REPUBLIC OF KENYA

MINISTRY OF ROADS AND TRANSPORT
STATE DEPARTMENT FOR AVIATION AND AEROSPACE DEVELOPMENT
AIRCRAFT ACCIDENT INVESTIGATION DEPARTMENT

INVESTIGATION REPORT

REPORT No. 01/08/2022

FINAL REPORT OF AN ACCIDENT INVOLVING AN AIRBUS AS 350 B3E HELICOPTER REGISTRATION 5Y-CCP ON 04 AUGUST 2022 AT LAKE LOGIPI, TURKANA COUNTY

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OBJECTIVE

This report contains 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, 2024*** and ***Annex 13*** to the International Civil Aviation Organization (ICAO) Convention on International Civil Aviation.

The primary objective of the investigation of an accident or incident under these regulations is to prevent future occurrences. The investigation is not intended to apportion blame or liability.

The information included in this report is based on data collected during the course of the accident investigation of the accident.

AN AIRBUS AS 350 B3E HELICOPTER

REGISTRATION 5Y-CCP

AIRCRAFT ACCIDENT INVESTIGATION DEPARTMENT

AIRCRAFT ACCIDENT INVESTIGATION FINAL REPORT SUMMARY

OPERATOR	:	Tropic Air Kenya
AIRCRAFT TYPE	:	Airbus AS 350 B3E
AIRCRAFT MANUFACTURER	:	Airbus Helicopters
YEAR OF MANUFACTURE	:	2012
AIRCRAFT REGISTRATION	:	5Y-CCP
AIRCRAFT SERIAL NUMBER	:	7448
DATE OF REGISTRATION	:	13 May 2013
NUMBER AND TYPE OF ENGINE	:	One, Arriel 2D
DATE OF OCCURRENCE	:	04 August 2022
LAST POINT OF DEPARTURE	:	Suguta Sand Dunes, Meru County
POINT OF INTENDED LANDING	:	Nabiyotum Crater
TIME OF OCCURRENCE	:	0757 (1057)
LOCATION OF OCCURRENCE	:	Lake Logipi, Turkana County
TYPE OF FLIGHT	:	Commercial - Charter
NUMBER OF PERSONS ON BOARD	:	06
INJURIES	:	One - serious, Five - Minor
NATURE OF DAMAGE	:	Destroyed
CLASS OF OCCURRENCE	:	Accident
PILOT IN COMMAND	:	ATPL holder
PIC FLYING EXPERIENCE	:	6,916 hours

All times given in this report are Coordinated Universal time (UTC), with East African local time in parenthesis

INVESTIGATION PROCESS

The accident involving the Airbus AS350 type of helicopter, registration 5Y-CCP was notified to the Aircraft Accident Investigation Department (AAID), State Department for Aviation and Aerospace Development (SDAAD) of the Ministry of Roads and Transport through a phone call by the operator.

AAID investigators were deployed to the site and conducted initial onsite investigation and witnesses' interviews.

After the initial on-site investigation phase, the occurrence was classified as an "accident" in accordance with the International Civil Aviation Organization's (ICAO) Annex 13 provisions.

AAID notified the following:

1) The Bureau d'enquêtes et d'analyses pour la sécurité de l'aviation civile (BEA France) as the aircraft accident investigation authority of the State of Design and Manufacture of the aircraft and engine; and
2) ICAO.

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**Photos and figures used in this report are taken from different sources and may be adjusted from the original for the sole purpose of improving the clarity of the report. Modifications to images used in this report are limited to cropping, magnification, file compression or enhancement of colour, brightness, contrast or addition of text boxes, arrows or lines.*

LIST OF ABBREVIATIONS/GLOSSARY OF TERMS

AAID	-	Air Accident Investigation Department
AOC	-	Air Operator Certificate
ATS	-	Air Traffic Services
ATPL	-	Airline Transport Pilot License
CAVOK	-	Visibility more than 10km no cloud cover below 5000ft
CB	-	Cumulonimbus
CPL	-	Commercial Pilot License
ECU	-	Engine Control Unit
EDR	-	Engine Data Recorder
ELT	-	Emergency Locator Transmitter
EPC	-	Engine Power Check
FADEC	-	Full Authority Digital Engine Control
HOGE	-	Hover out of ground effect
ICAO	-	International Civil Aviation Organization
KCAA	-	Kenya Civil Aviation Authority
NM	-	Nautical Mile
VEMD	-	Vehicle and Engine Multifunction Display
VFR	-	Visual Flight Rules
VHF	-	Very High Frequency
VMC	-	Visual Meteorological Conditions

SYNOPSIS

On 04 August 2022, at approximately 0757 (1057), an accident occurred involving an Airbus AS 350 helicopter, registration 5Y-CCP, operated by Tropic Air Kenya, at Lake Logipi, Turkana County. The helicopter was performing a scenic charter flight, with one pilot and five passengers on board.

The pilot had earlier departed Nanyuki Civil Airstrip on a solo positioning flight to Ekorian Tented Camp, Mugie, where five passengers were embarked for a sightseeing flight in Northern Kenya. The flight included several scenic stops, including Silali Crater and the Suguta Sand Dunes, before proceeding toward Lake Logipi.

While manoeuvring at low altitude within the vicinity of Lake Logipi to allow passengers to observe surrounding landmarks, the helicopter impacted the surface of the lake and crashed.

All six occupants survived the accident, with an occupant sustaining serious injuries. The helicopter sustained substantial damage.

At the time of the accident, Visual Meteorological Conditions (VMC) prevailed in the area, with variable wind conditions.

1. FACTUAL INFORMATION

1.1. History of the flight

On 04 August 2022, the Aircraft Accident Investigation Department (AAID) received notification of an accident involving an Airbus AS350 helicopter, registration 5Y-CCP, operated by Tropic Air Kenya Ltd. The accident occurred at approximately 0757 (1057) near Lake Logipi, Turkana County. There were six persons on board at the time of the accident.

According to information provided by the Pilot-in-Command (PIC), the helicopter was conducting a scenic charter flight in Northern Kenya on behalf of Scenic Treasures Ltd. The PIC departed Nanyuki Civil Airstrip at approximately 0633 (0933) on a solo positioning flight, routing via Ol Pejeta to Ekorian Tented Camp, Mugie, where he landed at about 0700 (1000) and embarked five passengers.

At approximately0430 (0730), the helicopter departed Ekorian for Silali Crater, landing on the northern rim at about 0510 (0810). The flight then continued to the Suguta Sand Dunes, arriving at approximately 0620 (0920). After a brief stop, the helicopter departed from the sand dunes for Lake Turkana at approximately 0740 (1040).

