



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

April 12, 2016

Group Chairman's Weather Study Report

METEOROLOGY

ANC16LA012

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A. ACCIDENT

Location: 6 miles southwest of Anaktuvuk Pass, Alaska
Date: January 2, 2016
Time: approximately 1205 Alaska standard time (2105 UTC¹)
Aircraft: Cessna 208B, registration: N540ME

B. METEOROLOGY GROUP

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C. SUMMARY

For a summary of the accident, refer to the *Accident Summary* report, which is available in the docket for this investigation.

D. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) Meteorologist was not on scene for this investigation and gathered all the weather data for this investigation from the NTSB's Washington D.C. office and from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the National Centers for Environmental Information (NCEI). All times are Alaska standard time (AKST) on January 2, 2016, and are based upon the 24-hour clock, where local time is -9 hours from UTC, and UTC=Z (unless otherwise noted). Directions are referenced to true north and distances in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The accident site was located at latitude 68.08° N, longitude 151.90° W, approximately elevation: 2,520 feet.

¹ UTC – is an abbreviation for Coordinated Universal Time.

E. 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 (NCEP), and the Weather Prediction Center (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-0045G CHG 1.

1.1 Surface Analysis Chart

The NWS Surface Analysis Chart for 1200 AKST is provided as figure 1 with the approximate location of the accident site marked. The chart depicted an occluded front to the south of the accident site stretching from west to east across the Alaska Range and then southeastward into western Yukon Territory. A stationary front was located across northern Alaska stretching from west to east from the Bering Sea eastward into northern Yukon Territory. The accident site was located about half way between these two frontal boundaries. A surface low pressure center with a pressure of 990-hectopascals (hPa) was located in northeastern Alaska and a surface low pressure center with a pressure of 968-hPa was located in southwestern Alaska. The station models around the accident site depicted air temperatures in the upper teens to low 30's Fahrenheit (F), with temperature-dew point spreads of 11° F or less, a variable wind around 5 knots, cloudy skies and light snow. With surface low pressure area located in southwestern Alaska, southerly wind flow from the surface up to the jet stream level would have been likely and any wind flow over the higher terrain would have promoted cloud cover. Areas of precipitation would have been favored in locations with enough surface to mid-level moisture. The accident site was in location of relatively higher surface moisture which would have promoted the development of continued widespread cloudy conditions and precipitation near the higher terrain.

