

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



WPR22FA255

METEOROLOGY

Specialist's Factual Report

October 21, 2022

TABLE OF CONTENTS

A. ACCIDENT	3
B. METEOROLOGY SPECIALIST	3
C. DETAILS OF THE INVESTIGATION	3
D. FACTUAL INFORMATION	4
1.0 SYNOPTIC SITUATION	4
1.1 Surface Analysis Chart.....	4
1.2 Upper Air Charts	5
2.0 SURFACE OBSERVATIONS	8
3.0 UPPER AIR SOUNDING	12
4.0 SATELLITE DATA.....	14
5.0 NATIONAL RADAR IMAGERY	15
6.0 PILOT REPORTS	16
7.0 SIGNIFICANT METEOROLOGICAL INFORMATION	16
8.0 CENTER WEATHER SERVICE ADVISORIES	17
9.0 ARMEN'S METEOROLOGICAL INFORMATION.....	17
10.0 GRAPHICAL FORECASTS FOR AVIATION.....	18
11.0 TERMINAL AERODROME FORECAST	18
12.0 NATIONAL WEATHER SERVICE AREA FORECAST DISCUSSION	19
13.0 WINDS AND TEMPERATURE ALOFT FORECAST.....	22
14.0 PILOT WEATHER BRIEFING	23
15.0 ASTRONOMICAL DATA	23
E. LIST OF ATTACHMENTS	23

A. ACCIDENT

Location: Lake McMurray, Washington
Date: July 16, 2022
Time: 0730 Pacific daylight time
1430 coordinated universal time (UTC)
Airplane: Aeronca 7BCM; Registration: N2588C

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 Pacific daylight time (PDT) and are based upon the 24-hour clock, where local time is -7 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.

The accident site was located at latitude 48.3092° N, Longitude 122.2555° W, at approximate elevation of 950 feet (ft).

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.¹

1.1 Surface Analysis Chart

The NWS Surface Analysis Chart centered over the Pacific Northwest region of the United States for 0800 PDT is provided as figure 1 with the location of the accident site within the black circle. The chart depicted a low-pressure system in eastern Washington with a pressure of 1013-hectopascals (hPa) and a high pressure system in southeastern Washington at 1018-hPa. A cold front stretched from eastern Washington southwestward across Oregon and California and into the eastern Pacific Ocean. A surface trough² stretched from the low pressure center in eastern Washington northward into southwestern Canada.

The closest station model to the accident site depicted a light southwesterly wind, an air temperature of 57° Fahrenheit (°F), with a dew point temperature of 54°F, and overcast clouds.

¹ https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1030235

² Trough - An elongated area of relatively low atmospheric pressure or heights.

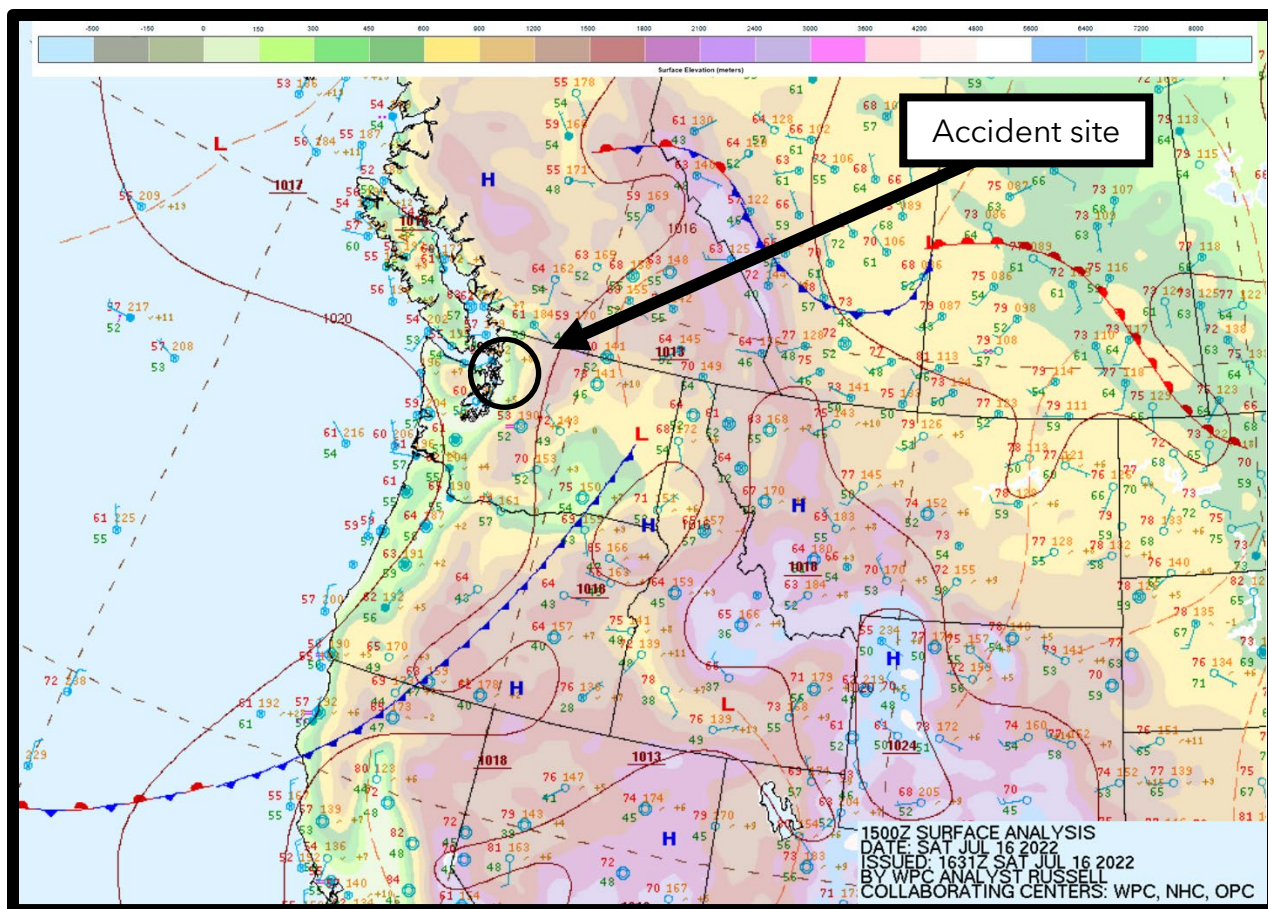


Figure 1. NWS Surface Analysis Chart for 0800 PDT.

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 0500 PDT at 925-, 850-, and 700-hPa are presented in figures 2 through 4. A low- and mid-level trough was located west of the accident at 850- and 700-hPa (figures 3 and 4). Troughs and fronts can act as lifting mechanisms to help produce clouds and precipitation if sufficient moisture is present. The 925-, 850-, and 700-hPa constant pressure charts depicted a southwest wind around 10 knots at 925- and 850-hPa with the wind speed increasing to 25 knots by 700-hPa (figure 4) above the accident site.