The flight toward Lake Turkana was uneventful until approximately 10 minutes after departure, when the helicopter began following the Suguta River toward Lake Alablab. As the helicopter continued westward, the PIC initiated a climb to approximately 200 feet above ground level (AGL) at an airspeed of about 65 knots. The PIC reported minimal external visual references in the area and relied primarily on Cathedral Rock for spatial orientation.

While attempting a right-hand turn to position the aircraft for improved visual observation of Cathedral Rock and its reflection, the helicopter unexpectedly contacted the surface of the lake shortly after leveling out from the turn. The impact was sudden and severe, resulting in the helicopter becoming submerged almost immediately.

The PIC reported regaining orientation after the impact and observed that the cabin structure had sustained significant damage, with the helicopter coming to rest on its right-hand side in shallow water. Despite sustaining fractures to his left leg and right arm, the PIC managed to release his harness and assist the other occupants.

The aircraft's Emergency Locator Transmitter (ELT) activated upon impact, transmitting a distress signal that facilitated the subsequent rescue operation.

All six occupants survived the accident, with one occupant suffering serious injuries. The helicopter was destroyed. All survivors were evacuated to shore and subsequently transferred to medical facilities for further examination and treatment.

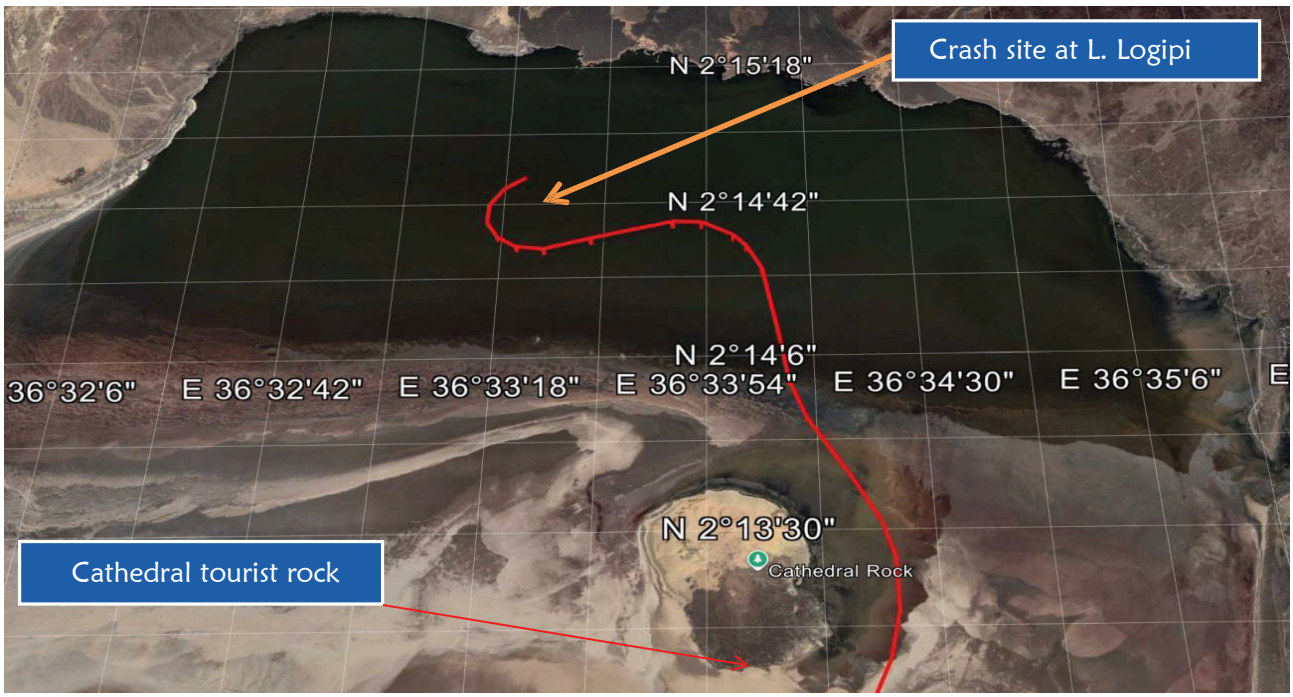


Figure 1: *Google maps showing Lake Logipi and the accident flight path to crash site*

