National Transportation Safety Board
Office of Aviation Safety
Washington, DC 20594

ANC22FA041

METEOROLOGY

Specialist's Factual Report

September 16, 2022

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A. ACCIDENT

Location: Kalea, Hawaii
Date: June 8, 2022
Time: 1726 Hawaii-Aleutian standard time
0326 coordinated universal time (UTC) on June 9, 2022
Helicopter: Bell 407 helicopter; Registration: N402SH

B. METEOROLOGY SPECIALIST

Specialist Paul Suffern
National Transportation Safety Board
Washington, DC

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's Senior Meteorologist was not on scene for this investigation and conducted the meteorology phase of the investigation remotely, collecting data from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the Weather Prediction Center (WPC) and the National Center for Environmental Information (NCEI). This Specialist's Factual Report contains the meteorological factors pertinent to the weather surrounding the accident time. All times are Hawaii-Aleutian standard time (HST) and are based upon the 24-hour clock, where local time is -10 hours from UTC. Directions are referenced to true north and distances are in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles. NWS station identifiers use the standard International Civil Aviation Organization 4-letter station identifiers versus the International Air Transport Association 3-letter identifiers, which deletes the initial country code designator "K" for U.S. airports and "P" for OCONUS[1] airports.

The accident site was at an approximate latitude 18.99572° N, Longitude 155.75438° W, and elevation of 160 feet (ft).

[1] Outside Continental United States (OCONUS) – Overseas, refers to any country or place beyond CONUS. Alaska, Hawaii, and the U.S. territories are considered overseas under the Space-A Regulation.

D. FACTUAL INFORMATION

1.0 Synoptic Situation

The synoptic or large-scale migratory weather systems influencing the area were documented using standard NWS charts issued by the National Center for Environmental Prediction and the WPC, located in College Park, Maryland. These are the base products used in describing synoptic weather features and in the creation of forecasts and warnings for the NWS. Reference to these charts can be found in the joint NWS and Federal Aviation Administration (FAA) Advisory Circular "Aviation Weather Services", AC 00-45H.[2]

1.1 Surface Analysis Chart

The Pacific surface analysis for 1400 HST is provided as figure 1 with the approximate location of the accident site marked within the red circle. The chart depicted no pressure centers near the accident site. A ridge[3] was noted north of the Hawaiian Islands with the Intertropical Convergence Zone (ITCZ) well south of the Hawaiian Islands. The station models around the accident site depicted an east-northeast wind at 10 knots.

[2] https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1030235

[3] Ridge – An elongated area of relatively high atmospheric pressure or heights.

