



THE REPUBLIC OF KENYA
MINISTRY OF TRANSPORT, INFRASTRUCTURE, HOUSING,
URBAN DEVELOPMENT AND PUBLIC WORKS

STATE DEPARTMENT FOR TRANSPORT

AIRCRAFT ACCIDENT INVESTIGATION

FINAL ACCIDENT REPORT

HELICOPTER AS350 B3

REGISTRATION 5Y-NMJ

LAKE NAKURU, KENYA

21 OCTOBER 2017

OBJECTIVE

This report contains factual information which has been determined up to the time of publication. The information in this report is published to inform the aviation industry and the public of the general circumstances of the accident.

This investigation has been carried out in accordance with *The Kenya Civil Aviation (Aircraft Accident and Incident Investigation) Regulations, 2018 and Annex 13 to the International Civil Aviation Organization Convention on International Civil Aviation.*

The sole objective of the investigation of an accident or incident under these Regulations shall be the prevention of accidents and incidents. It shall not be the purpose of such an investigation to apportion blame or liability.

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ABBREVIATIONS

AAID	-	Air Accident Investigation Department
AMSL	-	Above Mean Sea Level
ASI	-	Airspeed Indicator
ATC	-	Air Traffic Services
BEA	-	Bureau d'Enquêtes et d'Analyses
CPL	-	Commercial Pilot License
EDR	-	Engine Data Recorder
FADEC	-	Full Authority Engine Control
FLI	-	First Limitation Indicator
ICAO	-	International Civil Aviation Organization
KAF	-	Kenya Air force
KCAA	-	Kenya Civil Aviation Authority
KN	-	Kenya Navy
KWS	-	Kenya Wildlife Services
VEMD	-	Vehicle Engine Monitoring Display
VSI	-	Vertical Speed Indicator

SYNOPSIS

The report describes the accident involving the AS350 type of helicopter, registration 5Y-NMJ operated by Flex Air Limited that occurred in Lake Nakuru on 21 October 2017, causing fatal injuries to all five persons onboard including the pilot.

The helicopter took-off at approximately 0337 hours and impacted Lake Nakuru after 7 minutes and 38 seconds. The accident occurred whilst the helicopter was engaged in a scenic tour of Lake Nakuru National Park. The pilot in command lost control of the helicopter after the helicopter pitched up, rolled to left and lost altitude thereby colliding with the lake. The helicopter submerged and sunk to the bottom of the lake which was approximately 8m in depth. Only some fragments of the helicopter and fuel spillage were noticeable floating over water moments later. An eye witness who observed the crashing helicopter alerted the public and search and rescue mission was activated.

It took more than 25 days to locate the wreckage of the helicopter and recover three bodies of persons onboard. The search for two other bodies onboard the helicopter was however unsuccessful even after continued search several days later. The helicopter wreckage was retrieved from the water and the avionics computers recovered. The computers were retrieved, packed and sent to Bureau d'Enquêtes et d'Analysess (BEA) for download and analysis.

The investigation finding indicated that the aircraft had a valid certificate of airworthiness and the pilot was qualified and certified to fly the helicopter. Further findings revealed that the pilot in command and the four other persons onboard had been spotted at a night club the previous night. They arrived back to the hotel that morning and proceeded into boarding the helicopter whereby

the pilot took-off for the flight. Toxicological results on the sample of the pilot in command blood, indicated he had 0.041% alcohol concentration.

The investigation findings revealed that the accident was attributed to collision with the water due to loss of situation awareness by the pilot who was under the influence of alcohol. The pilot failed to recognize the loss of altitude, excessive banking to the left, and the obstacle proximity from the aircraft.

1. FACTUAL INFORMATION

1.1. Prior history and history of the flight.

1.1.1. The aircraft

A day before the accident at 1313 hours on 20th October 2017, 5Y-NMJ was refueled with 350 litres of JETA-1 by Gulf Energy Ltd based at Wilson Airport. The purpose for refueling was indicated on the receipt as travelling to Nakuru. Further information obtained from the company indicated that the pilot was scheduled to ferry passengers from Nakuru to Mau Narok the following day for a political rally.

1.1.2. The pilot

According to the company's records on flight and flight duty time, the captain had accumulated total of 24.8 hours within the last three months preceding the accident. In the month of August 2017, he clocked a total of 14.7 hours, September, 2017 he had a total of 10.1 hours and during the month of October, 2017 he had less than 1 hour before the accident.

On 20th October 2017, at 1420 hours, immediately after refueling, the pilot took-off from Wilson airport destined to Nakuru with one unknown passenger and arrived at 1500hours after landing at the Jarika hotel. According to the information provided by one of the hotel workers, after landing at the hotel that evening, the pilot first checked in to the hotel and spent less than one hour after which he was picked by unidentified car. Another witness informed the investigation that he had been spotted in company of unknown persons at a famous club in downtown Nakuru. The information was further collaborated with the club attendants who also informed the investigation team seeing the deceased at the club. The security guard at the hotel also informed the investigation that the deceased pilot arrived at the hotel in the morning at around 0300 hours on 21 October 2017 in company of three men and one female. The deceased pilot proceeded into the helicopter which was packed outside the hotel and boarded together with three men and one female passenger.

1.1.3 History of the flight

On arrival at the hotel that morning at 0320 hours on 21st October 201, the deceased pilot proceeded and boarded the helicopter with four passengers (three men and one female). Shortly thereafter, he started the engine and at about 0337 hours, the pilot was airborne and made a few circuits before heading towards Lake Nakuru. It was not immediately established what was the purpose of the flight as he never talked to anybody on arrival at the hotel. The air operator of the helicopter also did not know the purpose of flying around the lake other than the pre-planned scheduled flight to Mau Narok which was 42km from Nakuru town. There was rumored information at the hotel by a number of witnesses to the investigation team that the pilot had planned to fly around the lake for sightseeing before they could fly back to the hotel.

At 0341 hours an eye witness, saw the helicopter fly at low level towards the lake. She saw the helicopter fly over the lake then it made a turn on southern end. It then made a left turn and flew back on the eastern side of the lake before it plunged into the water. The witness immediately alerted Kenya Wildlife Service (KWS) security officials nearby about what she had seen which according to her was unusual. The KWS security officials did not however confirm the incident until after more than two hours when the operator confirmed missing the helicopter which was later discovered had crashed into Lake Nakuru.

According to the GPS download obtained from the laboratory, the helicopter was flown at a very low level altitude between 0339 hours and 0344 hours. For instance at 0340 hours, the helicopter was captured flying at 357ft above ground level. At 0341 hours it was at 861ft above the lake. At 0344 hours it was captured at 69ft above the water level of the lake.