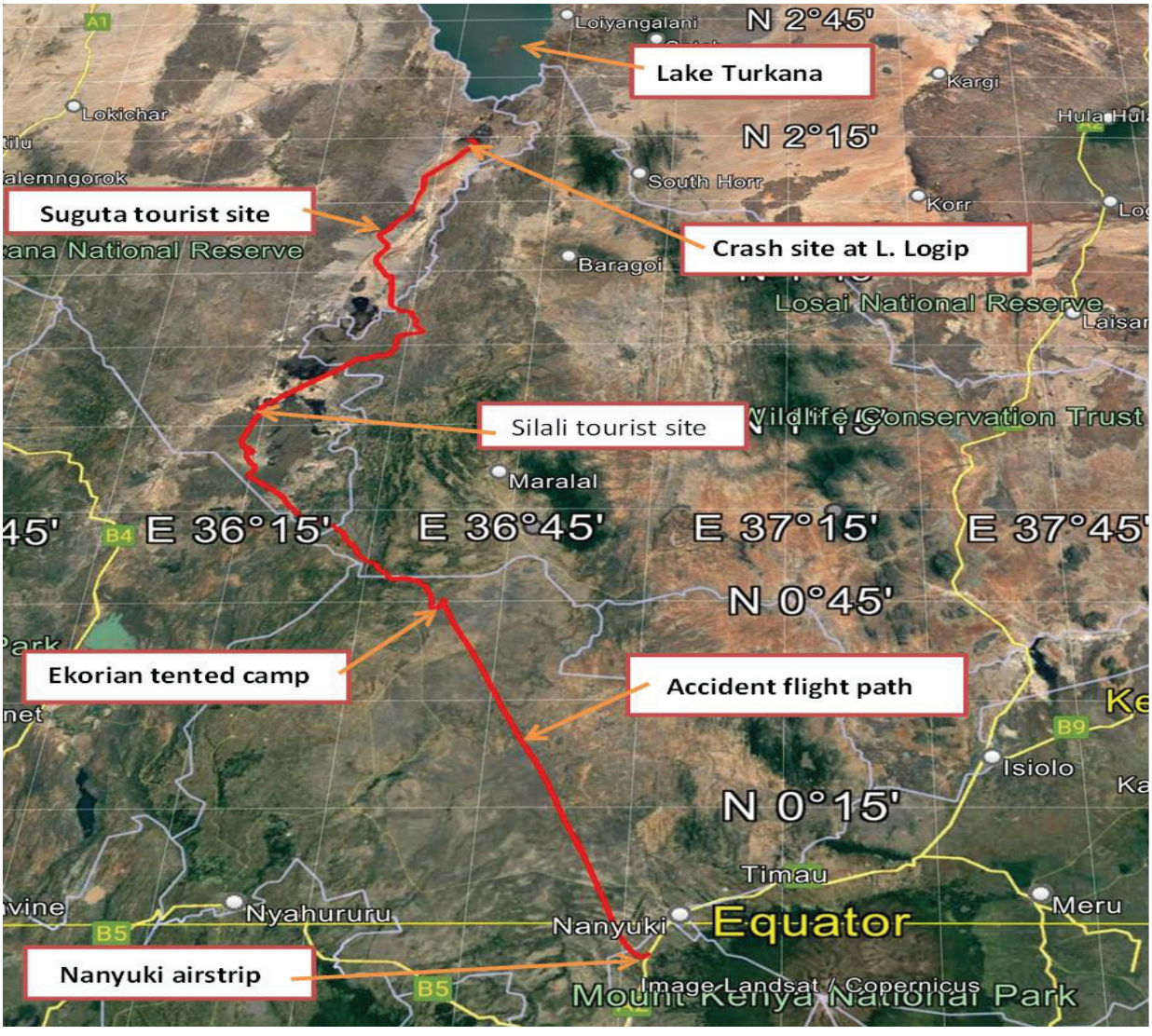


Figure 2: *Map showing departure point, pick location, flightpath, tourist sites and crash site*

1.2. Injuries to persons

Table 1-1. INJURY CHART

Injuries	Crew	Passengers	Others
Fatal	0	0	0
Serious	1	0	0
Minor/None	0	5	

1.3. Damage to aircraft

The aircraft was destroyed.

1.4. Other damage

Not applicable

1.5. Personnel information

1.5.1. The Pilot

The pilot, aged 48, held a valid Airline Transport Pilot Licence (ATPL) valid until 24 November 2022, and a current Class 1 medical certificate with no limitations. His type ratings included AS350, AS355, BO105, BK117, Bell 412, Agusta 119, and EC130B4 aircraft. At the time of the accident, he had accumulated a total of 6,916 flight hours.

1.6. Aircraft information

The helicopter, registration 5Y-CCP, was manufactured by Airbus Inc. in 2012 and registered in Kenya on 13 May 2013. It held a valid Certificate of Airworthiness issued on 27 October 2021, valid until 02 November 2022. The last Certificate of Release to Service, dated 17 June 2022, indicated that the aircraft was scheduled for its next routine maintenance on 16 December 2022 or upon reaching 4,464.2 airframe hours.

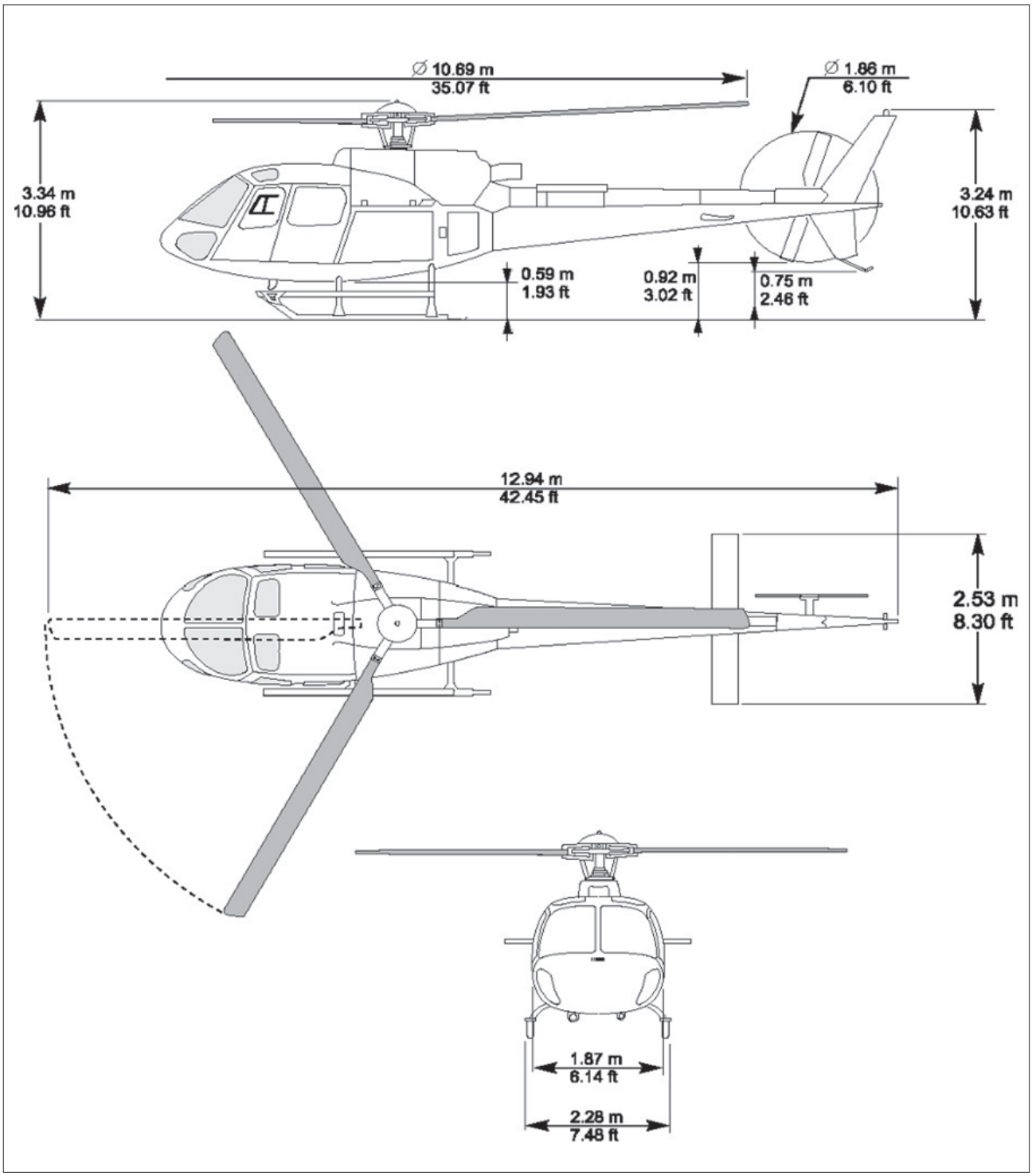


Figure 3: *Dimensions of AS350 B3 type of the helicopter*

At the time of the accident, the helicopter had accumulated 4,432 airframe hours, while the installed engine had 4,438 hours since new. No significant maintenance issues had been reported prior to the occurrence.

Figure 4: *Photograph showing the aircraft 5Y-CCP before the crash*

1.6.1. Maintenance Records

At the time of the accident, the aircraft held a valid Certificate of Airworthiness in the Commercial Air Transport (Passengers) category, issued by KCAA on 06 June 2019 and valid until 02 November 2022. A review of its records confirmed that there were no outstanding defects before the flight and that the aircraft was certified, equipped, and maintained in compliance with KCAA regulations and approved procedures.