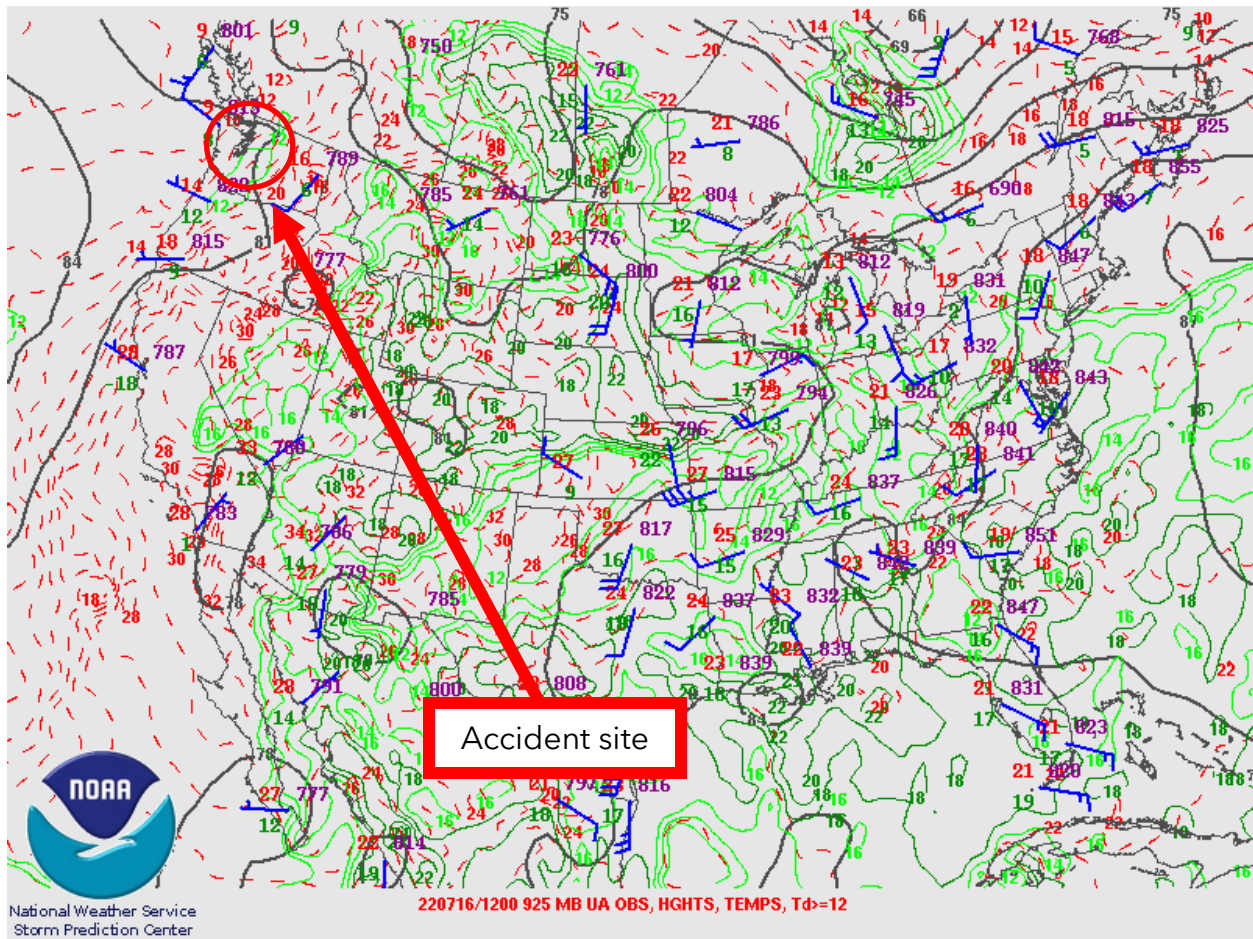


Figure 2. 925-hPa Constant Pressure Chart for 0500 PDT.

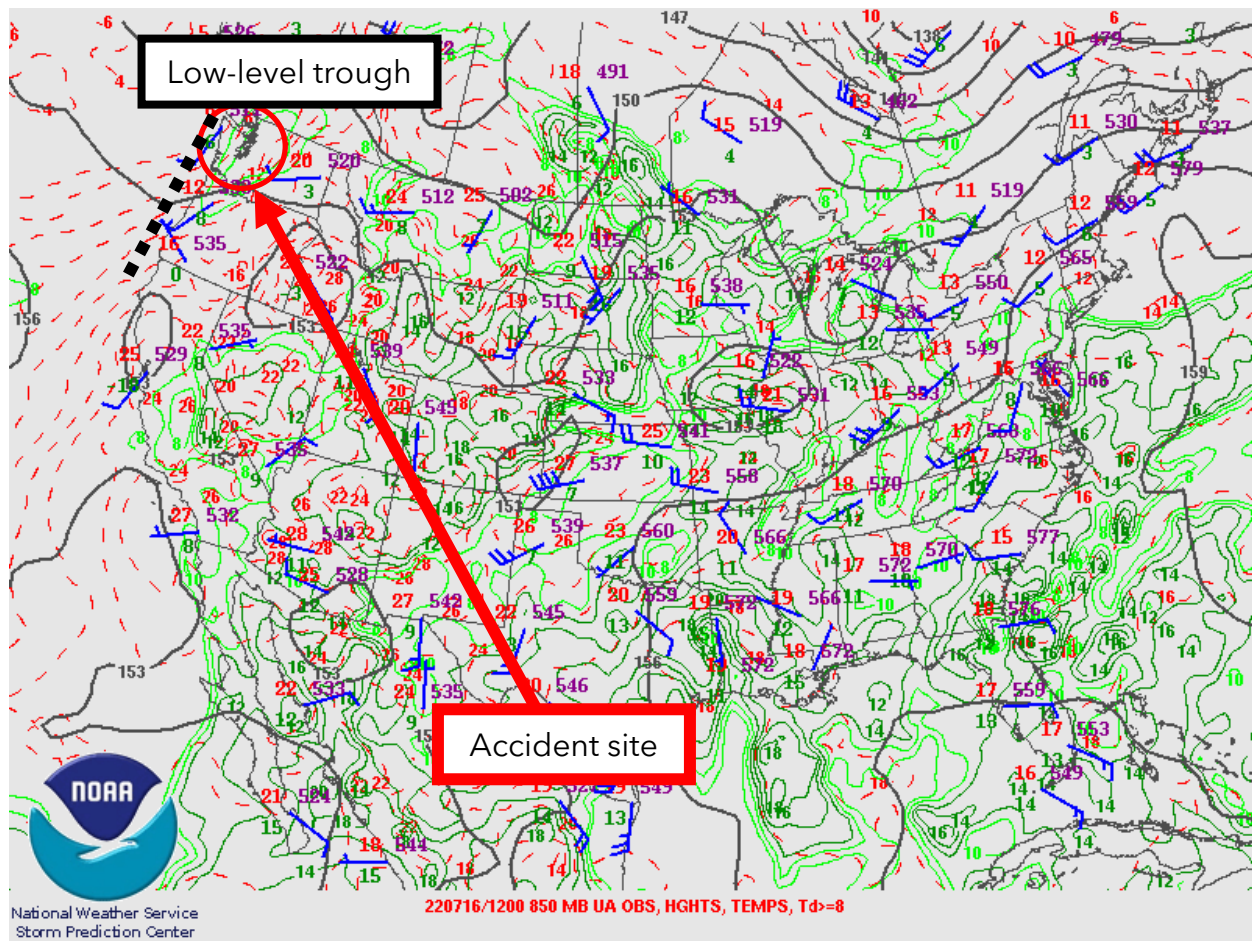


Figure 3. 850-hPa Constant Pressure Chart for 0500 PDT.