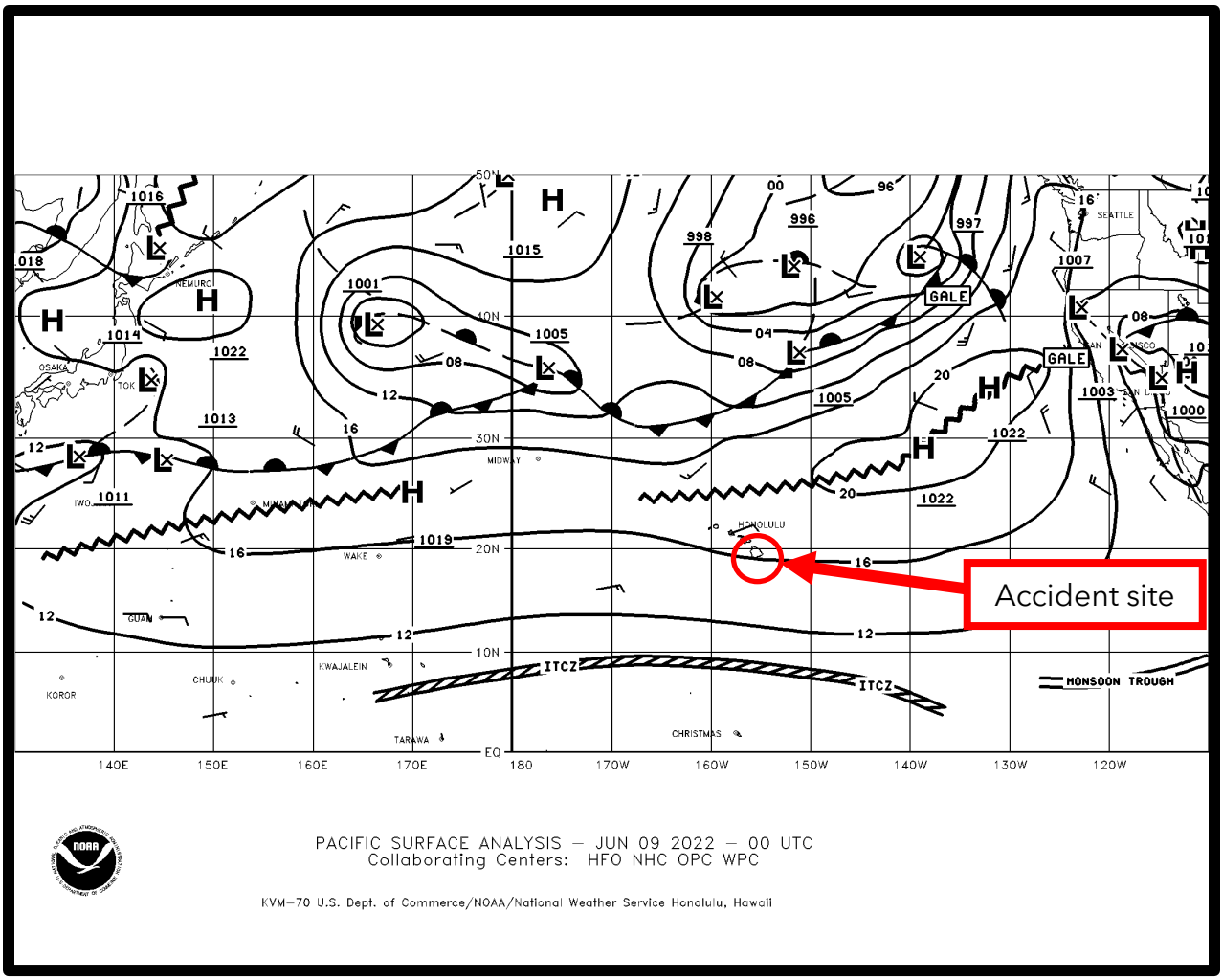

Figure 1. NWS Surface Analysis Chart for 1400 HST.

2.0 Surface Observations

The area surrounding the accident site was documented using official Aviation Routine Weather Reports (METARs) and Specials Reports (SPECIs). The following observations were taken from standard code and are provided in plain language. Figure 2 is a local sectional chart with the accident site and the closest weather reporting location marked. The chart depicted the magnetic variation[4] of 9.5° east over the area.

[4] Magnetic variation – The angle (at a particular location) between magnetic north and true north. Latest measurement taken from https://skyvector.com/

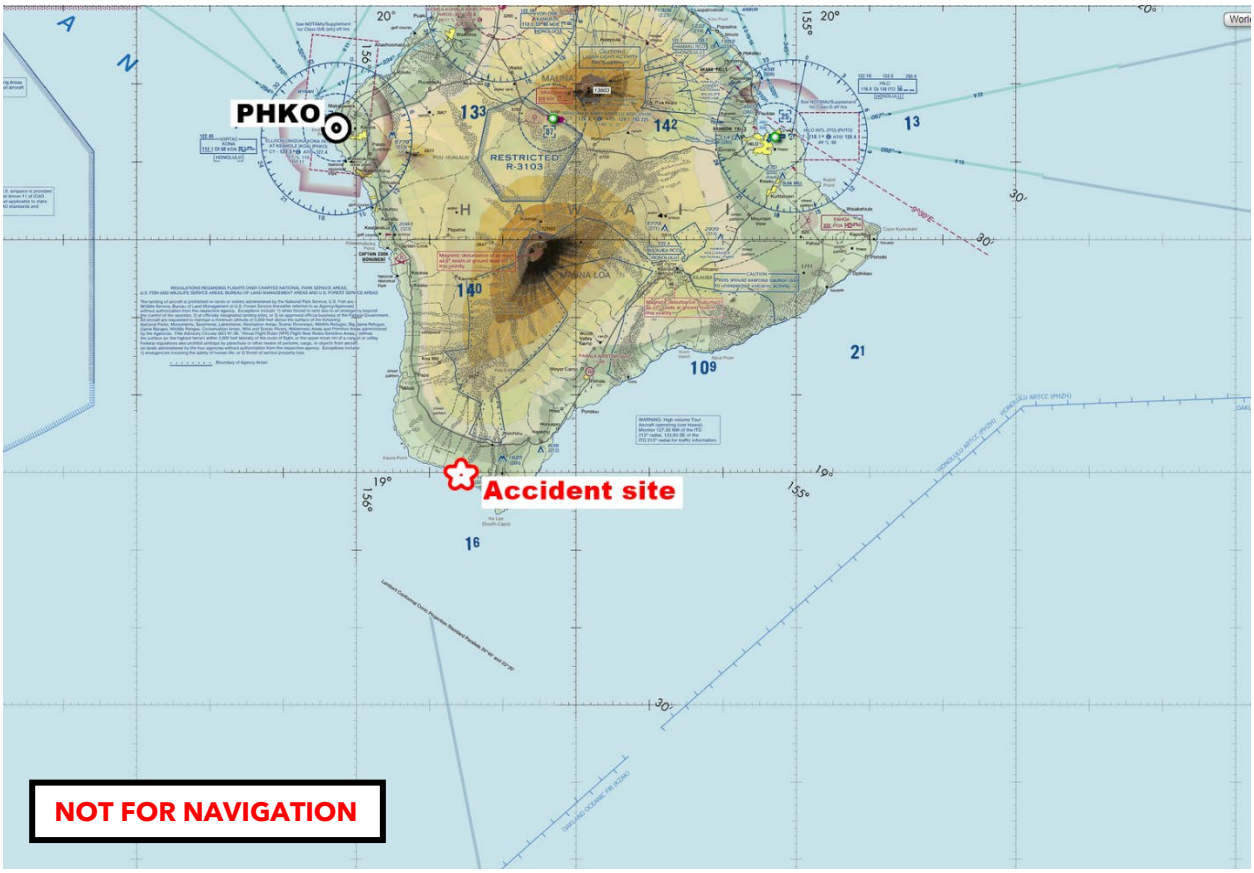

Figure 2. FAA sectional aeronautical chart of the accident area with the location of the accident site and surface observation sites.