1.6.2. Mass and Balance

Not considered a factor.

1.7. Meteorological information

The location of the accident was very far from weather recording stations and therefore the investigation was unable to obtain the exact weather at the time of the accident. The pilot of the accident aircraft indicated that it was CAVOK (Visibility was 10km or more. No CB or TCU and no cloud below 5000 feet or Minimum Sector Altitude (MSA). A second pilot flying the company aircraft and who came to their rescue collaborated same information that there was no significant weather on that day.

1.8. Aids to navigation

Not considered a factor.

1.9. Communication

The investigation team did not obtain any information or evidence to indicate that the pilot established radio communication with Air Traffic Services or with the company at any point during the flight. Upon a review of available records, including ATS logs and company communication channels, no transmissions or attempted contacts were identified. Consequently, the investigation could not verify whether the pilot made, attempted to make, or received any radio calls during the course of the flight.

1.10. Aerodrome information

Not Applicable.

1.11. Flight recorders

1.11.1. Recovered recorders

The helicopter was equipped with a Vehicle and Engine Multifunction Display (VEMD), a Full Authority Digital Engine Control (FADEC) system, an Engine Data Recorder (EDR), and a GPSMAP 696 navigation unit. All of these components were successfully recovered from the wreckage and subsequently shipped to The Bureau d'enquêtes et d'analyses pour la sécurité de l'aviation civile (BEA France) for data extraction and detailed analysis.

1.11.2. Engine data recorder (EDR)

The Engine Data Recorder (EDR) is a non-protected recording device designed to exclusively capture data transmitted by the Full Authority Digital Engine Control (FADEC) unit and store it in non-volatile memory for maintenance purposes. It continuously records engine parameters at a rate of one second, and, in the event of a system failure, it automatically increases the sampling rate to 20 milliseconds for a limited duration.

A visual inspection of the EDR determined that, although the unit had been exposed to water, it remained in good physical condition. The recorder was subsequently opened, and its electronic board was examined under magnification. The board was found to be clean, intact, and free of any signs of moisture intrusion. Owing to the satisfactory condition of the device, a direct data extraction was carried out using the manufacturer's proprietary software. This process produced a raw data file, which was then converted using a dedicated Safran analysis tool supplied to the BEA-France.

The converted dataset contained the parameters recorded at one-second intervals throughout the entire flight, along with the higher-resolution 20-millisecond parameters captured during failure events that occurred while the engine was running. It also included the failure words recorded during the flight, the engine power check (EPC) data corresponding to engine health monitoring activities, records of any exceedances, and any internal error entries generated by the EDR, although in this case, the absence of such entries indicated that no recorder errors were detected.

Figure 5: *A photograph showing the EDR*

1.11.3. FADEC

The Engine Control Unit (ECU) is a dual-module digital control system responsible for fuel regulation, engine parameter management, and engine data recording. During normal operation, engine parameters are recorded at one-second intervals, with the sampling rate increasing to 20 milliseconds for a limited duration when a failure is detected. The EDR dataset includes engine parameters from engine start-up through to the accident sequence. No additional work was carried out on the ECU, as further examination was not expected to provide any additional insight into the cause(s) of the accident.

Figure 6: *A photograph showing the ECU*

1.11.4. VEMD (vehicle and engine monitoring display)

The Vehicle and Engine Multifunction Display (VEMD) is a multifunction screen installed on the instrument panel and designed to present both flight data and engine information. It consists of a dual-module configuration, with each module capable of providing failure indications associated with relevant flight parameters. The system stores its data in non-volatile memory for maintenance purposes. For investigative use, the VEMD supplies flight reports, failure messages accompanied by associated parameters, and overlimit information. It also records the last eight Engine Power Checks (EPC) performed in flight to assess engine health in accordance with the maintenance and flight manuals; however, these EPC records are not time-stamped.

Figure 7: *A photograph showing the VEMD*

1.11.5. Garmin GPSMAP 696

This is a Global Navigation Satellite System (GNSS) receiver that records track points in a non-volatile memory. An SD card inserted allows the loading of topographical and navigational information.

1.12. Wreckage and impact information

Figure 8: *A photograph showing the topside of the aircraft partially submerged in water*

Figure 9: *An aerial photograph showing the final resting point of the aircraft, half-submerged in water*

Figure 10: *A Photograph showing the underside of the helicopter partially submerged in water*

The helicopter's main rotor blades impacted water first and the fuselage came to rest on its right side on the muddy lake bed in approximately 2 to 3 feet of water.

1.13. Medical and pathological information

No data was availed to the investigation.

1.14. Fire

There was no inflight or post impact fire.

1.15. Survival aspects

1.15.1. Survival

Following the impact, the pilot reported to becoming aware of being submerged underwater and restrained by seat harness. The pilot managed to release the harness using left hand, as right hand had been injured. Upon raising his head above the water, he was initially disoriented but was able to observe that the cabin structure integrity had been significantly compromised.

There was no engine noise or mechanical movement observed. The pilot stated that the initial concern was the possibility of fire; however, there were no visible signs of smoke or burning. The first individual he observed was a passenger positioned above him who was struggling to unfasten his harness. He also noted movement and sounds coming from the rear-seat passengers.

When the pilot attempted to stand and assist the passengers, he realized he was unable to do so due to an obvious fracture to his left leg. Although he was able to reach up and release his harness, he also became aware that his right arm was fractured, significantly limiting its use. All occupants appeared to be in shock; however, no immediately life-threatening injuries were apparent, except for a passenger who had sustained a blow to the left side of the head and was unable to speak. This passenger remained conscious, responsive, and able to acknowledge communication.

The injured passenger was moved to a stable position on a section of a main rotor blade where he could lie down. The pilot attempted to locate the helicopter tracking system "Spidertracks" control unit to activate the emergency switch but was unable to reach it. The only audible sound was the Emergency Locator Transmitter (ELT), which had activated upon impact, leading the pilot to believe that a distress signal was being transmitted.

All occupants were eventually able to move to the side of the aircraft and out of the water. The Pilot managed to locate and retrieve a bag containing his satellite phone; however, the device had been submerged and was not functional.

Several bottles of drinking water were salvaged from the wreckage and were used to maintain hydration until assistance arrived.

1.15.2. Search and rescue

The pilot was aware that another pilot from the same company was operating an Airbus AS350 helicopter in the northern area beyond the accident site and would likely overfly the lake at some point. Approximately two hours after the accident, they heard the sound of an approaching helicopter several minutes before they were able to visually identify it. Although none of them had a means of confirming the exact time at that moment, the PIC estimated that they had been at the site for between one and one and a half hours. As the helicopter passed overhead, he recognized it as 5Y-BXE. The rear right sliding door was open, and he could see passengers in the rear cabin looking out.