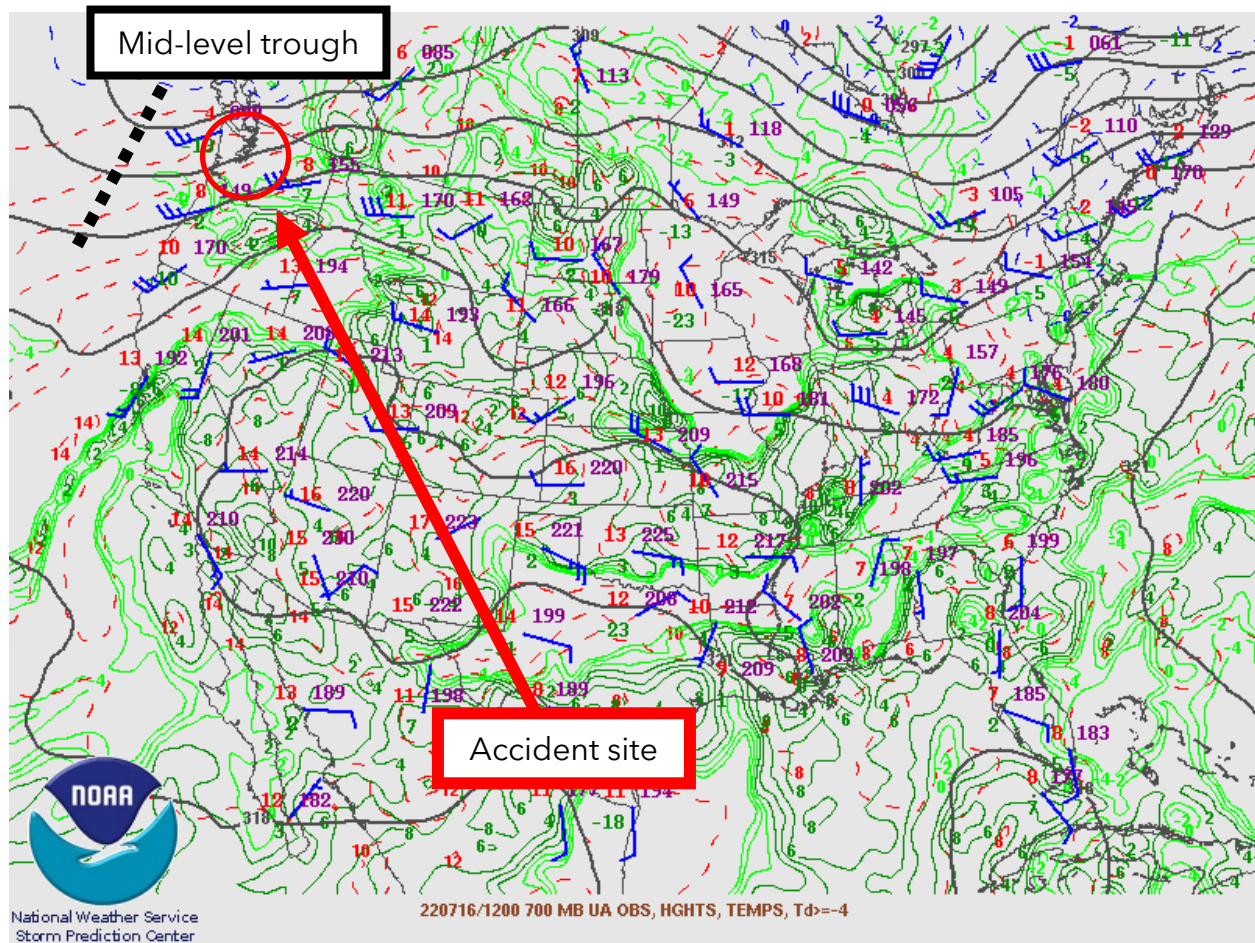


Figure 4. 700-hPa Constant Pressure Chart for 0500 PDT.

2.0 Surface Observations

The area surrounding the accident site was documented using official Aviation Routine Weather Reports (METARs) and Special Reports (SPECIs). The following observations were taken from standard code and are provided in plain language. Figure 5 is a local sectional chart with the accident site and the closest weather reporting locations marked. The chart depicted the magnetic variation³ of 16° east over the area.

³ Magnetic variation - The angle (at a particular location) between magnetic north and true north. Latest measurement taken from <https://skyvector.com/>

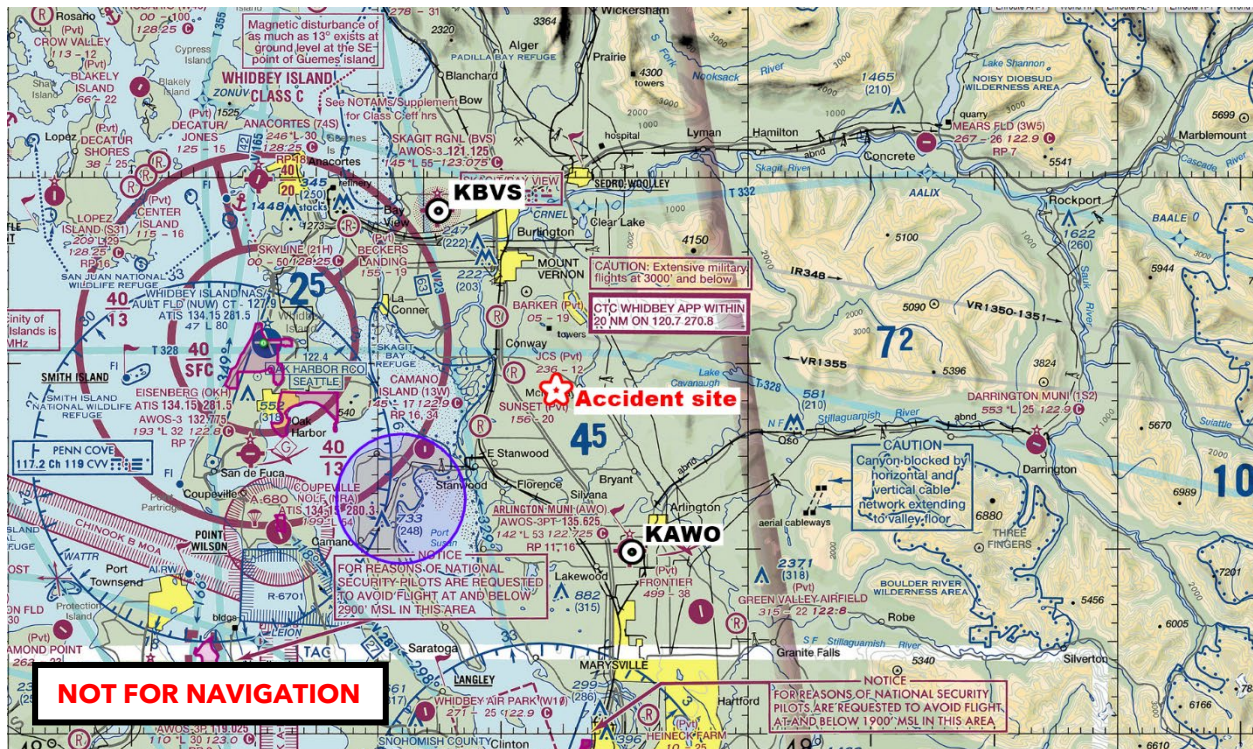


Figure 5. FAA sectional aeronautical chart of the accident area with the location of the accident site and surface observation sites.