Ellison Onizuka Kona International Airport at Keahole (PHKO) had the closest official weather station to the accident site and was the departure airport. PHKO had an Automated Surface Observing System (ASOS[5]) whose longline[6] reports were augmented by air traffic control (ATC) when the tower was in operation[7]. The PHKO ASOS was located 48 miles north-northwest of the accident site, at an elevation of 47 ft, and issued the following observations surrounding the accident time:[8]

[5] ASOS – Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, weather phenomena, ceiling, temperature, dewpoint, altimeter, and barometric pressure. ASOS are maintained by the NWS.

[6] "Longline" refers to the dissemination of weather observations with the intent that they are available in near-real time to national databases and accessible to the general global public from a large number of vendors. This does not include public accessibility to observations from a reporting station's Very High Frequency (VHF; line-of-site) or telephone broadcast, where applicable. Longline dissemination of weather observations is the primary vehicle through which the weather observations are distributed.

[7] ATC operation hours between 0600 and 2200 local.

[8] The bold sections in this NWS product and the rest of the products in this report are intended to highlight the text that directly reference the weather conditions that affected the accident location around the accident time. The local times in this section next to the METARs are provided for quick reference between UTC and local times around the accident time.

[1253 HST] METAR PHKO 082253Z 19009KT 10SM FEW055 SCT070 29/20 A3001 RMK AO2 SLP160 T02890200

[1353 HST] METAR PHKO 082353Z COR 23010KT 10SM SCT070 29/20 A3000 RMK AO2 SLP156 T02940200 10294 20261 58010

[1453 HST] METAR PHKO 090053Z 24010KT 10SM SCT050 BKN070 28/21 A2999 RMK AO2 SLP156 T02830206

[1553 HST] METAR PHKO 090153Z 25010KT 10SM BKN060 OVC070 28/21 A2998 RMK AO2 SLP153 T02780206

[1653 HST] METAR PHKO 090253Z 26009KT 10SM BKN055 BKN075 28/21 A2998 RMK AO2 SLP151 T02780206 58005

ACCIDENT TIME 1726 HST

[1753 HST] METAR PHKO 090353Z 25009KT 10SM FEW049 OVC070 27/21 A2998 RMK AO2 SLP152 T02720206

[1853 HST] METAR PHKO 090453Z 25012KT 10SM SCT026 BKN070 27/21 A2999 RMK AO2 SLP155 T02670206

The bold type observations decoded in plain language were as follows:

PHKO weather at 1653 HST, wind from 260° at 9 knots, visibility 10 miles or greater, broken ceiling at 5,500 ft above ground level (agl), broken clouds at 7,500 ft agl, temperature of 28° Celsius (C), dew point temperature 21°C, and an altimeter setting of 29.98 inches of mercury (inHg). Remarks, automated station with a precipitation discriminator, sea level pressure 1015.1-hectopascals (hPa), temperature 27.8°C, dew point temperature 20.6°C, 3-hourly pressure decrease of 0.5 hPa.

PHKO weather at 1753 HST, wind from 250° at 9 knots, visibility 10 miles or greater, few clouds at 4,900 ft agl, overcast ceiling at 7,000 ft agl, temperature of 27°C, dew point temperature 21°C, and an altimeter setting of 29.98 inHg. Remarks, automated station with a precipitation discriminator, sea level pressure 1015.2-hPa, temperature 26.7°C, dew point temperature 20.6°C.

The observations from PHKO surrounding the accident time indicated VFR[9] conditions.

[9] As defined by the NWS and the FAA Aeronautical Information Manual (AIM) section 7-1-7 defines the following general flight categories:

- Low Instrument Flight Rules (LIFR*) – ceiling below 500 ft above ground level (agl) and/or visibility

Several unofficial surface observations sites were closer to the accident site than PHKO and locations are documented in figure 3 using the MesoWest network[10]. Ocean View (AN738)[11], Lower Kahuku CS (LKHH1)[12], and South Point near Naalehu (SOPH1)[13] stations were located within 8 miles from the accident site. The data from AN738, LKHH1, and SOPH1 can be found in attachments 1, 2 and 3[14].