After overflying their position, the pilot of 5Y-BXE continued toward the shore, where he briefly landed before returning to the accident site a few minutes later. He initially approached

from the west. The accident pilot was unsure whether the pilot of 5Y-BXE intended to attempt a water landing, so he signaled him to break off the approach, believing that the water depth and muddy conditions made such a landing unsafe. The helicopter repositioned behind the wreckage, temporarily out of the accident pilot's line of sight. As 5Y-BXE approached again, the accident pilot, lying on the wreckage, saw the helicopter come into position overhead. He could not see precisely where the pilot placed the skid, but he could see the pilot through the chin bubble and also observed that the rear right sliding door remained open. A person inside the cabin beckoned the passengers forward and instructed them to board, using the right skid as a step. Four passengers boarded quickly, and the helicopter departed to ferry them to shore.

The accident pilot and a passenger remained begin while the first group was transported. 5Y-BXE flew back and rescued the remaining passenger. The accident pilot was left alone for a period before the helicopter returned again and disembarked two rescuers. Initially, there was an intention to drag him up onto the wreckage and load him into 5Y-BXE, but it soon became clear that this was not physically feasible. Several attempts were made to load him into the aircraft, but all were ultimately abandoned, and the helicopter returned to shore. The two rescuers remained with him and assisted in moving him back onto the wreckage.

The accident pilot was eventually transferred onto the kayak, which was paddled back to shore. Upon arrival, there appeared to be multiple helicopter movements, although he was not able to determine the specifics. He was placed on a spinal board and loaded into a helicopter. The flight to Sedar Airstrip lasted approximately 20 minutes. Upon landing, he was offloaded, provided with pain relief, positioned on a vacuum stretcher, and then transferred to an AMREF PC-12 aircraft along with two other passengers and flown to hospital.

1.16. Tests and research

Not applicable.

1.17. Organizational and management information

1.17.1. Tropic Air Kenya

Tropic Air Kenya is a charter company based at Nanyuki Civil Airport and Olkurut Airstrip in the Maasai Mara, specializing in commercial flight operations. The company operates a fleet of helicopters engaged in non-scheduled commercial activities for both public and

private passenger transport. It held a valid Air Service Licence (ASL) issued on 03 November 2021 valid until on 02 November 2024, authorizing international non-scheduled emergency medical services and aerial work. The licence permitted operations to and from Kenya across all points in Africa, the Indian Ocean islands, and the Middle East. The company also held a valid Air Operator Certificate issued by the KCAA on 01 April 2022 valid until on 31 March 2023. In addition, Tropic Air Ltd maintained an Approved Maintenance Organization certificate issued on 01 September 2022 and valid until 31 August 2023.

1.17.2. Kenya Civil Aviation Authority

KCAA Legal Notice No. 124, Regulation 10, titled "Minimum Height," provides that an aircraft shall not be flown over congested areas of cities, towns, or settlements, or over any open-air assembly of persons, unless at an altitude sufficient to permit, in the event of an emergency, a landing to be carried out without undue hazard to persons or property on the surface. This restriction does not apply when the aircraft is engaged in take-off or landing operations, or when specific authorization has been granted by the appropriate authority.

Furthermore, Regulation 10(2)(e) stipulates that an aircraft shall not be flown at a height of less than 500 feet above ground or water, unless otherwise permitted.

In accordance with the above provisions, KCAA issued Tropic Air Kenya with ASL No. 2264, reference KCAA/ASL/92 Vol II, dated 22 February 2022, which included authorization for low-flying operations. This approval was subsequently reaffirmed through a written confirmation issued by KCAA on 19 December 2022.

1.18. Additional information

Not applicable.

1.19. Useful and effective investigative techniques

Not applicable.

2. ANALYSIS

2.1. GENERAL

The accident occurred when the helicopter crashed into Lake Logipi during a sightseeing flight conducted under daytime visual meteorological conditions. On board were five tourists and the pilot. The pilot sustained serious injuries, while the passengers sustained minor injuries.

The flight lasted 19 minutes and 40 seconds from departure at Nanyuki to the point of impact.

The pilot held a valid ATPL issued by KCAA with no limitations. The pilot was type-rated on the accident aircraft and had accumulated more than 500 hours on that type.

The helicopter held a valid Certificate of Airworthiness and was scheduled for routine maintenance on 16 December 2022 or at 4,464.2 airframe hours.

Weather information from the accident pilot indicated that the conditions at the time of the accident were CAVOK, which was further corroborated by another pilot flying in the area who subsequently assisted with the rescue.

Analysis of the available recorded data did not reveal any evidence of engine failure prior to impact. The EDR data showed no anomalies before the helicopter struck the water. All recorded failures and contextual entries were most likely a result of the impact sequence, and no over-limit occurrences were noted during the flight. Technical findings indicate that the flight was uneventful until the moment of impact with the water surface.

According to the pilot, he had been flying between 100 ft and 200 ft AGL over the lake. He reported using Cathedral Rock as a visual reference to maintain altitude and navigate, thereby relying less on the aircraft's instruments. He stated that he was occupied with maneuvering the helicopter to provide the passengers with a view of Cathedral Rock and its reflection on the water surface, during which time he was inadvertently losing height.

The dangers associated with helicopter flight over water have long been recognized. In July 1985, Robinson Helicopter Company issued Safety Notice SN-19, warning of the risk of loss of depth perception when flying over water, and recommending maintaining a minimum height of 500 ft AGL and avoiding maneuvers below 200 ft AGL. Comparable accidents have occurred in Kenya, including the 17 October 2017 accident involving AS350 registration 5Y-NMJ at Lake Nakuru, which resulted in five fatalities. More recently, on 20 July 2023, a

Bell 206 operated by Maritime Helicopters, Inc. crashed into a lake in northern Alaska, killing all four occupants. Early findings did not associate that accident with mechanical failure.

2.2. INFORMATION OBTAINED FROM RECORDERS

The following information was obtained from the BEA-France recorders laboratory work carried out on EDR, FEDEC, VEMD and GPSMAP 696

2.2.1. EDR

During the conversion six files were generated

- Continuous recording channel A and B corresponding to parameters recorded every second during the entire flight,
- Context recording engine running channels A and B corresponding to parameters recorded every 20 milliseconds when failure occurs and the engine running,
- Flags records failure words recorded during flight
- Engine Power Check (EPC) which corresponds to motor health control,
- Overlimit records
- Errors in the EDR if the file is empty.

Errors were identified in the EDR, resulting in the absence of two files that should have contained the high-resolution data recorded at 20-millisecond intervals during engine-running failure events.

2.2.2. ECU

Since the EDR recording already contained the engine parameters from engine start-up through to the accident sequence, no additional work was conducted on the ECU, as further examination was not expected to provide any additional insight into the causes of the accident.