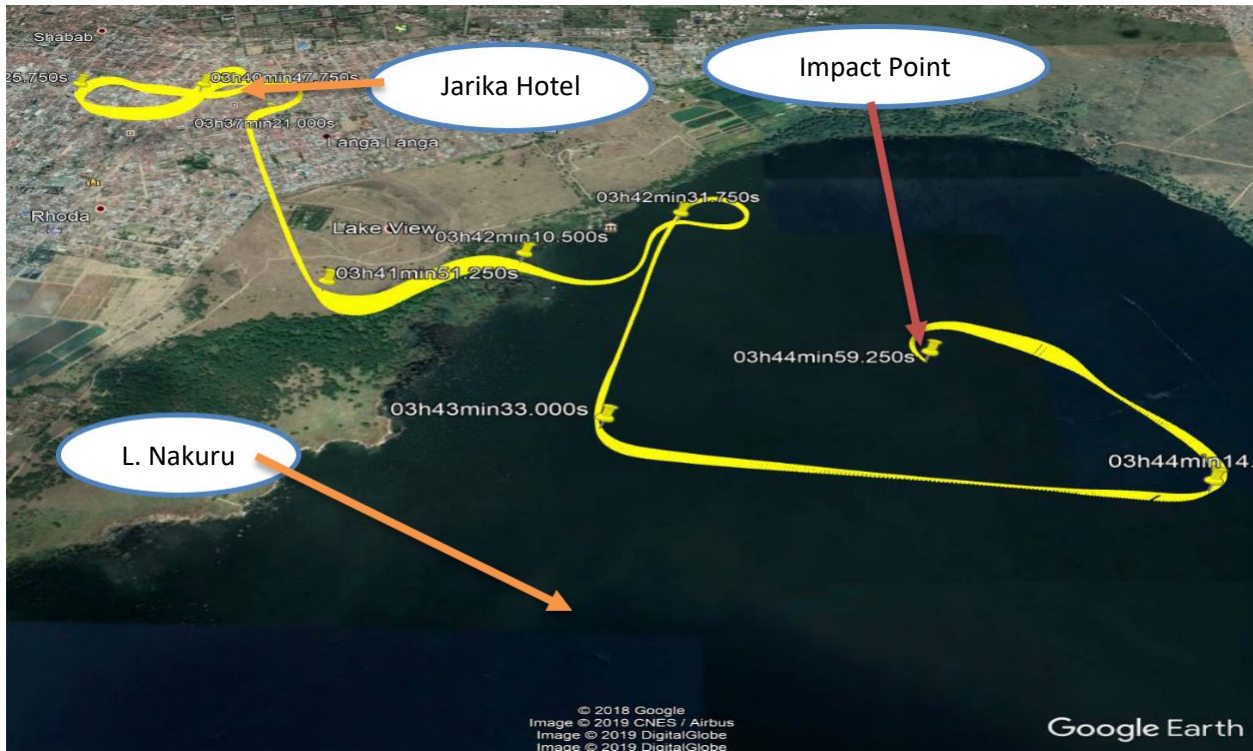


Figure 1: GPS Google map track showing the flight path taken by the helicopter before crash

1.2 Injuries to Persons

Table 1: Injury chart

Injuries	Crew	Passenger	Total in the aircraft	Others
Fatal	1	4	5	None
Serious	0	0	0	None
Minor/none	0	0	0	None
Total	1	4	5	None

1.3 Damage to Aircraft

Destroyed as a result of impact with water.

1.4 Other Damages

Oil and fuel spillage into the lake

1.5 Personnel Information

The pilot in command was 34 years old at the time of the accident. He was employed by Flex Air Charters Ltd where he doubled as a director flight safety and helicopter pilot. Other information revealed that the pilot was initially an employee of Kenya Air force (KAF) before joining the general aviation industry. Training records obtained from KCAA indicated that the pilot was initially trained in South Africa at Starlite Aviation Academy between May 2009 and February 2010. He was issued with Private Pilot License (Helicopters) on 01/12/2012 reference no. 0272325796 endorsed with Robinson R22 by South Africa Civil Aviation Authority. On 26/4/2012 the pilot passed KCAA private pilot license theory examinations. On 11/5/2012 the pilot passed KCAA Basic Gas Turbine and AS350 aircraft type rating examinations.

By 28/6/2012 about the time he left the KAF he had a total of 183.5 hours of which 31.5 were obtained as a pilot in command. While in KAF he had been trained on Bulldog S-100, RH22 and Bell 206.

On 10/8/2012 the pilot sat KCAA type rating for Bell206 examination and passed. On 16/5/2012 he was issued with KCAA private pilot license on helicopter (YK-7549-PL (H) endorsed with AS350 and B206. By the time of the accident the pilot had a valid commercial pilot license (YK-7549-CL (H)) issued by KCAA on 30/8/2017 expiring on 29/8/2018 with AS350 and B206 ratings. He had a medical class 1 certificate with no limitations recommended by a KCAA certified aviation medical officer. Other records obtained from KCAA indicated that by 30/8/2017 the pilot had a total of 2373.1 hours out which 392.1 hours was as a pilot in command on AS350 helicopter. He had a total of 220.2 hours within the last six months. There was no record obtained indicating if he had instrument rating or special training on low level flying.

1.6 Aircraft Information

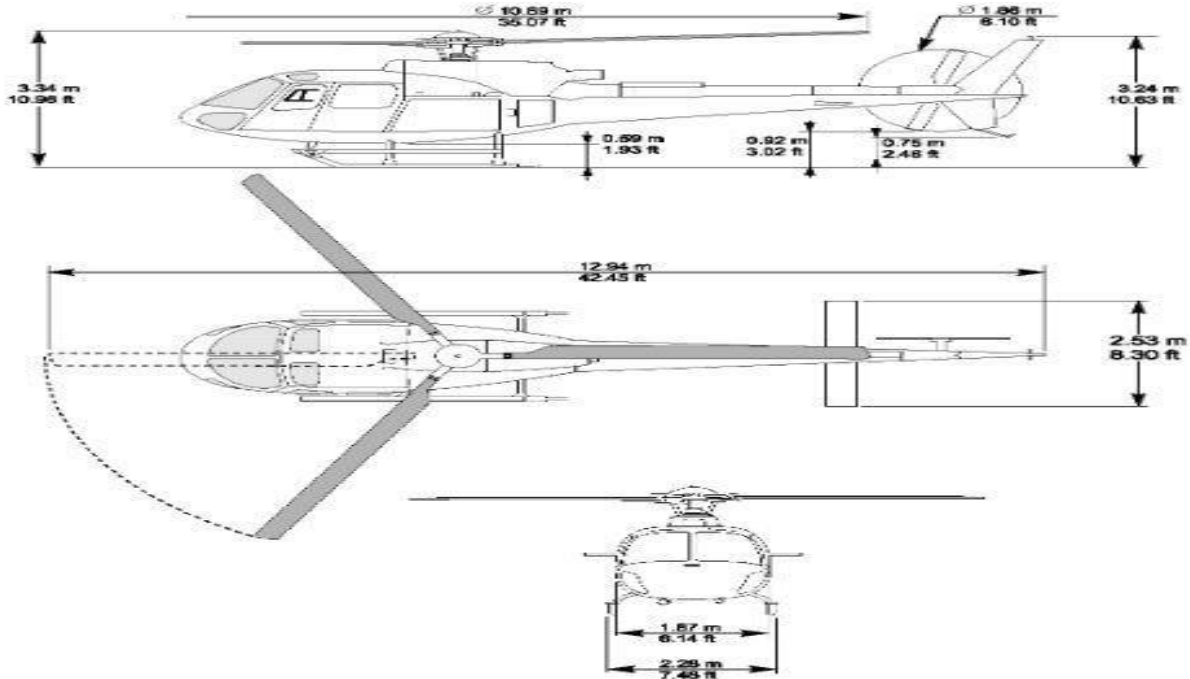


Figure 2: Dimensions of AS350 B3 Helicopter

1.6.1 General

The AS350 helicopter serial number 8231 type of helicopter was manufactured by Airbus Corporation on 31 March 2016. Records obtained from KCAA indicated that on 4th August 2016 the Airbus Helicopters Southern (PTY) Ltd confirmed that the AS350 B3 serial number 8231 was new and had no previous registration marks. It was issued with certificate of registration on 12th August 2016 and issued with registration mark 5Y-NMJ.