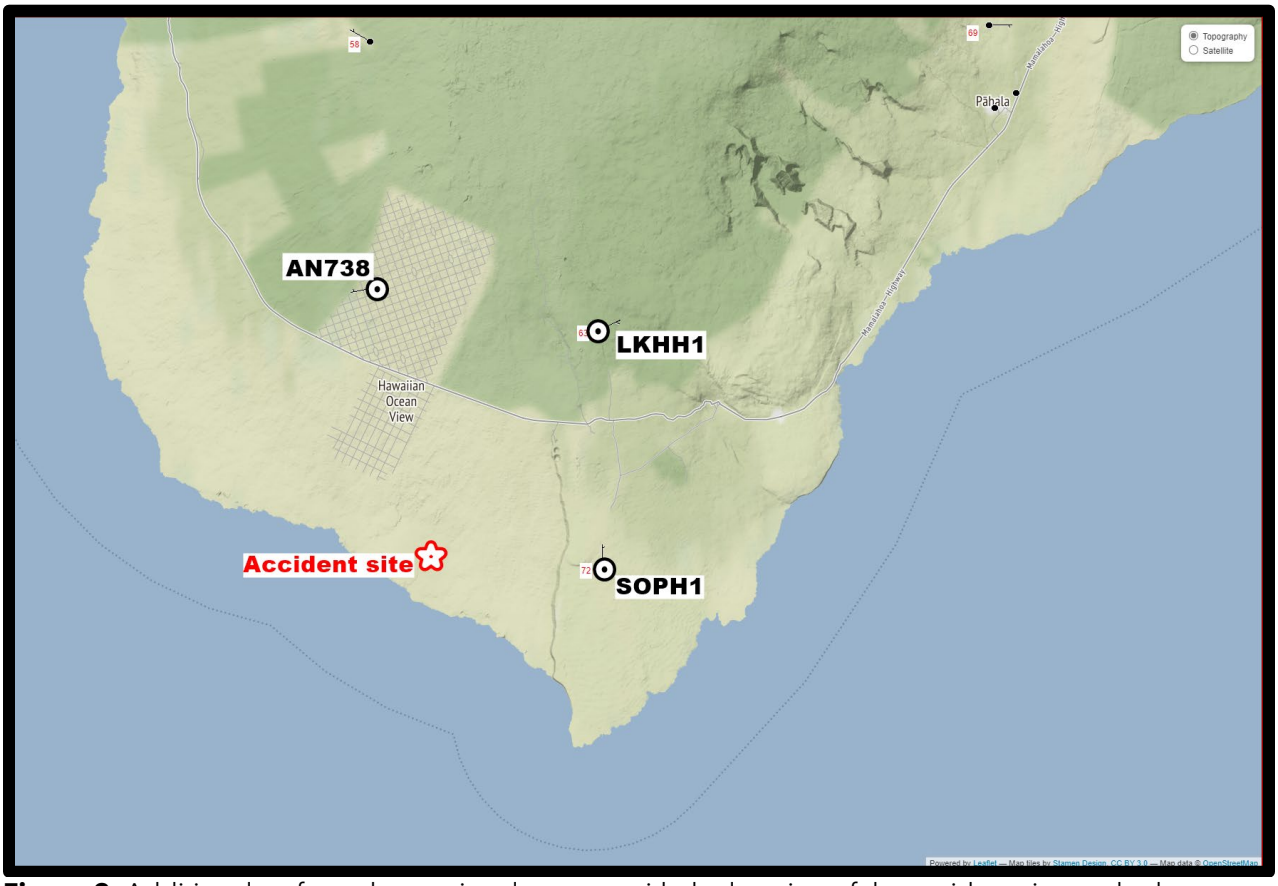

Figure 3. Additional surface observational sources with the location of the accident site marked.

less than 1 statute mile.

- Instrument Flight Rules (IFR) – ceiling between 500 to below 1,000 feet agl and/or visibility 1 to less than 3 miles.
- Marginal Visual Flight Rules (MVFR**) – ceiling from 1,000 to 3,000 ft agl and/or visibility 3 to 5 miles.
- Visual Flight Rules (VFR) – ceiling greater 3,000 ft agl and visibility greater than 5 miles.

* By definition, IFR is a ceiling less than 1,000 ft agl and/or visibility less than 3 miles while LIFR is a sub-category of IFR.

**By definition, VFR is a ceiling greater than or equal to 3,000 ft agl and visibility greater than 5 miles while MVFR is a sub-category of VFR.

[10] MesoWest Data (utah.edu)

[11] MESOWEST STATION INTERFACE (utah.edu)

[12] MESOWEST STATION INTERFACE (utah.edu)

[13] MESOWEST STATION INTERFACE (utah.edu)

[14] Maintenance schedule and reliability for these stations is unknown.

3.0 Upper Air Sounding

A Global Data Assimilation System (GDAS) model sounding was created for the accident site coordinates for 1700 HST with a surface elevation of 0 ft.[15] The GDAS sounding was plotted on a standard Skew-T Log P diagram[16] from the surface to 600-hPa (or approximately 14,000 ft) using the RAOB[17] software package and is included as figure 4. The sounding depicted the lifted condensation level (LCL)[18] at 2,516 ft, the level of free convection (LFC)[19] at 3,693 ft, and the convective condensation level (CCL)[20] at 7,999 ft. The precipitable water value at 1.18 inches.

[15] GDAS sounding was created using NOAA Air Resource Laboratory:
https://ready.arl.noaa.gov/READYamet.php
Closest point available was 19.07° N, 155.75° W.
[16] Skew T log P diagram – is a standard meteorological plot using temperature and the logarithmic of pressure as coordinates, used to display winds, temperature, dew point, and various indices used to define the vertical structure of the atmosphere.
[17] RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Eosonde Research Services, The Villages, Florida.
[18] LCL - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.
[19] LFC – The level at which a parcel of saturated air becomes warmer than the surrounding air and begins to rise freely. This occurs most readily in a conditionally unstable atmosphere.
[20] CCL – The level in the atmosphere to which an air parcel, if heated from below, will rise dry adiabatically, without becoming colder than its environment just before the parcel becomes saturated.