Arlington Municipal Airport (KAWO) had the closest official weather station to the accident site. KAWO had an Automated Weather Observing System (AWOS⁴) whose longline⁵ reports were not augmented. The KAWO AWOS was located 10 miles southeast of the accident site (figure 5), at an elevation of 142 ft, and issued the following observations surrounding the period of the accident:⁶

[0356 PDT] METAR KAWO 161056Z AUTO 17003KT 10SM BKN017
OVC024 17/14 A3008 RMK AO2 SLP188 T01670139

⁴ AWOS - Automated Weather Observing System is equipped with meteorological instruments to typically observe and report temperature, dewpoint, wind speed and direction, visibility, cloud coverage and ceiling up to 12,000 feet, and altimeter setting. AWOS are maintained by the FAA. Certain AWOS may have different reporting or observational equipment.

⁵ "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.

⁶ 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.

[0456 PDT] METAR KAWO 161156Z AUTO 16003KT 10SM OVC015
17/14 A3008 RMK AO2 SLP188 60000 T01670139 10178 20161 51002

[0532 PDT] SPECI KAWO 161232Z AUTO 20004KT 10SM OVC013
17/14 A3007 RMK AO2

[0556 PDT] METAR KAWO 161256Z AUTO 17004KT 10SM OVC013
17/14 A3007 RMK AO2 SLP187 T01670139

**[0656 PDT] METAR KAWO 161356Z AUTO 23003KT 10SM OVC013
17/14 A3009 RMK AO2 SLP192 T01670139**

ACCIDENT TIME 0730 PDT

**[0756 PDT] METAR KAWO 161456Z AUTO 32005KT 10SM OVC013
17/14 A3010 RMK AO2 SLP195 T01670139 53007**

[0856 PDT] METAR KAWO 161556Z AUTO 31005KT 10SM OVC011
16/14 A3010 RMK AO2 SLP198 T01610139

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

KAWO weather at 0656 PDT, automated, wind from 230° at 3 knots, visibility 10 miles or greater, overcast ceiling at 1,300 ft above ground level (agl), temperature of 17° Celsius (C), dew point temperature 14°C, and an altimeter setting of 30.09 inches of mercury (inHg). Remarks, automated station with a precipitation discriminator, sea level pressure 1019.2 hPa, temperature 16.7°C, dew point temperature 13.9°C.

KAWO weather at 0756 PDT, automated, wind from 320° at 5 knots, visibility 10 miles or greater, overcast ceiling at 1,300 ft agl, temperature of 17°C, dew point temperature 14°C, and an altimeter setting of 30.10 inHg. Remarks, automated station with a precipitation discriminator, sea level pressure 1019.5 hPa, temperature 16.7°C, dew point temperature 13.9°C, 3-hour pressure increase of 0.7 hPa.

Skagit Regional Airport (KBVS) had the next closest official weather station to the accident site. KBVS had an AWOS whose longline reports were not augmented. The KBVS AWOS was located 12 miles north-northwest of the accident site (figure 5), at an elevation of 145 ft, and issued the following observations surrounding the period of the accident:

[0555 PDT] METAR KBVS 161255Z AUTO 00000KT 10SM OVC030
15/14 A3007 RMK A01

[0615 PDT] METAR KBVS 161315Z AUTO 00000KT 10SM BKN024
OVC030 15/14 A3007 RMK A01

[0635 PDT] METAR KBVS 161335Z AUTO 00000KT 10SM OVC022
15/14 A3008 RMK A01

[0655 PDT] METAR KBVS 161355Z AUTO 00000KT 10SM OVC022
15/14 A3008 RMK A01

**[0715 PDT] METAR KBVS 161415Z AUTO 00000KT 10SM OVC023
15/14 A3008 RMK A01**

ACCIDENT TIME 0730 PDT

**[0735 PDT] METAR KBVS 161435Z AUTO 18004KT 10SM OVC025
15/14 A3009 RMK A01**

[0755 PDT] METAR KBVS 161455Z AUTO 00000KT 10SM BKN026
OVC033 15/14 A3009 RMK A01

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

KBVS weather at 0715 PDT, automated, wind calm, visibility 10 miles or greater, overcast ceiling at 2,300 ft agl, temperature of 15°C, dew point temperature 14°C, and an altimeter setting of 30.08 inHg. Remarks, automated station without a precipitation discriminator.

KBVS weather at 0735 PDT, automated, wind from 180° at 4 knots, visibility 10 miles or greater, overcast ceiling at 2,500 ft agl, temperature of 15°C, dew point temperature 14°C, and an altimeter setting of 30.09 inHg. Remarks, automated station without a precipitation discriminator.

The observations from KBVS and KAWO surrounding the accident time indicated MVFR⁷ conditions.

⁷ 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 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.

3.0 Upper Air Sounding

A High-Resolution Rapid Refresh (HRRR)⁸ model sounding was created for the accident site coordinates for 0800 PDT.⁹ The HRRR sounding was plotted on a standard Skew-T Log P diagram¹⁰ from the surface to 700-hPa (or approximately 10,000 ft) using the RAOB¹¹ software package and is included as figure 6. The sounding depicted an elevation of 725 ft over the grid point with a near surface temperature of 13.7°C and a dew point temperature of 13.3°C, with a relative humidity of 97%. The sounding depicted the lifted condensation level (LCL)¹² and the level of free convection (LFC)¹³ at 170 ft agl, and the convective condensation level (CCL)¹⁴ at 1,600 ft agl. The freezing level was located at 12,235 ft. The precipitable water value at 0.97 inches.

**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.

⁸ The HRRR is a NOAA real-time three-kilometer resolution, hourly-updated, cloud-resolving, convection-allowing atmospheric model, initialized by three-kilometer grids with three-kilometer radar assimilation. Radar data is assimilated in the HRRR every 15 minutes over a one-hour period.

⁹ HRRR sounding was created using NOAA Air Resource Laboratory:

<https://ready.arl.noaa.gov/READYamet.php>

¹⁰ 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.

¹¹ RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Esonde Research Services, The Villages, Florida.

¹² LCL - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

¹³ 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.

¹⁴ 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.