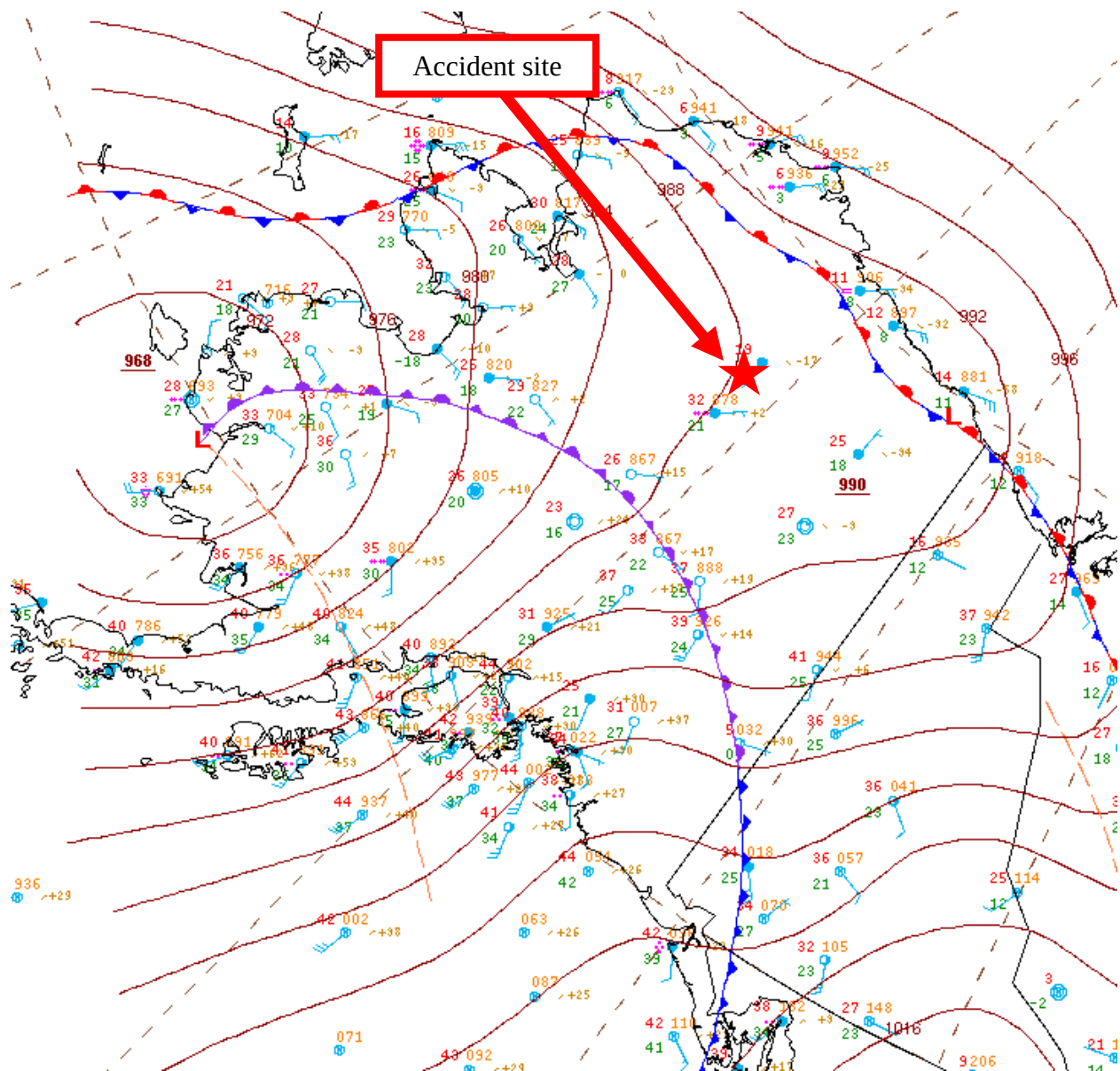


Figure 1 – NWS Surface Analysis Chart for 1200 AKST

2.0 Storm Prediction Center Products

There was no SPC Day 1 Convective Outlook issued for the accident site at the accident time.

3.0 Surface Observations

The area surrounding the accident site was documented utilizing official NWS Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). The following observations were taken from standard code and are provided in plain language.

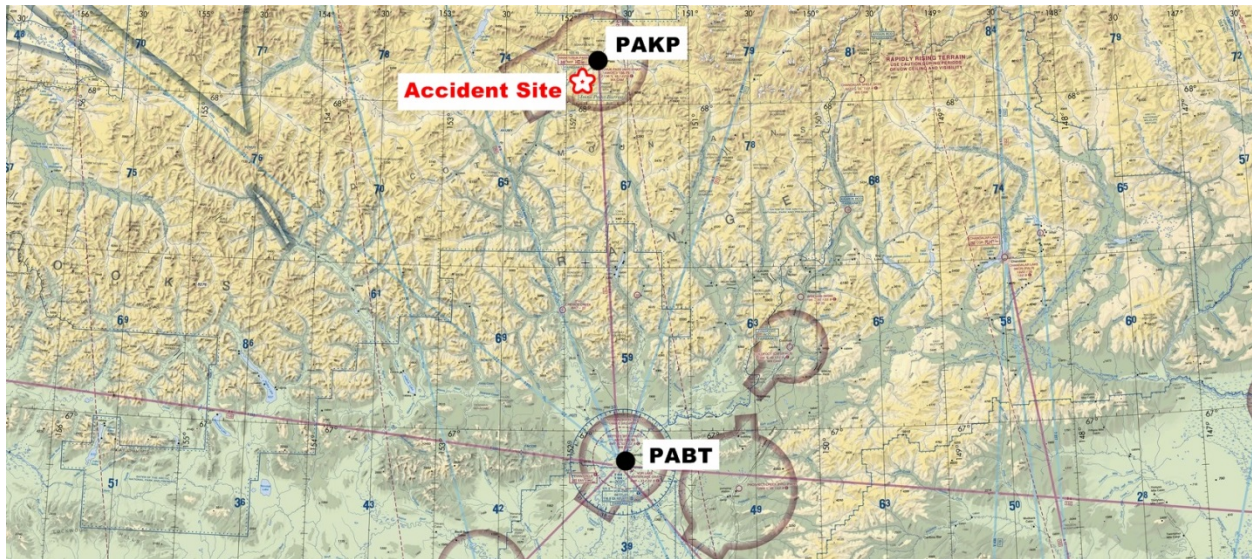


Figure 2 – Map of Alaska with the location of the accident site and surface observation sites

Anaktuvuk Pass Airport (PAKP) was the closest official weather station to the accident site along with being the destination airport. PAKP had an Automated Weather Observing System (AWOS²) whose reports were not supplemented. PAKP was located 5 miles northeast of the accident site, at an elevation of 2,106 feet, and had a 21° easterly magnetic variation³ (figure 2). The following observations were taken and disseminated during the times surrounding the accident:⁴