2.2.3. VEMD

The VEMD underwent a visual examination and was found to be heavily corroded. The unit was subsequently opened, and the two internal electronic boards were removed and dried for more than 48 hours at a temperature of 90°C. However, because the EDR recording already contained the engine parameters from engine start-up through to the accident sequence, further work on the VEMD was deemed unnecessary, as it was not expected to provide any additional insight into the causes of the accident.

2.2.4. The GPSMAP 696

Figure 11: *A photograph showing the GPSMAP 696*

The unit was visually examined and found to be dirty, corroded, and missing several buttons. The electronic board was removed and was also observed to be heavily corroded. The main electronic board was dried for more than 48 hours at a temperature of 90°C. The memory component was then unsoldered using an infrared rework station under controlled temperature monitoring, after which it was cleaned and read out using the BEA memory reader. The relevant data area was identified, and a binary file titled 5Y-CCP-GPSMAP-Dump-

cut.bin was generated. This binary file was subsequently converted using the BEA decoding tool, producing a CSV file (5Y-CCP-GPSMAP.csv), which was then transformed into Google Earth files corresponding to each flight conducted on the day of the occurrence:

Nanyuki	–	Ekorian		- 1.kml
Ekorian	–	Silali		- 2.kml
Silali	–	Suguta		- 3.kml
Suguta	–	Turkana	– Accident	- 4.kml

An SD card was recovered from the device. It was corroded. Its connection pads were cleaned using a fiberglass pen and subsequently electrically checked, with no anomalies detected. The SD card was then connected to a computer in read-only mode and no flight data was found on the card.

2.3. DISCUSSED RESULTS

The last flight recorded in the EDR corresponded to Power on Number (PON) 14,647 and flight number 457. The final 65 data points contained invalid flight numbers; however, the recorded flight duration of 19 minutes and 54 seconds was consistent with the duration reported by the pilot. This final recorded flight was determined to be the accident flight. Data recorded on channels A and B were compared and found to be equivalent; therefore, only the continuous data from channel A was used for the analysis.

The EDR continuous recording terminated at EDR time 21 minutes 21 seconds, with EDR time adopted as the reference for all subsequent timing. Up to EDR time 21 minutes 04 seconds, no inconsistencies were identified in the engine parameters. Two failure contexts were logged between 20 minutes 00 seconds and 21 minutes 21 seconds. Beginning at 21 minutes 05 seconds, the recorded torque (TRQ) increased sharply from 17 daN·m to 93 daN·m within 0.35 seconds, while the free turbine rotation speed (N2) simultaneously decreased from 99% to 60% in 0.25 seconds. This pattern is consistent with rotor blade contact with water. At the same moment, the main rotor speed increased abruptly from 101% to 149% within 20 milliseconds; the system's sampling rate and remained at 149% until the end of the recording. This abrupt increase is not physically plausible; therefore, rotor speed values recorded after this point are considered unreliable for analysis. The cause of this anomalous reading could not be conclusively identified, but it is most likely associated with the helicopter's impact with water.

No overlimit condition was recorded during the flight. The following flags were logged after

the sequence consistent with rotor blades striking the water and are therefore considered consequences of the accident sequence rather than indicators of pre-impact anomalies: XPC1, XPC2, XPA, P3 Drift, Flame Out, and Fail 2. No engine-running flags were present prior to the impact, confirming that all recorded flags occurred after the helicopter made contact with the water.

In conclusion, the accident flight was successfully identified. The analysis of the EDR data revealed no anomalies before the helicopter impacted the water, and all failures and context recordings were assessed to be the direct result of the accident sequence. No overlimit was recorded during the flight.

2.4.LOW-LEVEL FLIGHT OPERATIONS AND VISUAL ILLUSION EFFECTS

Although the Civil Aviation (Rules of the Air) Regulations, 2018 generally prohibit aircraft from operating below prescribed minimum heights, Regulation 10(2)(e) provides that an aircraft shall not be flown at a height of less than 500 feet above the ground or water except where authorized by the KCAA and in accordance with the conditions of such authorization. The operator held a valid KCAA approvals, including Air Operator Certificate (AOC) No. 602 and Air Service License (ASL) No. 2264, authorizing low-level sightseeing operations below 500 feet above the ground. However, such authorization was not a relief from complying with other applicable provisions of Regulation 10 unless specifically exempted. These provisions include the requirement under Regulation 10(1) that an aircraft be operated at a height that would permit a landing to be made without undue hazard to persons or property on the surface in the event of an emergency, and the requirement under Regulation 10(2)(b) that a helicopter be operated at a height that would enable it to alight safely without danger to persons or property on the surface following a power-unit failure. The operator also remained subject to the broader safety obligation under Regulation 9, which prohibits the operation of an aircraft in a negligent or reckless manner so as to endanger life or property.

The accident occurred during a low-level sightseeing flight over Lake Logipi when the helicopter impacted the water while maneuvering. Investigation evidence indicated that the helicopter was operating over a glassy, mirror-like water surface that significantly reduced visual references and created visual illusion conditions known to impair depth perception and height judgment. In such circumstances, pilots may experience difficulty accurately assessing their height above the surface, particularly during low-level manoeuvring. It is therefore likely that the pilot misjudged the helicopter's clearance above the water and inadvertently descended into it.

Additionally, while the approvals and the provisions of the operator's Operations Manual Part A (Ref. TAL/OMA/01/00, Section 8.10), the operator's had a responsibility to identify operational hazards and implement appropriate risk controls, the investigation established that there were limited details documented in the Standard Operating Procedures (SOPs) specifically addressing flights below 200 feet over water. Furthermore, even though the Operations Manual had been approved, it contained no guidance on minimum manoeuvring altitudes, visual illusion hazards associated with glassy-water conditions, altitude-monitoring techniques, operational limitations, or risk assessment requirements for low-level overwater operations. The absence of such procedures reduced organizational safety barriers for managing known hazards associated with low-level flight and increased reliance on pilot judgment as the primary means of risk control. This occurrence highlights the inherently reduced margin for error associated with very low-level sightseeing operations and demonstrates how environmental conditions that degrade visual depth perception can significantly increase operational risk when not supported by comprehensive procedures, hazard awareness measures, and effective operational controls.

3. CONCLUSION

3.1. FINDINGS

i) The helicopter had a valid Certificate of Airworthiness, Certificate of Registration, and Certificate of Release to Service. It had been maintained in compliance with the KCAA regulations and was certified airworthy for this flight;

ii) The helicopter was certified and maintained in accordance with prescribed procedures;

iii) The pilot sustained serious injuries, while the passengers sustained minor injuries;

iv) The pilot held a valid Airline Transport Pilot Licence issued by KCAA;

v) The weather conditions on the day of the flight were not significant and did not affect the operation;

vi) Analysis of the recorded data and post-accident examination indicated that the accident was not associated with engine or system failures;

vii) The pilot had been flying at an altitude of between 100 ft and 200 ft AGL over the lake;

viii) The cause of the accident was directly related to flight operations;

ix) There was no post-impact fire.