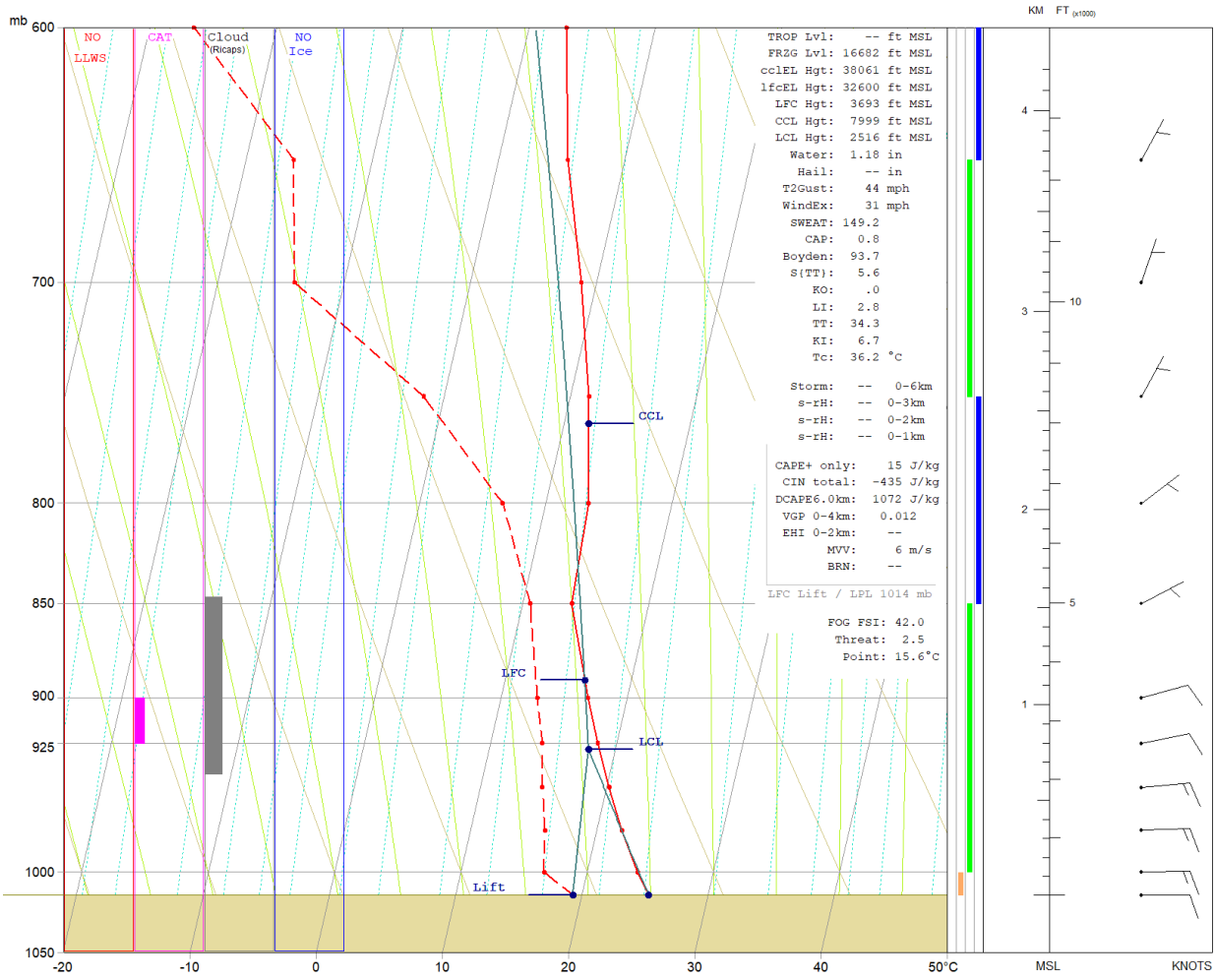

Figure 4. 1700 HST GDAS sounding.

The 1700 HST GDAS sounding indicated an unstable to conditionally unstable environment from the surface through 5,000 ft. Clouds were indicated by RAOB between 2,000 and 5,000 ft. No icing was indicated by RAOB below 14,000 ft.

The 1700 HST GDAS sounding wind profile indicated a near surface wind from 090° at 11 knots with the wind remaining westerly through 6,000 ft. The wind speed remained between 5 and 15 knots between the surface and 6,000 ft. RAOB did not indicate the possibility of low-level wind shear (LLWS).

4.0 Satellite Data

Geostationary Operational Environmental Satellite number 17 (GOES-17) visible and infrared data were obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man-computer Interactive Data Access System software. Visible and infrared imagery (GOES-17 bands 2 and 13) at wavelengths of 0.64 microns (μm) and 10.3 μm, respectively, were retrieved for the period from 1200 HST through 2000 HST and reviewed, and the closest images to the time of the accident were documented.

Figure 5 presents the GOES-17 visible imagery from 1730 HST at 1X magnification with the accident site highlighted with a red square. The cloud cover above the accident site was moving from northeast to southwest (attachment 4). Figure 6 presents the GOES-17 infrared imagery from 1730 HST at 4X magnification with the accident site highlighted with a red square. Cloud cover was depicted above the accident site. The cloud cover along the coastal regions and offshore had brightness temperatures of 288 Kelvin. It should be noted these figures have not been corrected for any parallax error.