On 10/08/2016 inspection was carried out for purpose of registration indicated that the helicopter had damage to tail boom, vertical fin and faulty MGB temperature switch. The inspection confirmed replacement of all the components before recommendation for issuance of the certificate of registration and all that was done by the manufacturer.

It was owned by Ropat Union Ltd and operated by Flex Air Charters Ltd. The helicopter was inspected by KCAA on 16/082016 for purpose of airworthiness, which was recommended after

successful certification process. The initial airworthiness certificate was issued on 19th August 2016 expiring on 18th August 2017.

The certificate of airworthiness was renewed on 19th August 2017 after attaining a total of 280.6 hours of airframe and was expected to expire on 18th August 2018.

Maintenance records indicated that, apart from the routine maintenance carried out for normal operations as per the manufacturers directives there was no any significant repair done to the helicopter since manufacturer except for the tail rotor blade which was struck with turning rotors at 143.54 hours.

1.6.2. Maintenance History

1.6.2.1 Airframe

On 14th October 2017, routine airframe hour's inspection was carried out at 461.35 hours as per the approved maintenance program. The inspection revealed de-bonding of the main rotor blade skin. The defective main rotor blade P/N 355A110030.01 SN. 44235; TSN 389.1 hours was removed and replaced with another serviceable loaner blade P/N 355A110030.04 S/N 43791, TSN 214hrs. The removal and installation was done as per aircraft maintenance manual (AMM) The main rotor track and balance was performed in accordance with AMM. It received satisfactory vibration levels in all flight regimes. The Airbus SB 25.029 was also complied with by installing heat shrink cap; P/N 8021-0382 on ELT Antennae

1.6.2.2. Engine

The 15/7 days engine inspection was carried out as per Arriel 2D Engine Maintenance Manual (EMM). During the inspection " FUEL PUMP" light came ON during the rotor tracking on ground failure messenger 185 on VEMD. Trouble shooting was conducted as per EMM and it identified the pump and metering valve unit as the cause of low fuel light not going off during the engine

running. Another loaner pump and metering unit was installed and post installation checks carried out as per EMM. No fuel or oil leak was noted. Engine power check results recorded during the test flight indicated TRQ Margin/TOT: +11.6% and TRQ Margin/NI: +9.1%. The aircraft was issued with CRS on 14/10/2017 expiring on 31st March 2018.

1.7. Meteorological Information

There was no significant weather reported that day.

1.8 Aids to Navigation

There were no ground navigational aid within the vicinity of the accident site, however the helicopter had onboard VHF/VOR/LOC/GPS, Transponder (mode A+C), and ELT. There was also an additional radio onboard by the company for monitoring position.

1.9 Communication

There was no information obtained by the investigation team to confirm any radio contact made by the pilot and air traffic services or the company during that flight.

1.10 Aerodrome Information

Not applicable

1.11 Flight Recorders

1.11.1. General

The helicopter was not required to be fitted with flight recorders by KCAA, however the Airbus manufacturer had fitted the helicopter with four computers which were recovered from the wreckage. The four recorders recovered from the wreckage of the helicopter included, Full Authority Engine Control (FADEC), Engine Data Recorder (EDR), Vehicle Engine Monitoring Display (VEMD) and Vision 1000

The Full Authority Engine Control (FADEC) which is a dual module digital control unit performing fuel regulation, engine parameters management and engine data recording. On each

module, engine parameters, logical words and failure flags are stored on non-volatile memory components for maintenance purposes. Engine parameters are recorded at a sample rate of 1 second in a continuous recording and at a sample rate of 20 ms on a limited duration when a failure occurs (context recording).

Engine Data Recorder (EDR), which is a light computer that exclusively records data sent by the FADEC, in the same manner, on a non-volatile memory component for maintenance purposes.

Vehicle Engine Monitoring Display (VEMD) which is a multifunction screen installed on the instrument panel and designed to display flight data and engine data. The VEMD is a dual module system. In each module, failure information, associated to flight parameters, can be stored on a non-volatile memory component for maintenance purposes. The relevant VEMD data for accident investigations that can be obtained are flight reports, failure messages with associated dated parameters and overlimits reports which are not dated. The VEMD also records the last 8 Engine Power Checks (EPC) performed in flight to check the engine health according to the maintenance and flight manuals (EPC are not dated).

Vision 1000 which is a light computer that records GNSS, attitude and acceleration parameters, audio data, image data (instrument panel and environment) sampled every 0.25 seconds. The data is stored on a SD card and on two internal non-volatile memory components.

The four computers were recovered from the wreckage, rinsed and preserved in pure water as per manufacturers specifications and shipped to the Bureau d'Enquêtes et d'Analyses (BEA) for downloading, testing and analysis

1.11.2. Flight Data Recorder Download

1.11.2.1. The Full Authority Engine Control (FADEC)



Figure 3: Photograph showing FADEC

At the BEA laboratory the FADEC was found with traces of damaged rust. It was opened and the two electronic boards with the six memory components visually inspected. The six memory components were wet but in good condition. They were dried for more than 48 hours at 90°C. The six memory components were unsoldered using an unsoldering machine under temperature monitoring. They were cleaned, electrically characterized and read out using the BEA memory reader. The reading of two of the six memories was unsuccessful.

1.11.2.2. Engine Data Recorder (EDR)



Figure 4; Photograph showing Engine Data Recorder

The EDR was wet with traces of rust. It was opened and dried for more than 48 hours at 90°C. The EDR was reassembled and connected to a computer for downloading. The download was unsuccessful probably due to the long exposure to water.

1.11.2.3. Vehicle Engine Monitoring Display (VEMD)

The VEMD is a duplex indicator equipped with two matrix liquid crystal displays located at the center of the instrument control panel. It displays all necessary engine and vehicle parameters. It comprises three operating modules, the processing module LANE 1 and LANE 2 and one display module which includes two screens and the control pushbutton. Some of the essential parameters displayed on the VEMD includes the computation of the engine first limitation (FLI), engine performance checks, the FADEC data, TQ, T4, fuel quantity and engine oil pressure and temperature, OAT , air bleeding (P2), bus bar current (BUS), GEN (generator current)



Figure 5; Photograph showing the VEMD electronic circuit board



Figure 6; Graphs showing Central Panel Display System (CPDS) phases of operation.

The distinction between flight and end of flight status is determined by the following parameters.

1. Engine start NG is between 10% and 60%
2. Flight status NG is higher than 60%
3. End of flight NG drops below 10% and NR is lower 70%

The VEMD was found wet with traces of rust. The VEMD has 2 electronic boards which were visually inspected and dried. There were traces of rust on it. The main electronic board was dried for more than 48 hours at 90°C. Due to the data retrieved in the other computers (in particular in Vision 1000), it was decided not to do further examination on the VEMD.