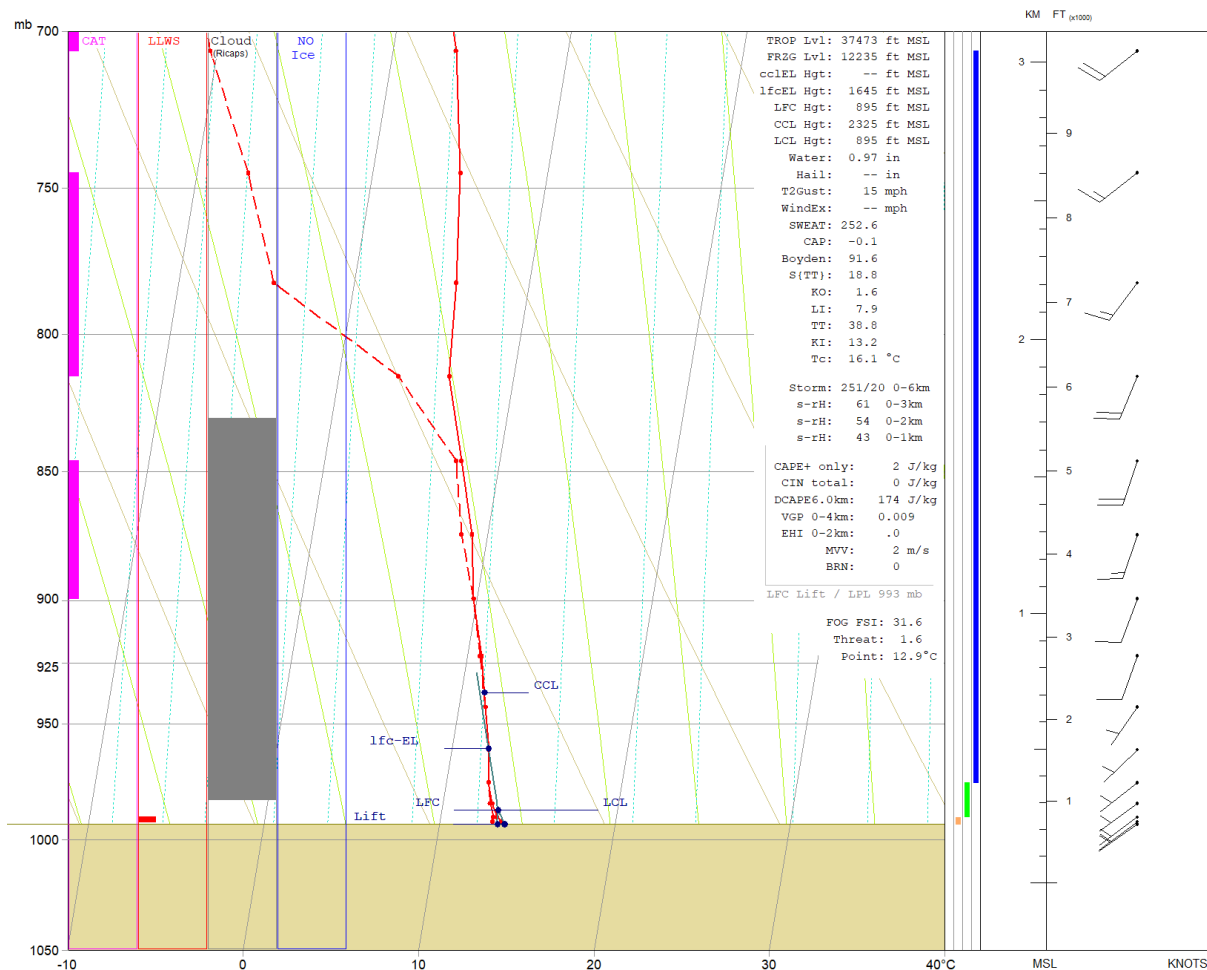


Figure 6. 0800 PDT HRRR sounding.

The 0800 PDT HRRR sounding indicated an unstable to conditionally unstable environment from the surface through 500 ft agl with a stable layer from 500 ft agl through 10,000 ft msl. No icing was indicated by RAOB below 10,000 ft. RAOB indicated cloud cover from 300 ft agl (~1,000 ft msl) through 5,500 ft msl.

The 0800 PDT HRRR sounding wind profile indicated a near surface wind from 233° at 5 knots with the wind remaining from the southwest through 10,000 ft. The wind speed increased to 15 knots by 4,000 ft. RAOB indicated the possibility of light low-level wind shear (LLWS) below 100 ft agl. Several areas of light clear air turbulence (CAT) were indicated by RAOB above 4,000 ft.

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 0500 PDT through 1100 PDT and reviewed, and the closest images to the time of the accident were documented.

Figure 7 presents the GOES-17 visible imagery from 0731 PDT at 2X magnification with the accident site highlighted with a red square and cloud cover indicated above the accident site. The cloud cover was moving from south to north (attachment 1). Figure 8 presents the GOES-17 infrared imagery from 0731 PDT at 6X magnification with the accident site highlighted with a red square. The lower cloud top temperatures (red and yellow colors; higher cloud tops) were located north of the accident site at the accident time. The cloud cover had a radiative cloud top temperature of 277 Kelvin above the accident site and would have been near 9,000 ft based on the vertical temperature profile provided by the 0800 PDT HRRR sounding. It should be noted these figures have not been corrected for any parallax error.

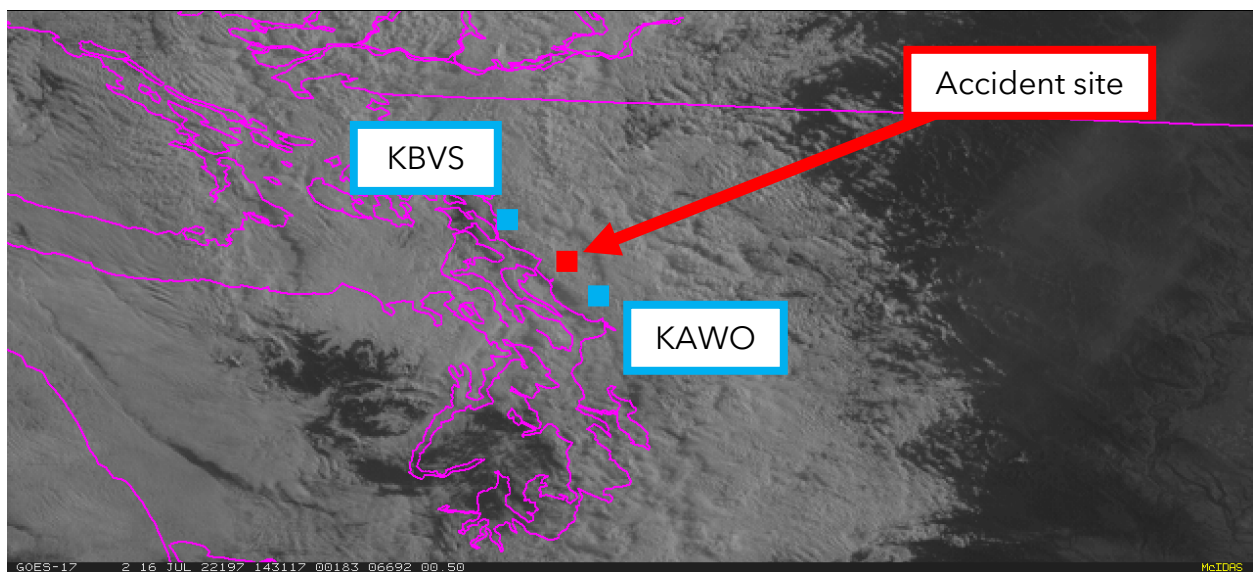


Figure 7. GOES-17 visible image at 0731 PDT.