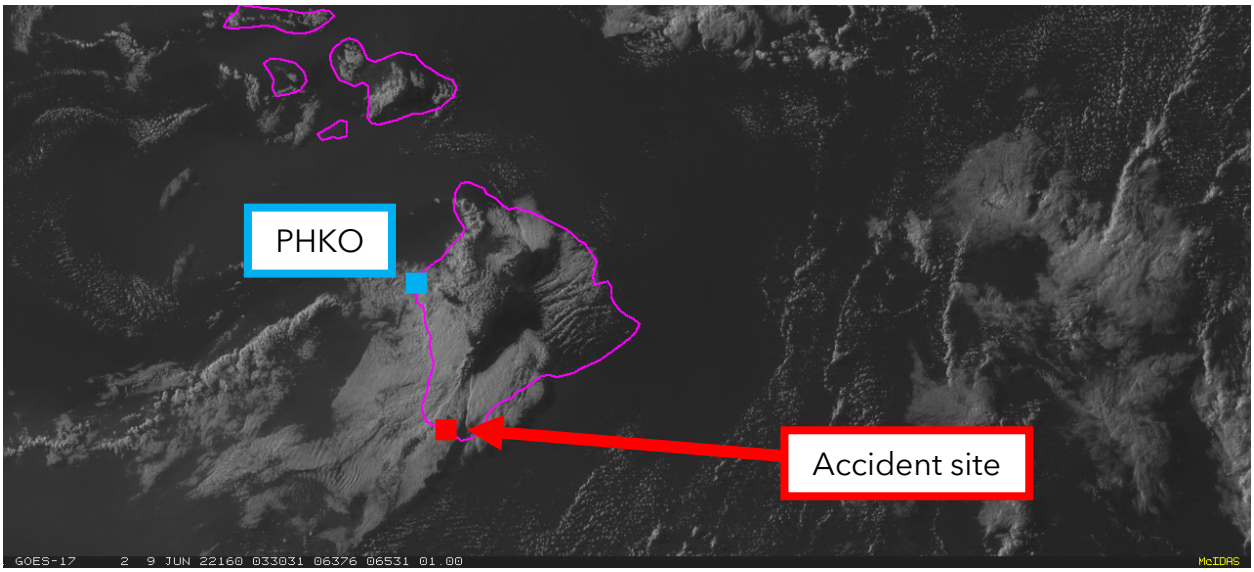

Figure 5. GOES-17 visible image at 1730 HST.

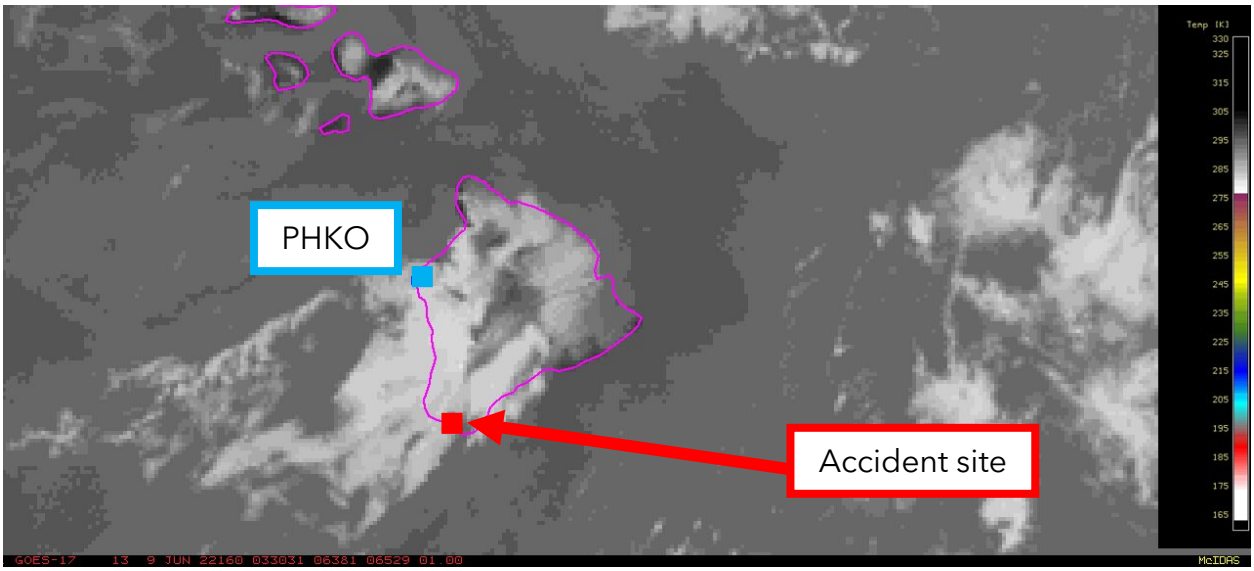

Figure 6. GOES-17 infrared image at 1730 HST.

5.0 Weather Surveillance Radar Imagery

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)[21] to the accident site was the South Shore, Hawaii, (PHWA) WSR-88D located 12 miles east-northeast of the accident site that had an elevation of 1,461 ft. Level II archive PHWA radar data were obtained from the NCEI utilizing the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software. Due to terrain blockage issues near the accident site and PHWA, WSR-88D data were unavailable for altitudes below 6,000 ft. Reflectivity values between -10 to 0 dBZ[22] were noted around and above 6,000 ft above the accident site. The PHWA 1.3° elevation scans (WSR-88D center beam height around 3,200 ft) are provided in attachments 5 and 6 with base reflectivity and correlation coefficient (CC) imagery between 1704 and 1800 HST.