[0936 AKST] PAKP 021836Z AUTO 00000KT 10SM BKN048 OVC060 M09/M13
A2908 RMK AO1=

[0956 AKST] PAKP 021856Z AUTO 21004KT 10SM BKN039 OVC048 M09/M14
A2906 RMK AO1=

[1016 AKST] PAKP 021916Z AUTO 00000KT 10SM FEW035 BKN042 OVC055
M09/M13 A2905 RMK AO1=

[1036 AKST] PAKP 021936Z AUTO 19004KT 10SM SCT040 BKN046 OVC065
M08/M13 A2905 RMK AO1=

[1056 AKST] PAKP 021956Z AUTO 18003KT 10SM FEW044 BKN055 OVC065
M08/M13 A2904 RMK AO1=

² AWOS – Automated Weather Observing System is equipped with meteorological instruments to observe and report temperature, dewpoint, wind speed and direction, visibility, cloud coverage and ceiling up to twelve thousand feet, and altimeter setting.

³ Magnetic variation – The angle (at a particular location) between magnetic north and true north.

⁴ The bold sections in this NWS product and the rest of products in the weather study report are to highlight the individual sections that directly reference the weather conditions that are or will affect the accident location around the accident time.

[1116 AKST] PAKP 022016Z AUTO 00000KT 10SM SCT047 OVC065 M08/M13
A2904 RMK AO1=

**[1136 AKST] PAKP 022036Z AUTO 21005KT 7SM BKN043 OVC050 M08/M12
A2904 RMK AO1=**

**[1156 AKST] PAKP 022056Z AUTO 17005KT 6SM BKN044 OVC050 M07/M11
A2904 RMK AO1 57017=**

ACCIDENT TIME 1205 AKST

**[1216 AKST] PAKP 022116Z AUTO 34003KT 4SM FEW035 OVC042 M07/M11
A2902 RMK AO1=**

**[1456 AKST] PAKP 022136Z AUTO 18007KT 6SM SCT034 BKN043 OVC070
M07/M11 A2903 RMK AO1=**

[1556 AKST] PAKP 022156Z AUTO 14005KT 6SM BKN050 OVC065 M07/M11
A2902 RMK AO1=

[1656 AKST] PAKP 022216Z AUTO 00000KT 10SM BKN042 OVC050 M06/M09
A2902 RMK AO1=

PAKP weather at 1136 AKST, wind from 210° at 5 knots, 7 miles visibility, a broken ceiling at 4,300 feet above ground level (agl), overcast skies at 5,000 feet agl, temperature of -8° Celsius (C), dew point temperature of -12° C, and an altimeter setting of 29.04 inches of mercury. Remarks: automated station without a precipitation discriminator.

PAKP weather at 1156 AKST, wind from 170° at 5 knots, 6 miles visibility, a broken ceiling at 4,400 feet agl, overcast skies at 5,000 feet agl, temperature of -7° C, dew point temperature of -11° C, and an altimeter setting of 29.04 inches of mercury. Remarks: automated station without a precipitation discriminator, 3-hourly pressure decrease of 1.7 hPa.

PAKP weather at 1216 AKST, wind from 340° at 3 knots, 4 miles visibility, few clouds at 3,500 feet agl, an overcast ceiling at 4,200 feet agl, temperature of -7° C, dew point temperature of -11° C, and an altimeter setting of 29.02 inches of mercury. Remarks: automated station without a precipitation discriminator.

PAKP weather at 1236 AKST, wind from 180° at 7 knots, 6 miles visibility, scattered clouds at 3,400 feet agl, a broken ceiling at 4,300 feet agl, overcast skies at 7,000 feet agl, temperature of -7° C, dew point temperature of -11° C, and an altimeter setting of 29.03 inches of mercury. Remarks: automated station without a precipitation discriminator.

Bettles Airport (PABT) was the next closest official site to the accident site, located in Bettles, Alaska. PABT had an Automated Surface Observing System (ASOS⁵) whose reports were not supplemented. PABT was located 70 miles south of the accident site, at an elevation of 647 feet, and had a 20° easterly magnetic variation (figure 2). The following observations were taken and disseminated during the times surrounding the accident:

[0753 AKST] PABT 021653Z 05011KT 10SM FEW070 OVC090 01/M08 A2915
RMK AO2 SLP884 T00061078 \$=

[0853 AKST] PABT 021753Z 05012G19KT 10SM FEW070 OVC085 01/M06 A2913
RMK AO2 SLP876 4/026 T00061056 10006 21028 56024 \$=

[0953 AKST] PABT 021853Z 06009G16KT 10SM FEW070 OVC085 01/M04 A2911
RMK AO2 SLP872 T00061039 \$=

**[1053 AKST] PABT 021953Z VRB03KT 10SM SCT060 OVC070 01/M08 A2914
RMK AO2 SLP882 T00061078 \$=**

**[1153 AKST] PABT 022053Z 04004KT 10SM -SN OVC040 00/M06 A2913 RMK
AO2 SNB45 SLP878 60000 931000 T00001061 52002 \$=**

ACCIDENT TIME 1205 AKST

**[1253 AKST] PABT 022153Z 03005KT 10SM FEW032 BKN042 BKN055 M01/M04
A2914 RMK AO2 SNE15 SLP879 T10061044 \$=**

**[1353 AKST] PABT 022253Z 02006KT 10SM FEW032 SCT070 BKN090 M02/M04
A2914 RMK AO2 SLP880 T10171044 \$=**

[1453 AKST] PABT 022353Z 00000KT 10SM FEW032 FEW070 SCT100 M04/M06
A2915 RMK AO2 SLP885 4/026 T10441061 10011 21044 53006 \$=