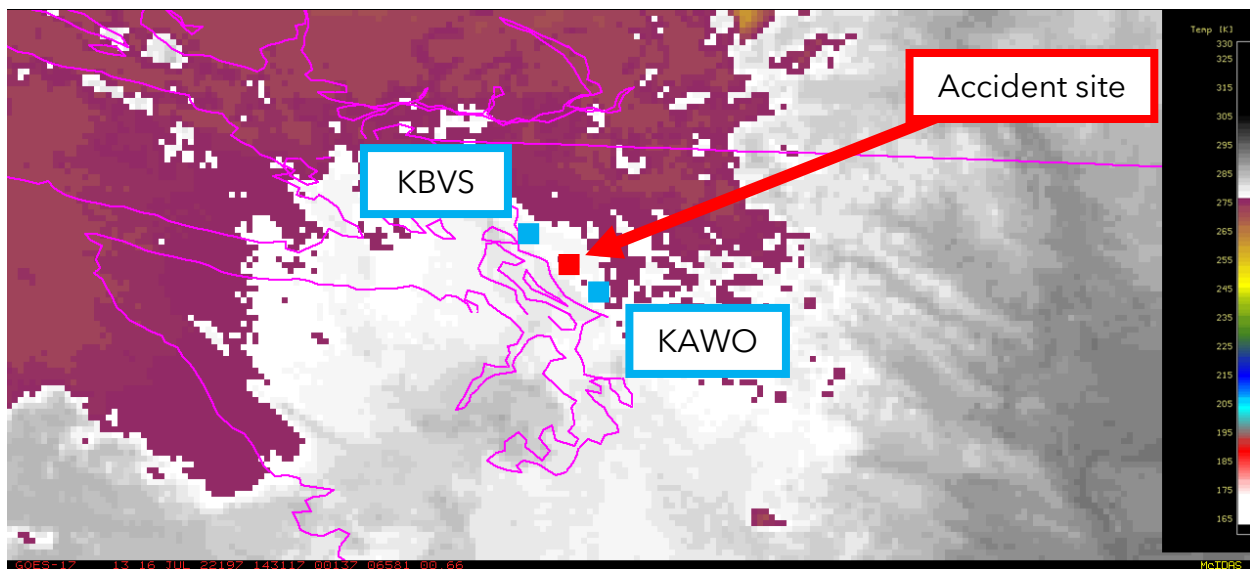


Figure 8. GOES-17 infrared image at 0731 PDT.

5.0 National Radar Imagery

A regional view of the NWS National Reflectivity Mosaic is included as figure 9 for 0730 PDT with the approximate location of the accident site marked by a red circle. The image depicted no precipitation echoes above the accident site at the accident time.

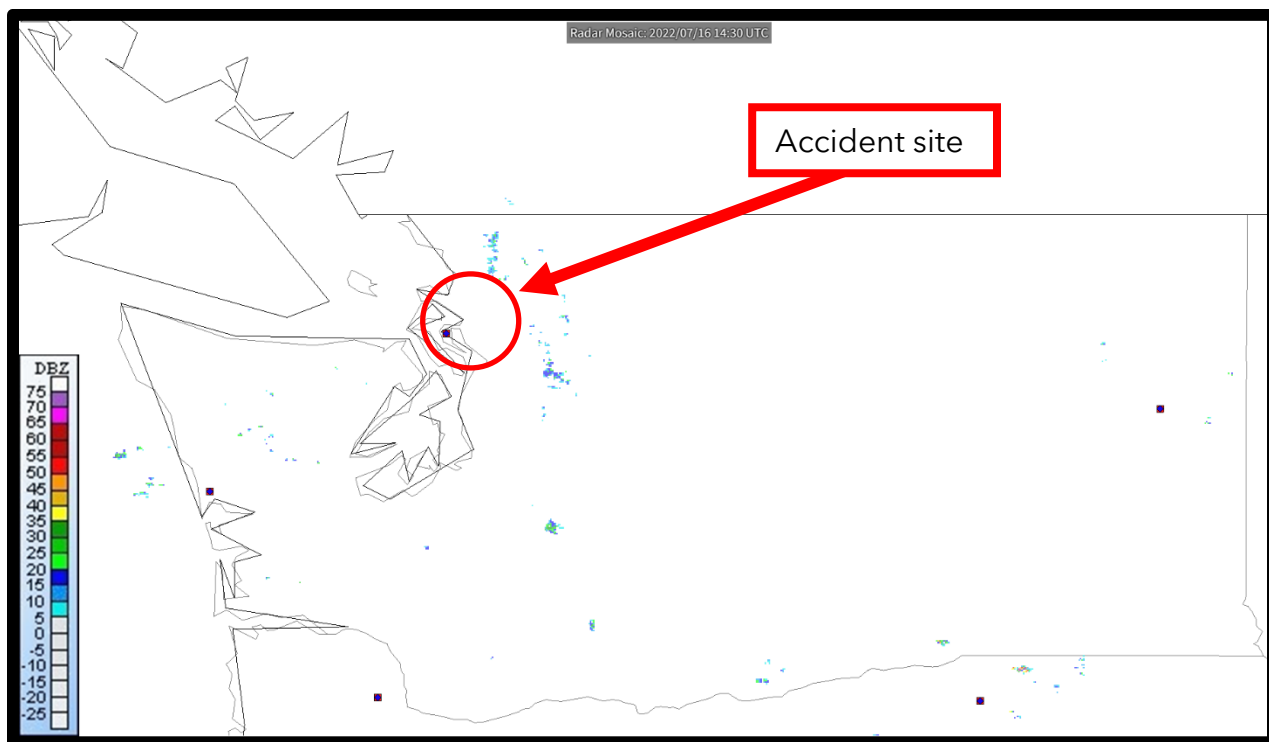


Figure 9. National Reflectivity Mosaic for 0730 PDT.