6.0 Pilot Reports

The longline-disseminated pilot reports[23] (PIREPs) were reviewed for about two hours on either side of the accident time and there were no PIREPs issued into the national airspace system within 100 miles of the accident site.

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[21] The WSR-88D is an S-band 10-centimeter wavelength radar with a power output of 750,000 watts, and with a 28-foot parabolic antenna that concentrates the energy between a 0.87° and 0.96° beam width. The radar produces three basic types of products: base reflectivity, base radial velocity, and base spectral width.

[22] dBZ – A non-dimensional "unit" of radar reflectivity which represents a logarithmic power ratio (in decibels or dB) with respect to radar reflectivity factor, Z.

[23] Only pilot reports with the World Meteorological Organization headers UBHI** were considered.

7.0 Significant Meteorological Information

There were no non-convective or convective Significant Meteorological Information (SIGMET) advisories valid for the accident site at the accident time.

8.0 Center Weather Service Advisories

The Honolulu (ZHN) Air Route Traffic Control Center (ARTCC) Center Weather Service Unit (CWSU) was responsible for the accident region. There was no Center Weather Advisory (CWA) valid from ZHN CWSU at the accident time.

9.0 Airmen's Meteorological Information

There were no text Airmen's Meteorological Information (AIRMET) advisories valid for the accident site at the accident time.

10.0 Area Forecast

The Area Forecast valid for the accident site at the accident time was issued at 1701 HST and forecast few clouds at 3,000 ft with broken to scattered clouds at 5,000 ft and cloud tops at 7,000 ft with isolated areas with broken clouds at 3,500 ft and light rain showers:

000
FAHW31 PHFO 090301
FA0HI

HNLC FA 090335
SYNOPSIS AND VFR CLD/WX
SYNOPSIS VALID UNTIL 092200
CLD/WX VALID UNTIL 091600...OUTLOOK VALID 091600-092200
.
SEE AIRMET SIERRA FOR IFR CLD AND MTN OBSC.
TS IMPLY SEV OR GREATER TURB SEV ICE LOW LEVEL WS AND IFR COND.
NON MSL HGT INDICATED BY AGL OR CEILING.
.
SYNOPSIS...LIGHT TO MODERATE TRADES WILL PUSH ISOLATED SHOWERS
MAINLY ACROSS WINDWARD COASTS AND SLOPES.
.
INTERIOR BIG ISLAND ABV 070.
FEW080. 06Z SKC. OUTLOOK...VFR.
.
BIG ISLAND LOWER SLOPES...COAST...AND ADJ WATERS FROM LAUPAHOEHOE

These do not include pilot reports only broadcast via radio.

TO CAPE KUMUKAHI TO APUA POINT.
FEW-SCT025 SCT045 TEMPO BKN045 TOPS 070 ISOL BKN020 TOPS 080
-SHRA. OUTLOOK...VFR.
.
BIG ISLAND LOWER SLOPES...COAST...AND ADJ WATERS FROM APUA POINT TO SOUTH CAPE TO UPOLU POINT TO LAUPAHOEHOE.
FEW030 BKN-SCT050 TOPS 070 ISOL BKN035 -SHRA. OUTLOOK...VFR.
.
MTN...N THRU E SECTIONS AND ADJ WATERS OF MAUI MOLOKAI LANAI
OAHU AND KAUAI.
FEW025 SCT035 ISOL BKN030 TOPS 080 -SHRA. OUTLOOK...VFR.
.
REST OF AREA.
FEW-SCT030 SCT050. OUTLOOK...VFR.

11.0 Terminal Aerodrome Forecast

There were no NWS Terminal Aerodrome Forecast[24] (TAF) sites located within 30 miles of the accident site.

12.0 National Weather Service Area Forecast Discussion

The NWS weather forecast office in Honolulu, Hawaii, (WFO HFO) was responsible for the public forecast in the region of the accident site. WFO HFO issued the following Area Forecast Discussion (AFD) at 1535 HST, the closest AFD to the accident time with an aviation section:

FXHW60 PHFO 090135
AFDHFO

Area Forecast Discussion
National Weather Service Honolulu HI
335 PM HST Wed Jun 8 2022

.SYNOPSIS...
Mostly dry and pleasant weather can be expected through the remainder of the week and on through the weekend thanks to high pressure centered several hundred miles east northeast of the state. Clouds and a few showers will primarily be focused over windward and mauka areas with most leeward locations remaining dry. Trade winds may pick up a bit over the weekend and on into early next week as the high builds toward the west.