1.11.2.4. Vision 1000

1.11.2.4.1. General

The helicopter was fitted with APPAREO Vision 1000 cockpit imaging device. The system was capable of capturing aircraft position by GPS, flight attitudes (pitch, roll, yaw, etc), cockpit imagery (instrument panel, console, (partly), flight controls and partial exterior view), and ambient audio. The vision 1000 was fitted by the manufacturer to allow the operator review previous flight

and to aid in accident investigations. Unlike an FDR or CVR the vision 1000 is not certified by KCAA

On recovery it was noted that vision 1000 had slight damage with traces of rust. It was opened and the electronic board with the two memory components visually inspected and found with wet traces of rust. The electronic board was dried for more than 48 hours at 90°C. The two memory components were unsoldered using an unsoldering machine under temperature monitoring. They were cleaned, electrically characterized and read out using the BEA NAND memory reader.



Figure 7; Photograph showing Vision 1000 cockpit imaging camera

The binary data was decoded using manufacturer (Appareo) software. The flight of the event was identified. The pictures of the previous flight were also extracted.

1.11.2.4.2. Imagery Recording of the Previous Flight

More than 6055 picture images of the previous flight was downloaded. Observations made on the images shows the deceased pilot with unidentified male passenger on the left front seat during the initial start of the flight. The pilot was also seen undertake routine preflight inspection including assisting the passenger fasten his safety belt including the wearing on the communication headset. The pilot then started the aircraft engine and from the display, the VEMD detects engine start. At first the altimeter reading shows 5500ft which corresponds with the local area elevation (Wilson airport). The FLI gauge then rises from zero to approximately 20% on the display. The N1, TOT, and TRQ reading on the display are not clear and so the investigation could not provide the exact reading. The engine oil temperature and pressure was approximately seen at 75°C and 4.5 bar respectively.

During the flight the ASI increase from zero to 150knots. The VSI helicopter reading also showed ROC of 150fpm as the altimeter reading rose to 6800ft and 8600ft. The FLI gauge reading pointed between 9 and 10. The oil temperature and pressure reading indicated 65°C and 5 bar.

Most of the picture images observed had indicated that the helicopter was maintaining speed of between 140knots and a maximum of 170knots throughout the flight at an altitude of 5800ft and 8600ft. Occasionally, the pilot descended and sometimes climbed at the rate of between 50fpm and 200fpm. The oil temperature and pressure was also maintained at an average of 65 °C and 5 bar respectively.

In conclusion there was nothing unusual with the flight.

1.11.2.4.3. Imagery Recordings of the Event Flight

Initially, during the start of the flight on the FLI gauge the oil temperature and pressure increased to 20°C and 2 bar respectively. The engine TOT was at 5, TRQ and N1 was at zero. After 2 minutes after engine start, the VEMD display shows an increase in ASI speed to 100knots as the helicopter

climbs to 6100ft on the altimeter. The power reading on FLI increased from 50% to 70%. After 5 minutes to the flight the ASI increases to 130knots and the VSI shows abrupt descend to 5800ft. 6 minutes after engine start showed the ASI maintain 130knots as the FLI moved to 90%. At 7.29 minutes the ASI drops to 120knots and the VSI shows abrupt descend at 900fpm as the FLI goes to 70% and the recording disappears.

In conclusion according to the video imagery recording captured, the event flight took seven minutes and 38 seconds. During the initial stages the pilot is seen undertaking routine preflight inspection including assisting the female passenger on the front seat fix headset before flight (See figure; 8). On the VEMD the image captured the fuel quantity at more than 400 liters. Before departure the altimeter reading indicated an elevation of 5800ft.



Figure 8: Picture video showing the pilot carrying out preflight check.

After 4 minutes and 14 seconds of flight the pilot is seen handling his mobile phone while flying (See figure 9) and nothing unusual appear with the flight.



Figure 9: Picture video showing the pilot handling mobile phone while flying.

In conclusion all the video images downloaded throughout do not show any time in flight when the pilot displays unusual behavior with the flight.

1.11.2.4.4. Flight Parameters of the Event Flight

1.11.2.4.4.1. General

At 03:37.00 hours the pilot took-off and lifted from a ground elevation of 1575m to 1762m where he hovered for 2 minutes and 30 seconds on a heading of 60° (See figure 10.)

At 03:39:50 he changed course through 360° and flew in the general direction of 120° heading at a ground speed of 110knots.

Between 03:40:00 and 03:45:00 the flight was characterized by consistent change of course, ground speed, altitude and the vertical speed until impact.

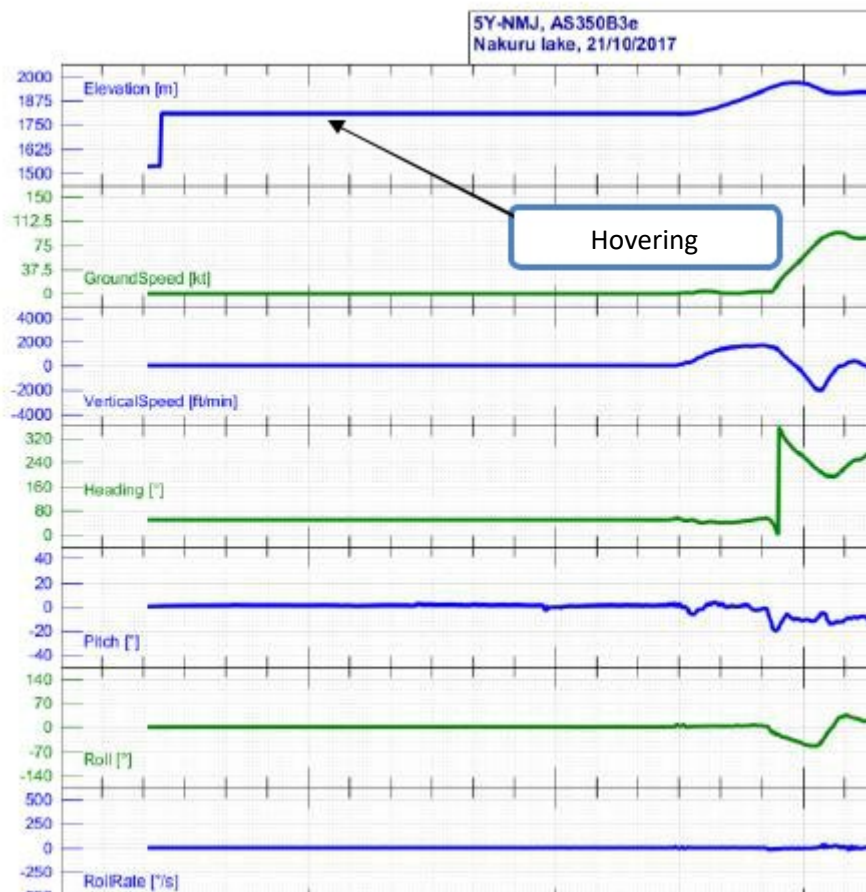


Figure 10: Graph showing initial helicopter flight parameters

1.11.2.4.4.2. The last 30 seconds of the event flight before impact

At 03:44:30 the helicopter was spotted heading 320° at 1762meters above mean sea level(amsl), at ground speed of 120knts. It then suddenly pitched up and reduced its ground speed to 50knots within 10 seconds as it gained altitude at 2000fpm.

There was also significant variation of the lateral acceleration ranging between -0.5g to 0.8g.

At 03:44:40 the pilot maintained same heading of 320° at 1912m amsl and increased the ground speed from 50knts to 90knots as he slightly pitched down.

At 03:44:45 the pilot descended as he increased his ground speed to 110knots.