3.2. PROBABLE CAUSE

The probable cause of the accident was the pilot's failure to maintain adequate height clearance above the water surface on Lake Logipi during a sightseeing flight resulting in the helicopter impacting water.

3.3. CONTRIBUTING FACTORS

- The pilot's reliance on limited visual references while maneuvering at low altitude over a glassy lake severely degraded depth perception, causing an altitude misjudgment during a turn that resulted in inadvertent water impact. This risk was compounded by the mirror-smooth surface eliminating vital visual cues;

- A lack of company Standard Operating Procedures for flights below 200 ft over water.

4. SAFETY RECOMMENDATIONS

4.1. RECOMMENDATIONS TO THE KENYA CIVIL AVIATION AUTHORITY

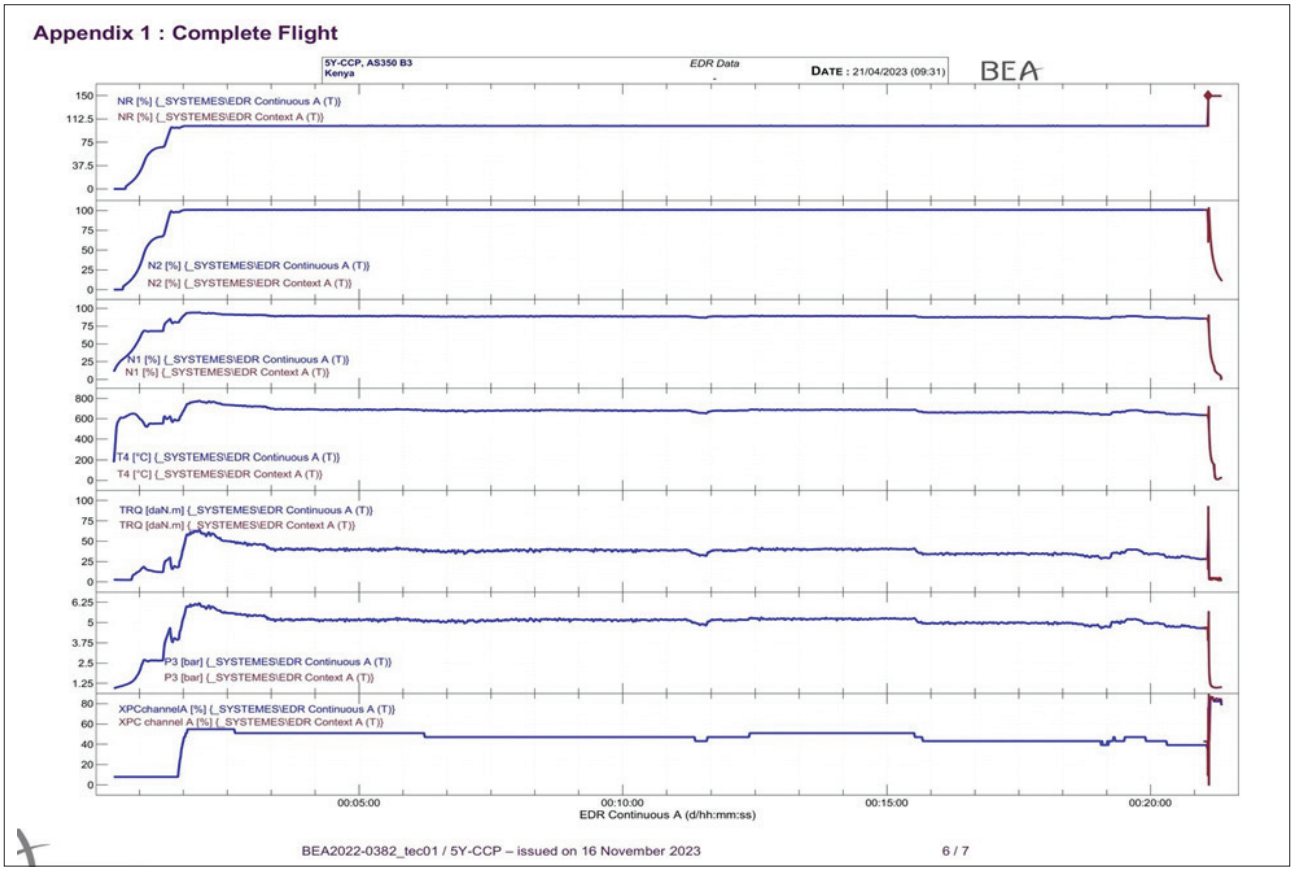
The investigation identified that although operators may be authorized to conduct flights below general minimum altitude requirements, there is limited regulatory guidance regarding the specific hazards of low-level flight over water, particularly below 200 ft AGL. This guidance gap is acute regarding "glassy water" phenomena, which strip pilots of visual depth perception and surface definition. Operating below 200 ft over calm, mirror-like water significantly elevates the risk of spatial disorientation, altimeter misinterpretation, and inadvertent water impact due to the inability to accurately judge height

It is therefore recommended that the KCAA:

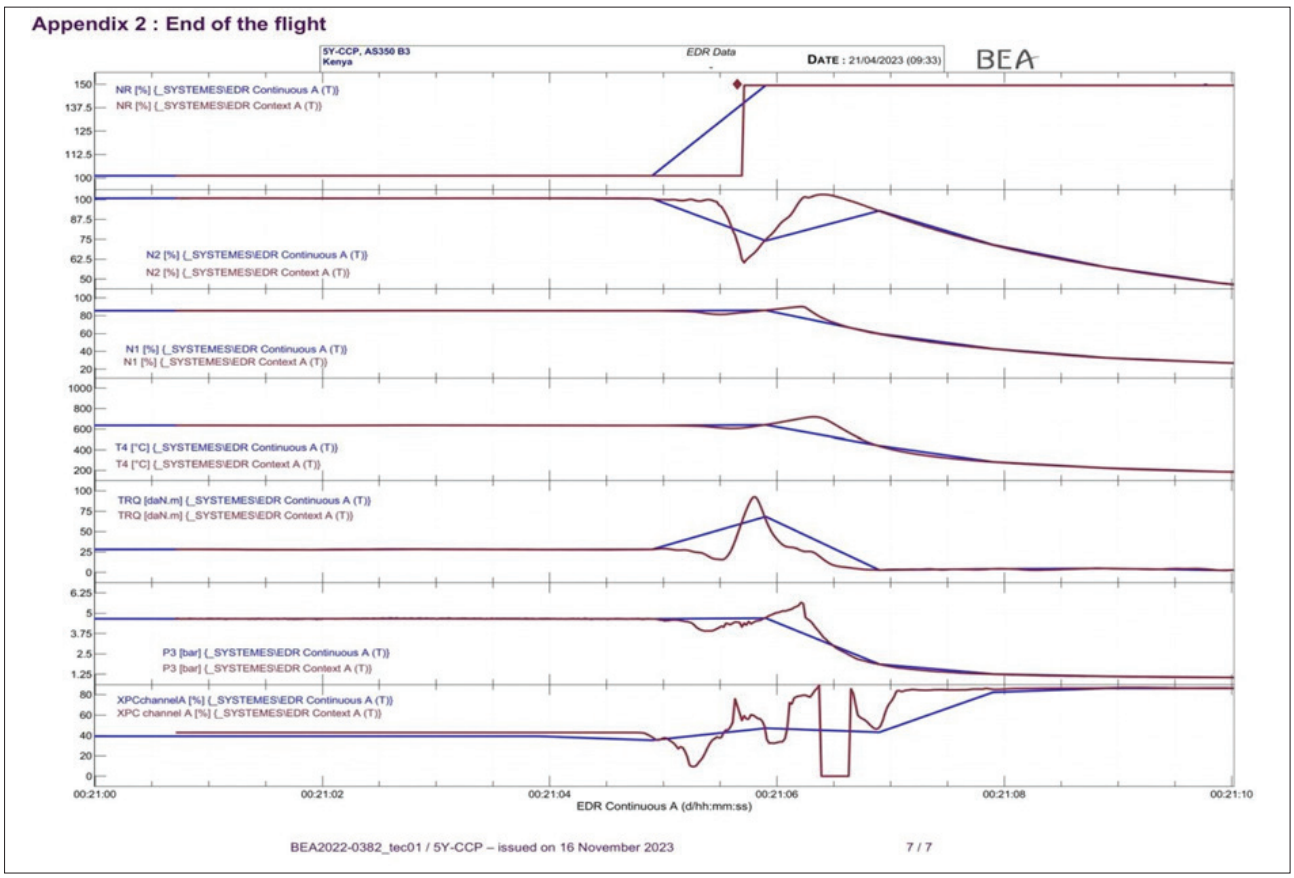
1) Develop and publish guidance to the industry addressing the operational hazards associated with low-level flight over water including visual perception limitations, environmental factors, and common visual illusions encountered by flight crews.
2) Provide guidance to operators on the establishment of Standard Operating Procedures (SOPs), minimum operating altitudes, and use of altitude reference systems for over-water operations.
3) Review the approval and oversight processes applicable to operators' conducting operations with increased risks to ensure that appropriate risk assessments, training programmes, operational procedures, and safety mitigations are in place; and
4) Promote awareness of the risks associated with low-level over-water operations through safety bulletins, seminars, safety promotion activities, and inclusion of the subject in relevant inspector and pilot training programmes.

Ag. Chief Investigator of Aircraft Accidents - KENYA

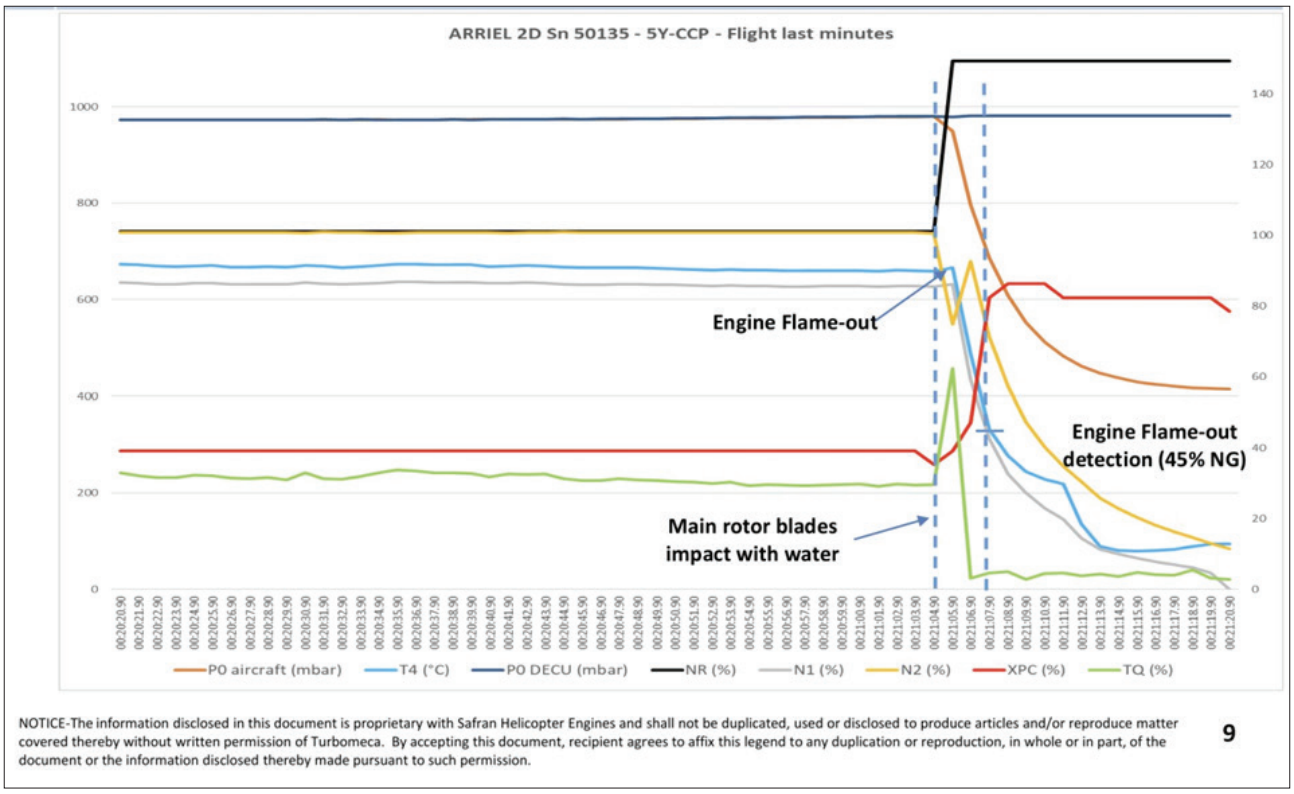
APPENDICES



Appendix 1: Complete flight



Appendix 2: End of flight



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Appendix 3: Last minutes of the flight

REPUBLIC OF KENYA

MINISTRY OF ROADS AND TRANSPORT
STATE DEPARTMENT FOR AVIATION
AND AEROSPACE DEVELOPMENT
AIRCRAFT ACCIDENT INVESTIGATION DEPARTMENT

FINAL INVESTIGATION REPORT

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