[24] According to NWS Instruction 10-813: "An NWS TAF consists of the expected meteorological conditions significant to aviation at an airport for a specified time period. For the U.S., this is the area within five (5) statute miles (SM) of the center of an airport's runway complex." www.nws.noaa.gov/directives/sym/pd01008013curr.pdf

&&

.DISCUSSION...
Surface high pressure is centered far east northeast of the area with a ridge axis extending west to a position a few hundred miles north of the state. This places the islands in a light to locally moderate trade wind environment. Low level moisture embedded in the trades has been providing for some brief passing light showers over windward and mauka areas with most leeward areas being generally dry. Winds are light enough that local sea breezes will develop across some area during the day with a few clouds and isolated showers possible over interior areas. We expect little change in this weather pattern through Friday. Trade winds are expected to pick up a bit over the weekend and on into early next week as the high strengthens and builds westward. There may also be a slight uptick in windward and mauka showers as a weak mid level trough moves over the area.

&&

.AVIATION...
A ridge just north of the main Hawaiian Islands will drive moderate trade flow across the area through the rest of the work week. Clouds and showers will favor windward areas, especially at night and during the morning hours. Expect TAF sites to remain VFR, although leeward cloud cover may increase across protected leeward areas during the afternoons.

There are currently no AIRMETs in effect and none are anticipated today.

&&

.MARINE...
A ridge will persist north of the islands. Trade winds will thus remain in the light to moderate range into Friday for most areas. The ridge is expected to build farther to the north beginning by late Friday or Friday night. Trade winds will then increase into the moderate to locally strong category, reaching the Small Craft Advisory threshold over the windier eastern waters around Maui County and the Big Island Saturday and Sunday.

A series of small, medium period, south swells will keep surf along south facing shores from going flat over the next couple of days. Surf heights will drop from Friday into the weekend as south swell energy begins to ease.

The current small northwest swell will fade, with declining surf heights along north and west facing shores through Friday. Another small, medium period, northwest swell arrives late Saturday into Sunday. Eastern facing shores will see small wind wave chop through Friday. East shore surf heights will rise through the weekend as trade winds strengthen.

&&

.HFO WATCHES/WARNINGS/ADVISORIES...
None.

&&

$$

13.0 Winds and Temperature Aloft Forecast

The NWS 1559 HST Winds and Temperature Aloft forecast valid for the closest points to the accident site are included below:

FBHW31 KWNO 100159
FD1HW1
DATA BASED ON 100000Z
VALID 100600Z FOR USE 0200-0900Z. TEMPS NEG ABV 24000

FT 1000 1500 2000 3000 6000 9000 12000 15000 18000 24000
KOA 9900 9900 9900 9900 9900+13 9900+09 0605+06 0808+04 1211-05 1312-19
ITO 9900 9900 1005 1110 0807+10 0911+11 0908+08 0910+04 0910-05 1312-18

The closest forecast points to the accident site were Kailua, Hawaii, (KOA) and Hilo, Hawaii, (ITO). The 1559 HST KOA forecast for use between 1600 HST and 2300 HST indicated a calm wind at and below 3,000 ft. The 1559 HST ITO forecast indicated calm winds at 1,000 and 1,500 ft, a wind at 2,000 ft from 100° at 5 knots, and a wind at 3,000 ft from 110° at 10 knots.

14.0 Weather Camera Imagery

Images from the FAA's Aviation Weather Cameras[25] were retrieved for the Pahala weather camera location around the accident timeframe and are contained in attachment 7.

[25] FAA WeatherCams

15.0 Pilot Weather Briefing

Title 14 CFR 91.103 states that "Each pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight." FAA AC 91-92 "Pilot's Guide to a Preflight Planning" (dated March 15, 2021) provided pilot guidance on preflight self-briefings, including planning, weather interpretation, and risk identification/mitigation skills. The AC further stated in part:

> Pilots adopting these guidelines will be better prepared to interpret and utilize real-time weather information before departure and en route, in the cockpit, via technology like Automatic Dependent Surveillance-Broadcast (ADS-B) and via third-party providers. [26]

The accident pilot did request weather information from Leidos Flight Service at 0858 HST and was provided the weather and some additional information found in attachment 8. Standard weather observations and forecasts were taken from a 50-mile ring surrounding the departure location and winds aloft forecast information was taken from a 200-mile ring surrounding the departure location. A search of archived ForeFlight information indicated that the accident pilot did not have a ForeFlight account. It is unknown what, if any, additional weather information the accident pilot viewed before or during the accident flight.

16.0 Astronomical Data

The astronomical data obtained for the accident site on June 8, 2022, indicated the following:

SUN	
Begin civil twilight	0521 HST
Sunrise	0545 HST
Sun transit	1222 HST
Accident time	**1726 HST**[27]
Sunset	1900 HST
End civil twilight	1924 HST

At the time of the accident the Sun was located at an altitude of 19.82° and azimuth of 288.30°.

[26] https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_91-92.pdf. The AC also listed multiple online FAA resources for aviation flight planning services for adverse weather.
[27] Inserted accident time for reference and context.

E. LIST OF ATTACHMENTS

Attachment 1 – Weather data from AN738

Attachment 2 – Weather data from LKHH1

Attachment 3 – Weather data from SOPH1

Attachment 4 – GOES-17 animation of visible imagery from 1600 to 1800 HST

Attachment 5 – PHWA 1.3° base reflectivity animation from 1704 and 1800 HST

Attachment 6 – PHWA 1.3° CC animation from 1704 and 1800 HST

Attachment 7 – FAA weather camera imagery from Pahala site

Attachment 8 – Leidos briefing information from 0858 HST

Submitted by:

Paul Suffern
Senior Meteorologist