At 03:44:49 he changed heading to 240°

At 03:44:50 the pilot was captured steering 280° at ground speed of 110knots and then changed the heading to 80°

At 03:44:51 there was significant variation of the lateral acceleration ranging from (-0.5 to +0.5) g for a period of more than 4 seconds

At 03:44:55 the pilot maintained a heading of 200° as he descended considerably.

At 03:44:58 the helicopter was captured at 1762m amsl heading 120° doing a ground speed of 90knots, then suddenly he changed through 90° right to 320° and back to 90° heading and rolls through 140° as pitched up and banked to the left before he plunged into water. There was significant longitudinal acceleration of between -2 to -6 before crash.

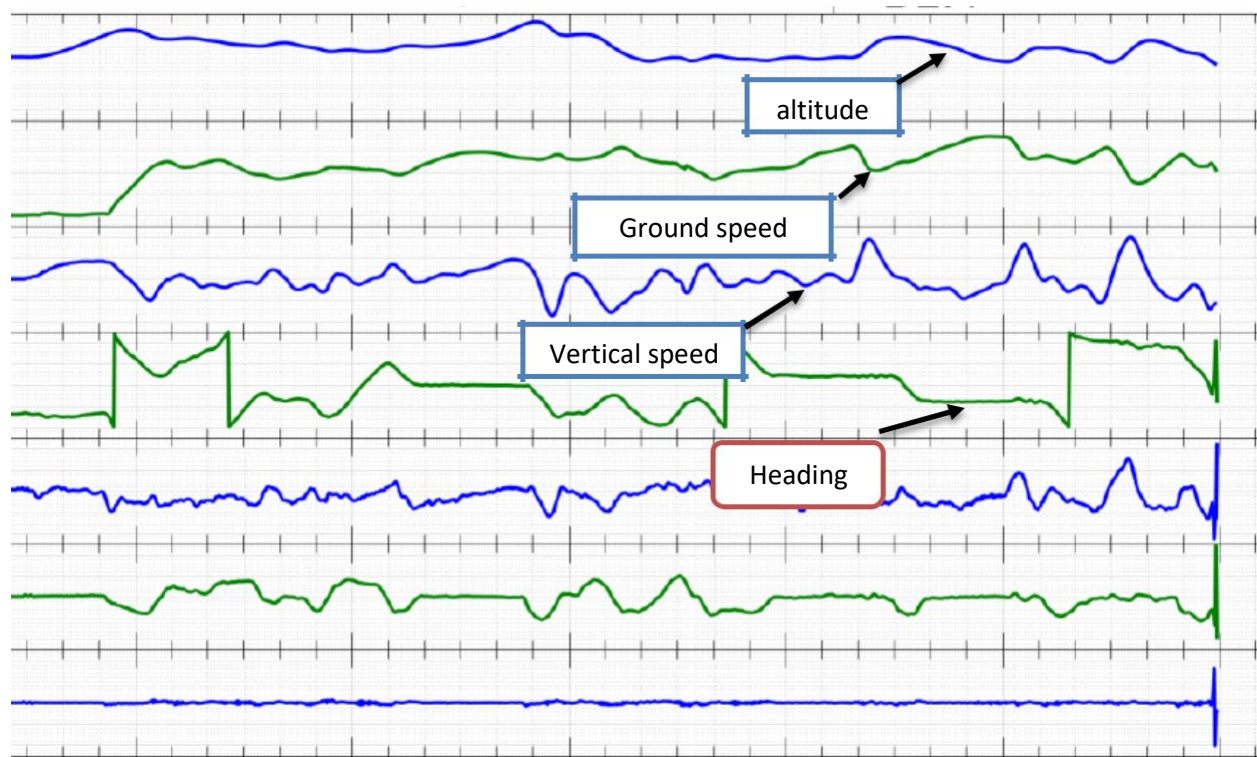


Figure 11: Graph showing helicopter flight parameters in the last 30 seconds before impact

1.12. Wreckage and Impact Information

Examination of the wreckage revealed that the helicopter was extensively damaged after impact. The windscreen was broken and bungled, the tail boom broke and separated from main airframe even though it remained less than 5metres from the main wreckage. All the doors were missing except one (front left) where the female passenger was seated, possibly or perhaps that explains why the other bodies were not found within the wreckage. It could be possible the occupants struggled and managed to break the doors as they were trying to escape. The battery was also missing, the main rotor blades were broken but remained still attached to the main rotor shaft. The helicopter cabin was generally dented and bungled in all directions.



Figure 12: Photograph showing the wreckage of the helicopter retrieval from the lake



Figure 13: Photograph showing the electric power line and dry acacia trees in the lake

There was heavy presence of dry acacia trees submerged by water on the northern part of the lake even though there was no evidence of collision with the trees and the powerline cutting across the lake.

1.13 Medical and Pathological Information

1.13.1 Basic Postmortem

Basic postmortem conducted on the pilot and the two passengers did not ascertain cause of death due to decomposition of the bodies.

1.13.2. Toxicological Tests

The pilot's blood samples were taken from liver, gall bladder, stomach, and kidney for toxicological screening. The results indicated presence of alcohol (ethanol) at a concentration of 41mg per 100ml of the sample. It indicated a minimum intake of 1 half-litre bottle of beer or 2 tots of whisky. There was no other chemically toxic substance detected on the post mortem specimens.

1.14 Fire

There was no post fire on impact

1.15. Survival Aspects



Figure 14: A photograph showing search and rescue team in the lake

1.15.1. Search and Rescue

On 21st October, 2017 at 0730 hours a Kenya Police Airwing Helicopter arrived at the accident site and first flew over the lake and reported spotting aircraft parts and oil spillage floating over the water on the lake. After information was relayed, a search and rescue operation for the missing helicopter and persons onboard was launched. An additional search and rescue team was also mobilized from Kenya Navy (KN), local security agencies in Nakuru, Lake Naivasha boat operators, local divers and KWS boat rescue team. At 1030hours the existing rescue team was joined by Kenya Navy divers as search and rescue continued. The exercise continued the rest of the afternoon until 1530 hours when it was called off due to darkness and bad weather.

On 22nd October 2017 at 0430 hours the rescue team commenced the exercise which continued until 0830 hours when parts of the helicopter were found north of the Lake near the shore scattered over a stretch of 100m. Thirty minutes later the first body (passenger) of the accident victim was discovered at the same location. The search for the main wreckage and the missing persons continued the whole day until 1530 without any success. It was called off at 1530 hours until the following day.

On 23rd October 2017, the search and rescue team commenced the exercise as usual focusing on specific target areas as guided by the location of the oil spillage and the information given by eye witness. At 0930 hours, the second body (pilot) of the accident victim was discovered on the eastern side of the Lake, 4km away from the point where the first body was discovered. The search and rescue continued for the rest of day until very late into darkness without further success. It was again postponed for the following day as usual.

Between 24th October 2017 and 29th October 2017 the Kenya Navy and a team of local divers continued the search and rescue with no success of locating the main wreckage or getting the body of the missing victims. The Kenya Navy was equipped with down vision sonar (Raymarine Dragonfly-7 Sonar GPS).

On 30th October 2017, a team from the department of Mines and Geology, Ministry of Mining joined the rescue team at the Lake to assist locate the main wreckage. The team was equipped with two types of magnetometers (Gem Systems GSM19 over-Houser and Gem System GSM 19T Proton Precession).

On 14th November 2017, the team from the department of Mines and Geology called off the exercise due to lack of facilitation but left the other team to continue with the exercise.