6.0 Pilot Reports

The longline-disseminated pilot reports¹⁵ (PIREPs) distributed into the national airspace system (NAS) were reviewed for about two hours on either side of the accident time and the PIREPs issued into the NAS within 100 miles of the accident site for below 19,000 ft are shown below:

PLU UA /OV PLU/TM 1220/FLUNKN/TP CH7A/WX BR/RM CIG APPEARS TO BE DROPPING

SEA UA /OV SEA161015/TM 1257/FL070/TP A321/SK 020SCT030 OVC030 TOP 065/TB NEG/IC NEG/RM DURC

SEA UA /OV SEA161015/TM 1341/FL070/TP B739/SK 025SCT030 030OVC065/TB LT TURB/IC NEG/RM DURC CLR ABV

ARP UAL529 4726N 12218W 1400 F065 TB NONE SK CLEAR IC RM B739 OV SEA TOP OF OVC 6500 CLR ABV

PAE UA /OV PAE/TM 1410/FL010/TP E175/SK OVC009

SEA UA /OV SEA/TM 1445/FL040/TP B739/SK BKN040

BLI UA /OV BLI/TM 1452/FLDURGD/TP C208/SK BKN030-TOP050/TB NEG/RM ILS RWY 16 BLI

PAE UA /OV PAE/TM 1500/FL012/TP E175/SK OVC012

BFI UA /OV BFI/TM 1530/FL019/TP C208/SK BKN019

SEA UA /OV SEA161015/TM 1531/FL070/TP E75L/SK 028OVC050 OVC055 TOP 060/TB NEG/IC NEG/RM DURC CLR ABOVE

SEA UA /OV SEA/TM 1549/FL035/TP B739/SK BKN035

PAE UA /OV PAE160001/TM 1600/FL012/TP E75L/SK BASES OVC006

BFI UA /OV BFI 2NW/TM 1615/FL012/TP GLEX/SK SCT012

BFI UA /OV KBF1315002/TM 1615/FL012/TP GLEX/SK SCT012

PAE UA /OV PAE160001/TM 1630/FL012/TP E75L/SK BASES OVC006

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.

¹⁵ Only pilot reports with the World Meteorological Organization headers UBWA**, UBOR**, and UBID** were considered. These do not include pilot reports only broadcast via radio.

8.0 Center Weather Service Advisories

The Seattle (ZSE) 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 ZSE CWSU at the accident time.

9.0 Airmen's Meteorological Information

There was a text Airmen's Meteorological Information (AIRMET) advisory Sierra valid for the accident site at the accident time. The text AIRMET Sierra was issued at 0145 PDT and forecast mountain obscuration conditions due to clouds and mist:

WAUS46 KKCI 160845

WA6S

-SFOS WA 160845

AIRMET SIERRA UPDT 1 FOR IFR AND MTN OBSCN VALID UNTIL 161500

.

AIRMET IFR...WA OR CA AND CSTL WTRS

FROM 30NNW TOU TO 50SW HUH TO 40SSW SEA TO 40SSE FOT TO 20NW RZS

TO 30NE LAX TO 30NE MZB TO 20S MZB TO 220SW MZB TO 140WSW FOT TO

150WNW FOT TO 60NNW ONP TO 60WNW TOU TO 30NNW TOU

CIG BLW 010/VIS BLW 3SM BR/FG. CONDS CONTG BYD 15Z THRU 21Z.

.

AIRMET MTN OBSCN...WA OR

**FROM 30SE YDC TO 50NW EPH TO 20WNW OED TO 70WSW OED TO 70WNW
OED**

TO ONP TO HQM TO TOU TO HUH TO 30SE YDC

MTNS OBSC BY CLDS/BR. CONDS CONTG BYD 15Z THRU 21Z.

....

10.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) products issued before the accident flight and valid at 0800 PDT are shown in attachment 2. The GFA surface forecast applicable to the accident site that was valid before the accident flight's departure for times surrounding the accident time indicated VFR surface visibilities, a 30 to 60 percent chance of drizzle or rain showers, and a variable surface wind at 5 knots. The GFA cloud forecast applicable to the accident site that was valid before departure for times surrounding the accident time indicated few clouds at 600 ft, overcast clouds between 2,400 and 3,500 ft, and cloud tops between 7,000 and 10,000 ft. The Graphical AIRMET¹⁶ (G-AIRMET) Sierra valid for the accident site at accident time is shown on the GFA cloud forecast figures in attachment 2. The only human-generated information reflected in the two GFA products were the G-AIRMETs. For more information, please see attachment 2.

11.0 Terminal Aerodrome Forecast

Whidbey Island Naval Air Station (KNUW) was the closest site with a Terminal Aerodrome Forecast¹⁷ (TAF) current at the time of the accident and was located 16 miles west-northwest of the accident site. The KNUW amended TAF was issued at 0032 PDT and was valid for a 24-hour period beginning at 0000 PDT. The 0032 PDT TAF for KNUW was as follows:

TAF KNUW 1607/1707 26008KT 9999 SCT015 BKN040 OVC060 QNH3003INS
FM161000 24008KT 8000 BR BKN025 OVC040 QNH3004INS
TEMPO 1611/1617 25006KT 1600 BR BCFG BKN005 OVC012
FM162300 27012KT FEW015 BKN030 OVC050 QNH3005INS
BECMG 1704/1706 25010G20KT 9999 FEW020 SCT030 BKN050
QNH3006INS T09/1612Z T19/1623Z FS30173=

¹⁶ **Graphical AIRMETs (G-AIRMETs)**, found on the Aviation Weather Center webpage at <http://aviationweather.gov>, are graphical forecasts of en-route weather hazards valid at discrete times no more than 3 hours apart for a period of up to 12 hours into the future (for example, 00, 03, 06, 09, and 12 hours). G-AIRMETs are snap shots at discrete time intervals as defined above. The text AIRMET is the result of the production of the G-AIRMET but provided in a time smear for a 6hr valid period.

¹⁷ A 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.

Between 0300 PDT and 1600 PDT, the forecast expected a wind from 240° at 8 knots, 8000 meters (~5 miles) visibility, mist, a broken ceiling at 2,500 ft agl, overcast skies at 4,000 ft agl, and minimum altimeter setting of 30.04 inHg. Temporary¹⁸ conditions were forecast between 0400 and 1000 PDT with a wind from 250° at 6 knots, 1600 meters (~1 mile) visibility, mist, patchy fog, a broken ceiling at 500 ft agl, and overcast skies at 1,200 ft agl.

12.0 National Weather Service Area Forecast Discussion

The NWS weather forecast office in Seattle, Washington, (WFO SEW) was responsible for the public forecast in the region of the accident site. WFO SEW issued the following Area Forecast Discussion (AFD) at 0257 PDT, which was the closest AFD to the accident time with an aviation section:

FXUS66 KSEW 160957
AFDSEW

Area Forecast Discussion
National Weather Service Seattle WA
257 AM PDT Sat Jul 16 2022

.SYNOPSIS...A weakening frontal boundary will make for a few light showers and pockets of drizzle this morning before some clearing ensues later in the day. An upper level low will then sink south across the area Sunday, sparking a few showers and possibly some lightning strikes across Whatcom County and the North Cascades. Ridging then returns early next week with an overall benign, typical summertime weather pattern holding strong, keeping conditions warm and dry.

&&

.SHORT TERM /TODAY THROUGH MONDAY/...The large scale pattern this morning is characterized by broad troughing off of the PNW and BC Coast into the far NE Pacific and eastern Gulf of Alaska. Within the broad scale troughing resides an area of closed low pressure around Haida Gwaii. Downstream from the trough continues to reside a strong anticyclone centered around the Four Corners region and nearby TX/OK panhandles, with influence encompassing much of the desert SW, Rockies, and Great Plains. Near the surface, the remnants of a weakening frontal boundary are noted over W WA, with weak troughing continuing over E WA and E OR. High pressure then expands across much of the Western US.

