Sheriff's Department; Auburn, CA
Original Publish Date:	July 16, 2018
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=92255