On 17th November 2017, the Kenya Navy and other local divers managed to locate the main wreckage at position S 00°19'33.42'' E 036°05'55.02'' on the northern part of the lake. The aircraft wreckage was positively confirmed and location marked. Except the landing skid most parts of the aircraft were found damaged. The third body (a female passenger) was discovered still strapped in the front left seat of the helicopter and recovered.

On 19th November, 2017 the search and rescue team led by Kenya Air force and Kenya Police managed to airlift the main wreckage of the helicopter from the lake to an open field in the vicinity of Lake Nakuru National Park. The tail boom had separated from the main wreckage after impact but sunk and remained near the location of the main wreckage.

On 23rd November 2017, the tail boom and others parts of the aircraft wreckage were discovered near the same location of the main wreckage and brought to the lake shore by use of boat.

1.15.2. Survival and emergency equipment

The AS350B3 was equipped with adequate and sufficient survival safety equipment including lifesaving jacket. The Pilot-in-Command (PIC) was responsible for ensuring that all the prerequisite equipment is onboard prior to commencement of the flight. The PIC was also responsible for ensuring that all passengers are briefed on the location of the emergency exit and the location and content of safety briefing card.

There was no evidence obtained to show if any of the passengers or the PIC attempted to use any of the safety equipment available or if the passengers were briefed about the use of safety equipment prior to the commencement of the flight.

1.16. Tests and Research.

Not applicable

1.17. Organization and Management Information

1.17.1. Kenya Civil Aviation Authority

1.17.1.1. KCAA Requirement for commercial operation

According to KCAA Legal Notice No. 126 Regulation 62, on the use of narcotics, drug or intoxicating liquor, a person shall not act or attempt to be a crew member of an aircraft; within 8 hours after consumption of alcohol, under influence of alcohol, while using drugs that affects the person's faculties in any way contrary to safety or while having alcohol concentration of 0.04 percent of blood.

Additionally, KCAA Legal Notice No. 97, Regulation 111, "Fitness of flight crew member", states that the pilot in command shall not commence a flight if he is incapacitated from performing flight duties by any cause such as injury, sickness, fatigue or the effect of alcohol or drug. Regulation 131 "Drug and alcohol testing and reporting" also states that the authority may prohibit any person from operating an aircraft who tests positive for drug or alcohol usage.

1.17.1.2. KCAA Minimum permitted heights

KCAA Legal Notice No. 124 Regulation 10 "minimum height" states that a person shall not fly an aircraft over the congested areas of cities, towns or settlements or over an open-air assembly of persons, unless at such a height as will permit, in the event of an emergency arising, a landing to be made without undue hazard to persons or property on the surface, except when necessary for take-off or landing, or except by permission from the appropriate authority. Sub-regulation 2 paragraph (e) states that an aircraft shall not fly less than 500ft above ground or water.

1.17.2 Flex Air Charters

1.17.2.1. General operation

Flex Air Charters had a valid air service license for non-scheduled air services for passenger freight and aerial work issued on 4th May 2017 valid until 3rd May 2018. The base station as Wilson airport and the route operation out/into Kenya within Eastern Africa region. The company operated two AS350B3 helicopters and one C208 type of aircraft. It had four crew members in which two were assigned to the helicopters and the other assigned to the C208. The company was contracted by Jubilee Party during the just concluded general elections to transport its members to the political rallies. The deceased pilot doubled as the helicopter pilot and the Director of flight safety.

1.17.2. 2. Flight Duty Time

According to the flight and duty time monitoring worksheet obtained from the company, within the month of October 2017, the deceased had done one flight which was conducted on 2nd October 2017 and lasted only 12 minutes. On 20th October 2017 the deceased conducted a flight between Nairobi Wilson to Nakuru and took only 42 minutes

1.18 Additional Information.

Not applicable

1.19 Useful or Effective Investigation Techniques

Not applicable

2. ANALYSIS

2.1. History of the flight

The pilot departed Jarika hotel at 03:37:21 hours with four passengers (four men and one female) onboard with unknown purpose of flight. However according to Flex Air Charters, the pilot was supposed to fly that day from Nakuru to Mau Narok. There was no scheduled time of departure from Nakuru to Mau Narok. The only known information about the flight was the two deceased onboard, were part of the delegation meant to be flown to Mau Narok that day. Secondly, it was not known if the pilot had decided to fly his friends around the lake for sightseeing before they could return to the hotel or not. The helicopter flew

around around the Lake Nakuru for 7 minutes and 38 before it crashed at 03:44:59 hours. Analysis of the flight within the last 5 minutes (See figure 14 below) indicates that the pilot flew at low level to the ground/water with very small safety imagine in the event of loss of control. At one point the pilot was flying as low as 79ft above water.