With SW aloft along the eastern periphery of upper level

¹⁸ TEMPO is used to indicate temporary fluctuations to forecast meteorological conditions which are expected to: a. Have a high percentage (greater than 50%) probability of occurrence; b. Last for one hour or less in each instance; and c. In the aggregate, to cover less than half of the period.

troughing, combined with a weak sfc frontal boundary, some light shower activity is affecting W WA early this morning. Most of the activity as of 3AM is noted from Snohomish Co northward to Whatcom Co and across portions of the coast and Olympic Mountains, per MRMS radar imagery. Most of this activity is associated with weak lift along the frontal boundary and some WAA around 700mb. By daybreak, some of this activity will remain ongoing, especially east of the Sound, with a few pockets of drizzle around as well. Skies will be overcast for most locations, with temps around 60.

Through the afternoon and into the evening, the closed upper low near Haida Gwaii will begin to slowly shift south, helping to provide better troughing and upper level support. Despite this, the frontal boundary will become essentially non-existent and with the overall lack of moisture, most precip activity will come to and end. Should isolated activity remain, the best chance for this will be across the northern and eastern slopes of the Olympics and Whatcom and San Juan County. With more cloud cover and upper level trough influence, high temps will be a few degrees cooler than previous days, dropping back into the low to perhaps middle 70s (mid 60s nearest water).

On Sunday, mid level heights will fall noticeably in response to the southward progression of the closed low near Haida Gwaii. The center of the closed low should push towards the N WA Coast by Sunday afternoon, with some form of weak sfc trough likely accompanying it. Given the robust nature of the low, enough PVA should aid in the development of a few showers, particularly from the northern Olympics/Olympic Coast through the San Juans and into Whatcom and perhaps Skagit Counties. As the center of the upper level crosses the Puget Sound area late Sunday afternoon and through Sunday evening, model guidance shows deep layer moisture along the northern periphery and backside of the low. With mid level temps falling to near -20C amidst this moisture, expect the development of scattered convective showers across the northern Cascades into portions of central Whatcom County and into southern BC. Enough instability may materialize for lightning through midnight. Activity should then wind down overnight Sunday given loss of favorable dynamics as the low crosses the Cascade crest. High temps on Sunday will be the coolest of the next 7 days, struggling to reach 70 for locations north of the Sound/King Co and remaining lowland locations topping off near 70 in the low 70s.

Heights will then substantially rise in the wake of the low on Monday as a shortwave ridge takes it place. After some morning cloud cover, clear skies will return with high temps able to rebound nicely back into the mid to upper 70s.

Kovacik

.LONG TERM /TUESDAY THROUGH FRIDAY/...The upper level pattern to

begin the long term forecast period will feature a split-flow pattern as a shortwave trough pushes across BC and a loosely organized broad area of closed low pressure meanders well offshore the N CA and OR coast. Onshore flow should dominate the low levels in W WA given expansive high pressure offshore. A thermal trough will attempt to develop north across OR but currently appears it'll stop short of W WA. Despite the troughing offshore, a portion of the continued ridge over the 4 Corners region may be able to build N/NW into the PNW. Essentially this points towards some morning marine stratus with sunny skies returning for the late morning/afternoon with highs around 80 or into the low 80s.

Thereafter into midweek, ensemble guidance still struggles some with the evolution of the upper level pattern. The favored solution still points towards a slight amplification of the upper level ridge influence downstream from the meandering offshore low/trough. This would make for similar high temps near 80. Then towards the latter half of the week the forecast will be influenced by either prolonged upper level ridge influence, or the eastward progression of the offshore low towards the region. More ensemble guidance currently leans more towards the nearby troughing. Will reflect this for now, which still keeps conditions dry through Friday but knocks afternoon high temps down a few degrees.

Kovacik

&&

.AVIATION...Southwest flow through today as a weak system moves across the area. Lowering cigs this morning, mainly to MVFR/IFR with areas of LIFR possible along the coast. Light rain mainly along the coast, though potentially into areas of the interior as well in the morning. Cigs improving to VFR later this afternoon and evening. VFR cigs into tonight, lowering along the coast. Mainly light southwesterly winds this morning, increasing more W/NW this afternoon/evening.

KSEA...VFR cigs lowering to MVFR this morning. Slight potential to IFR, but mainly MVFR is expected through early afternoon, improving to VFR late afternoon/evening. Light southwesterly winds this morning, increasing W/NW this afternoon/evening, tapering off tonight. JD

&&

.MARINE...A weak system is moving across the area this morning, though mainly light winds with this front. Increasing W/NW winds this afternoon and evening. Increasing winds through the central and eastern Strait of Juan de Fuca this evening/tonight for a Small Craft Advisory in this area. The winds will increase along the coast Sunday afternoon/evening, though mainly below SCA winds. Small Craft Advisory winds possible Sunday evening and Sunday night for the

central and eastern Strait of Juan de Fuca. Mainly increasing N/W winds each day through mid-week. Swells of 4 to 5 feet through Sunday. JD

&&

.HYDROLOGY...The daily hydrology discussion has ended until the start of the next rainy season; it will only be updated as needed until then.

&&

.SEW WATCHES/WARNINGS/ADVISORIES...

WA...None.

PZ...Small Craft Advisory from 5 PM this afternoon to 4 AM PDT Sunday
for Central U.S. Waters Strait Of Juan De Fuca-East
Entrance U.S. Waters Strait Of Juan De Fuca.

&&

\$\$

13.0 Winds and Temperature Aloft Forecast

The NWS 0700 PDT Winds and Temperature Aloft forecast valid for the closest point to the accident site is included below:

FBUS31 KWN0 161400

FD1US1

DATA BASED ON 161200Z

VALID 161800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT 3000 6000 9000 12000 18000 24000 30000 34000 39000

SEA 2408 2111+06 2220+06 2231+02 2244-11 2352-23 235339 235848 246751

The closest forecast point to the accident site was Seattle, Washington, (SEA). The 0700 PDT SEA forecast for use between 0700 PDT and 1400 PDT indicated a wind from 240° at 8 knots at 3,000 ft, a wind at 6,000 ft from 210° at 11 knots with a temperature of +6°C, and a wind at 9,000 ft from 220° at 20 knots with a temperature of +6°C.

14.0 Pilot Weather Briefing

A search of archived information indicated that the accident pilot did not request weather information¹⁹ from Leidos Flight Service or via ForeFlight. It is unknown what, if any, weather information the accident pilot viewed before or during the accident flight.

15.0 Astronomical Data

The astronomical data obtained for the accident site on July 16, 2022, indicated the following:

SUN

Begin civil twilight 0446 PDT

Sunrise 0525 PDT

Accident time 0730 PDT²⁰

Sun transit 1315 PDT

Sunset 2105 PDT

End civil twilight 2144 PDT

At the time of the accident the Sun was located at an altitude of 18.19° and azimuth of 78.07°.

E. LIST OF ATTACHMENTS

Attachment 1 - GOES-17 visible satellite animation from 0701 and 0906 PDT

Attachment 2 - GFA information valid at the accident time

Submitted by:

Paul Suffern
Senior Meteorologist

¹⁹ https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_91-92.pdf

²⁰ Inserted accident time for reference and context.