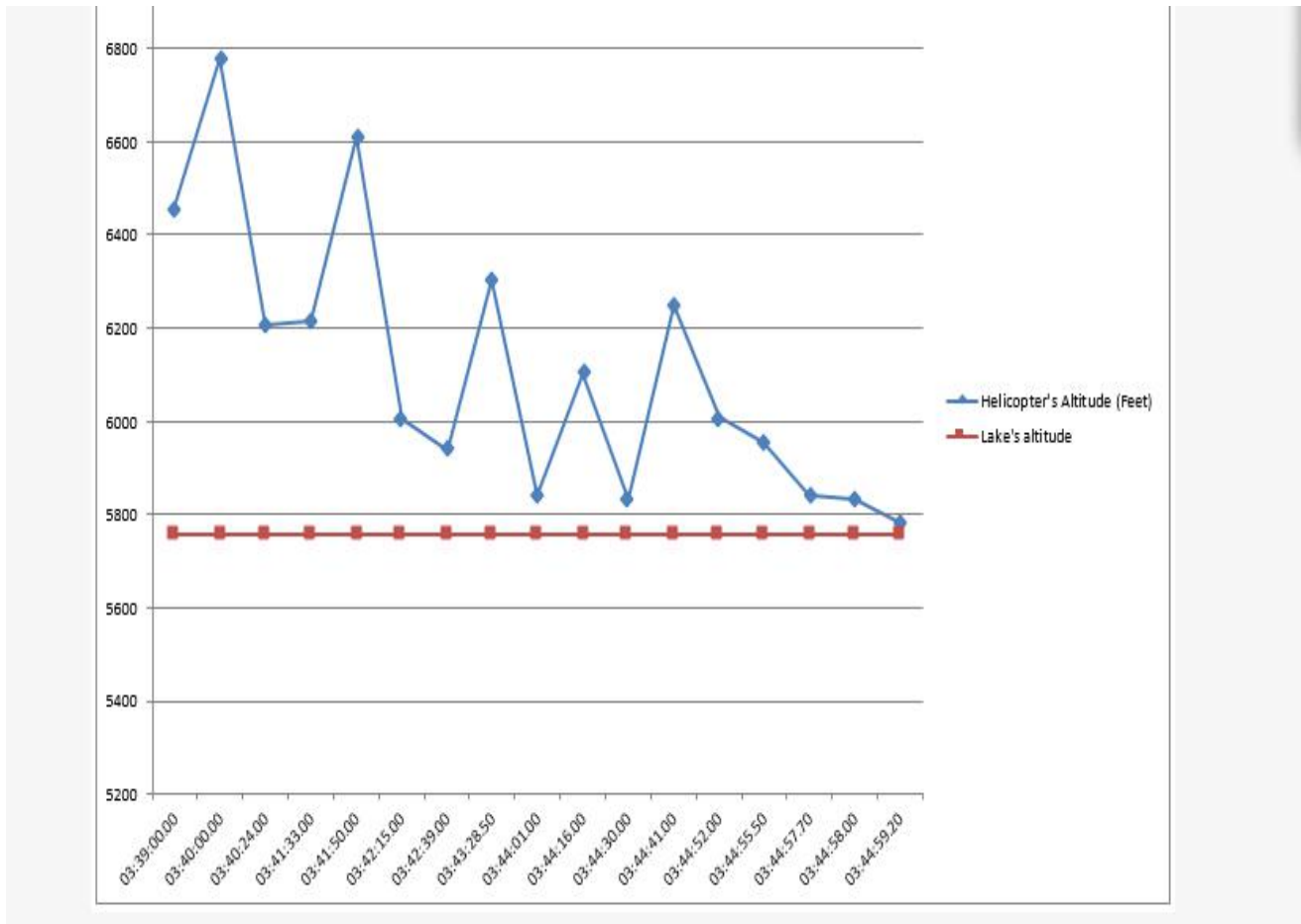


Figure 14: Graph showing altitude position of the helicopter within 5 minutes before impact

2.2. Injuries to persons onboard

All persons onboard the helicopter including the pilot received fatal injuries. The body of the pilot and two passengers were recovered from the lake, however the search for the bodies of two other male passengers was unsuccessful.

2.3. Personnel information

It was established that the pilot was 34 years old and was properly certified with no limitation by KCAA to fly the helicopter. By time of the accident he had a total of 2373.1 hours with 392.1 on AS350 type of the helicopter.

2.4. Aircraft information

The helicopter was less than two years since manufacture. Apart from the routine maintenance, the helicopter had not received any major repair or serious incident since new. It had a total of 280.6 hours since new and had a valid certificate of airworthiness. The aircraft was substantially destroyed after impact. There was no any other damages

2.5. Weather

There was no significant weather that day which would adversely affected the flight.

2.6. Communication

There was no information obtained by the investigation team to confirm any contact made by the pilot and air traffic services or the company during that flight.

2.7 Flight recorders

2.7.1. General

The helicopter was not required to be fitted with flight recorders, however the manufacturer had fitted the helicopter with four computer devices. The four computers were examined and data download conducted. Download on two recorders was unsuccessful out four. One of the other two recorders was successfully downloaded and there was no need of downloading the other because the relevant data required had been obtained.

2.7.2. Imagery recording of the previous flight

Initial captured images shows the pilot carrying out routine preflight inspection. During the flight he maintained an altitude between 5800ft and 8600ft. The helicopter did a speed of between 140knots to

170knots. The power output ranged between 9 and 10 on the FLI. The fuel quantity was more than 400 liters. At some point the pilot is seen handling his phone during flight.

2.7.3 Imagery recording of the event flight and flight parameters

Initial stages of the flight showed the pilot took-off at 03:37:00 hours and lifted upto 613ft agl where he hovered for 2 minutes and 30 seconds on a heading of 60°. Thereafter he flew overhead Nakuru town, changed heading and flew in the general direction of 120° towards the lake at a speed of 110knots. He then overflew the lake between 500ft and 1100ft agl

2.7.4 Flight parameters of the event flight within the last 30 seconds before impact

In the last 30 seconds before impact, the helicopter was captured at 1762m amsl. This was very low altitude compared to the elevation profile of Lake Nakuru. It implied that the helicopter was actually flying below 50ft above water surface which was actually very risk considering the rate at which the pilot was changing altitudes. At a heading of 300° at 90knots, it suddenly rolled through 140° with a relative big banking angle to the left, then a sudden pitch up and then the helicopter plunges.

2.8 Impact and wreckage information

On impact the helicopter got completely destroyed. Several parts of the fuselage separated and got scattered all over the lake on a stretch of 1km. one back left seat was found at the lake shore 400m from the point impact. Most parts that separated were pushed by the strong water currents. The main fuselage including the tail boom remained at the point of impact.

2.9. KCAA Regulations

According to the KCAA regulations regarding fitness to fly, it was established that the pilot-in-command was not fit to fly since the toxicological results indicated he used alcohol. Secondly, the level of alcohol concentration was excess the required limit of 0.04%. Thirdly, it was established from the flight parameters that the flight was conducted below 500ft above ground and water which is against KCAA regulations.

2.10. Medical and toxicological examination

Basic postmortem examination carried out on the pilot and the passengers did not reveal cause of death. Toxicological tests conducted on the samples of the pilot's blood revealed presence of alcohol (ethanol) at a concentration of 41mg per 100ml which is equivalent to 0.041% of alcohol in the blood. This was above alcohol concentration limit set by KCAA of 0.04%.

2.11. Search and Rescue

The exercise was coordinated and conducted by Kenya Navy with the assistance of local divers and other government agencies. The search and rescue exercise took approximately twenty five days to successfully locate the wreckage and recover a body of the female passenger which was still trapped in the wreckage.

The exercise took long due to lack of suitable equipment and qualified personnel. Lake Nakuru water was also very dirty which made the divers work more difficult as they could hardly see anything. The bodies of two male passengers could not be located and recovered

2.12. Flex Air Charters

The company had a valid certificate of air service for non-scheduled commercial air transport.

3. CONCLUSIONS

3.1 Findings

- 3.1.1. The previous flight before the accident was uneventful
- 3.1.2. The pilot was properly certified and licensed to fly the helicopter but did not have instrument rating or special training rating for low flying
- 3.1.3. The toxicological test carried on the pilot revealed that he had high level of alcohol concentration in his blood
- 3.1.4. The pilot's medical records did not reveal any ailment that would adversely affect his ability to fly the helicopter safely.

- 3.1.5. The aircraft was properly maintained and had a valid certificate of airworthiness
- 3.1.6. There was no significant weather that morning which would adversely affect the flight.
- 3.1.7. The investigation after the crash did not find any anomalies which would have precluded normal operation of the helicopter (engine, main rotor or tail rotor)
- 3.1.8. The pilot flew at a very low level height above ground and water less than 500ft above the ground and water against the KCAA requirements of not less than 500ft agl.
- 3.1.9. The pilot and all onboard suffered fatal injuries

3.2 Probable Cause

The investigation findings revealed that the accident was attributed to collision with the water due to loss of situation awareness by the pilot who was under the influence of alcohol. The pilot failed to recognize the loss of altitude, excessive banking to the left, and the obstacle proximity from the aircraft.

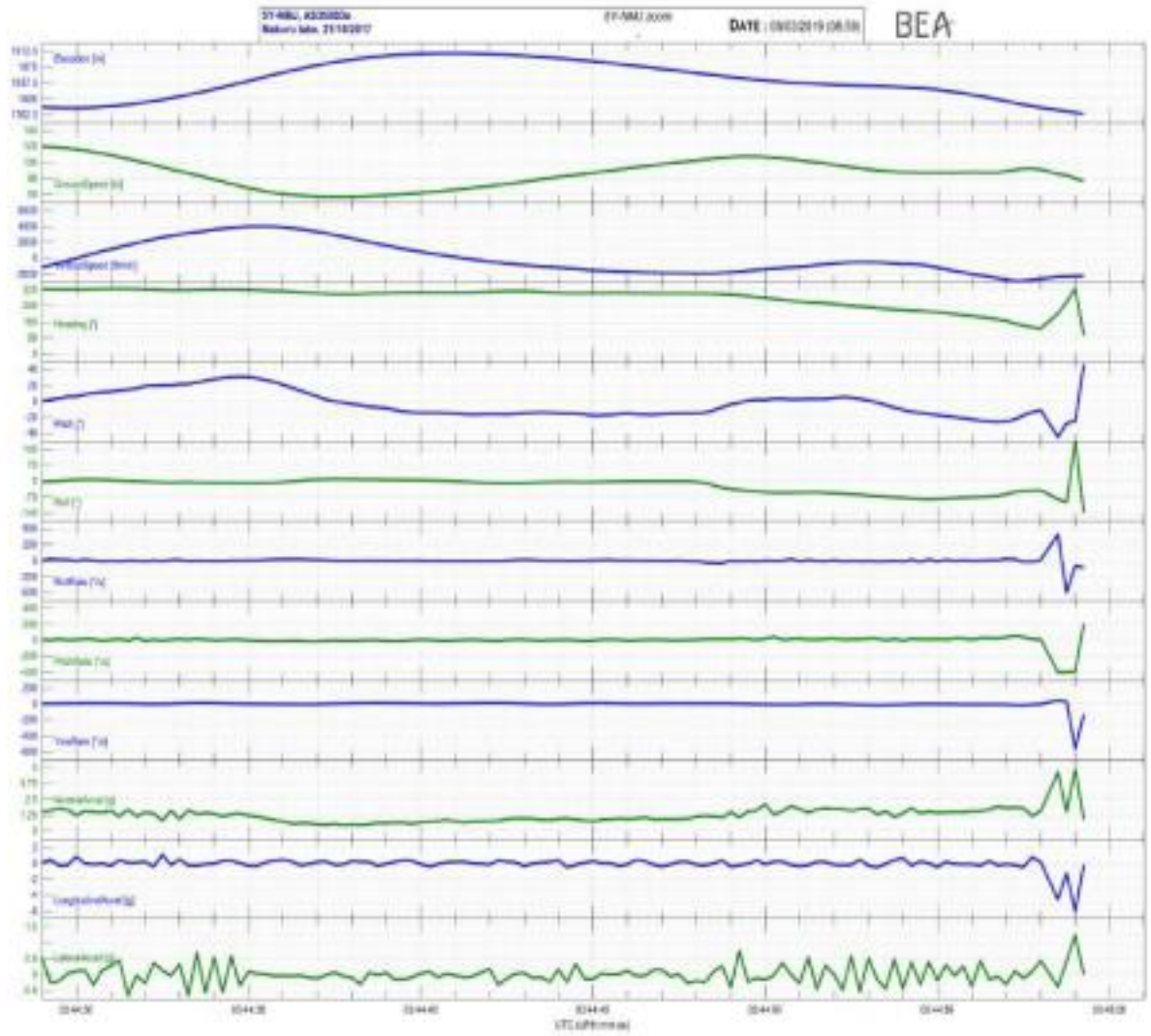
4.0 SAFETY RECOMMENDATIONS

AAID recommends to the KCAA to ensure that all Air Operators Certificate holders to conduct employee background checks when hiring in order to safeguard the safety of the organizations, employees and passengers.

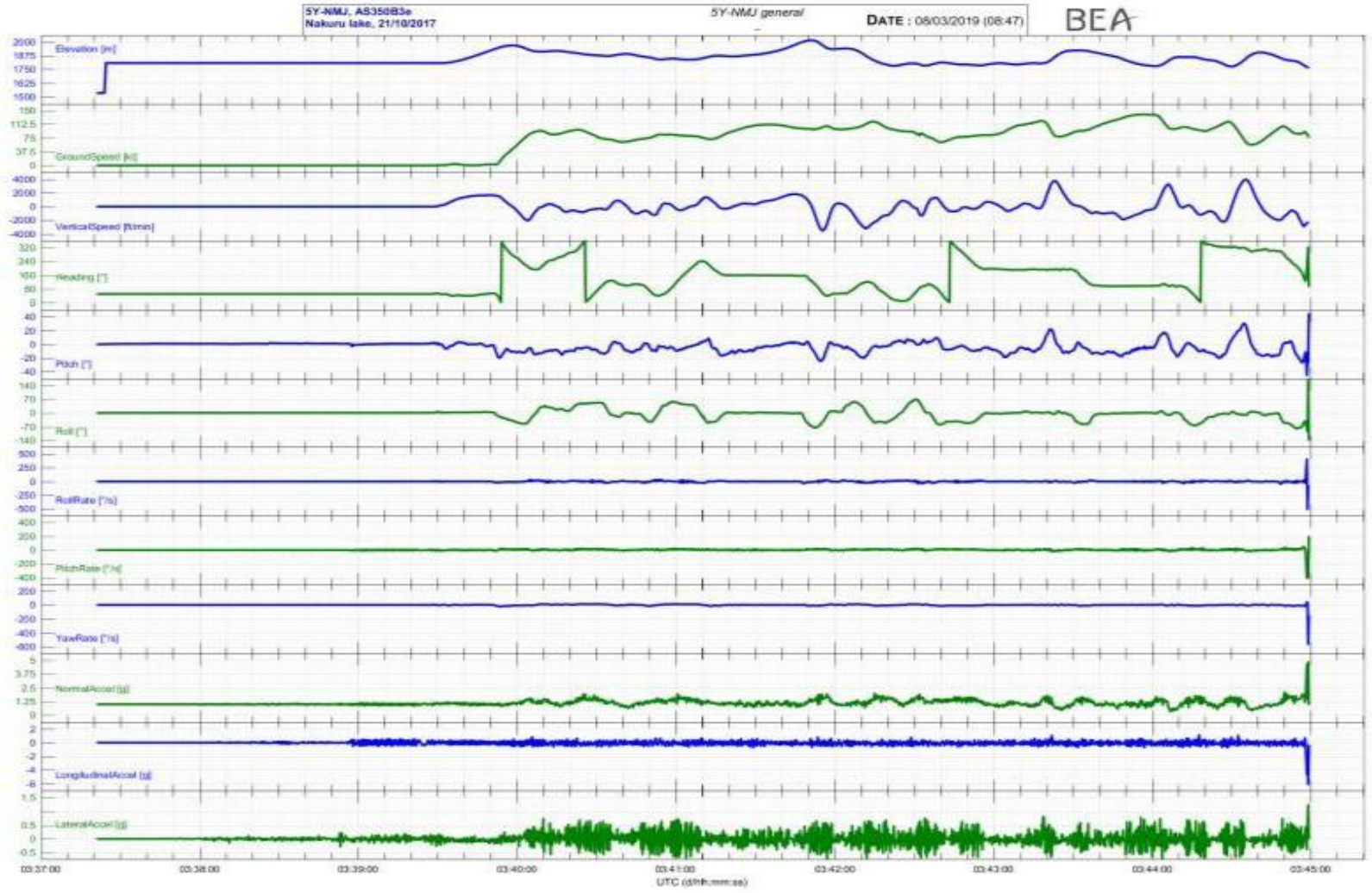
Martyn Lunani
CHIEF INVESTIGATOR OF ACCIDENTS
12 November, 2019

APPENDICES

APPENDIX A; Initial Flight Parameters of the Event Flight



APPENDIX B; Parameters of the Event Flight 30 seconds before Impact



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