[1553 AKST] PABT 030053Z 00000KT 10SM FEW032 FEW070 SCT120 M08/M09
A2916 RMK AO2 SLP890 I1000 T10831094 \$=

[1653 AKST] PABT 030153Z 03005KT 10SM FEW032 FEW070 M09/M10 A2916
RMK AO2 SLP891 T10891100 \$=

[1753 AKST] PABT 030253Z 00000KT 10SM FEW032 FEW070 M11/M12 A2919
RMK AO2 SLP899 T11061117 53013 \$=

⁵ ASOS – Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, ceiling, temperature, dewpoint, altimeter, and barometric pressure.

PABT weather at 1053 AKST, variable wind at 3 knots, 10 miles visibility, scattered clouds at 6,000 feet agl, an overcast ceiling at 7,000 feet agl, temperature of 1° C, dew point temperature of -8° C, and an altimeter setting of 29.14 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure of 988.2 hPa, temperature of 0.6° C, dew point temperature of -7.8° C, maintenance is needed on the system.

PABT weather at 1153 AKST, wind from 040° at 4 knots, 10 miles visibility, light snow, an overcast ceiling at 4,000 feet agl, temperature of 0° C, dew point temperature of -6° C, and an altimeter setting of 29.13 inches of mercury. Remarks: automated station with a precipitation discriminator, snow began at 1145 AKST, sea level pressure of 987.8 hPa, 6-hourly precipitation of a trace, water equivalent of a trace of snow, temperature of 0.1° C, dew point temperature of -6.1° C, 3-hourly pressure decrease of 0.2 hPa, maintenance is needed on the system.

PABT weather at 1253 AKST, wind from 030° at 5 knots, 10 miles visibility, few clouds at 3,200 feet agl, a broken ceiling at 4,200 feet agl, broken skies at 5,500 feet agl, temperature of -1° C, dew point temperature of -4° C, and an altimeter setting of 29.14 inches of mercury. Remarks: automated station with a precipitation discriminator, snow ended at 1215 AKST, sea level pressure of 987.9 hPa, temperature of -0.6° C, dew point temperature of -4.4° C, maintenance is needed on the system.

PABT weather at 1353 AKST, wind from 020° at 6 knots, 10 miles visibility, few clouds at 3,200 feet agl, scattered clouds at 7,000 feet agl, a broken ceiling at 9,000 feet agl, temperature of -2° C, dew point temperature of -4° C, and an altimeter setting of 29.14 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure of 988.0 hPa, temperature of -1.7° C, dew point temperature of -4.4° C, maintenance is needed on the system.

The observations from PAKP and PABT surrounding the accident time indicated MVFR⁶ visibilities with light snow and precipitation. While the PAKP AWOS does not have a precipitation discriminator given the drop in visibilities around the accident time and relatively light winds, it was likely lightly snowing at PAKP at and around the accident time. Ceilings were VFR⁷ at both PABT and PAKP around the accident time, but mountain obscuration, light snow, and reduced visibilities were likely along the mountainous terrain given the FAA's Aviation Web Camera images surrounding the accident time near the accident flight (section 13.0).

⁶ Marginal Visual Flight Rules – Refers to the general weather conditions pilots can expect at the surface. MVFR criteria means a ceiling between 1,000 and 3,000 feet agl and/or 3 to 5 miles visibility.

⁷ Visual Flight Rules – Refers to the general weather conditions pilots can expect at the surface. VFR criteria means a ceiling greater than 3,000 feet agl and greater than 6 miles visibility.

4.0 Upper Air Data

A Global Data Assimilation System (GDAS) computer model upper air sounding for the accident site was generated for 1200 AKST. The 1200 AKST sounding was plotted on a standard Skew-T log P diagram⁸ with the derived stability parameters included in figure 3 (with data from the surface to 600-hPa, or 13,000 feet msl.) This data was analyzed utilizing the RAOB⁹ software package. The sounding depicted the Lifted Condensation Level (LCL)¹⁰ at 5,355 feet msl and a Convective Condensation Level (CCL)¹¹ of 7,699 feet. The freezing level was located at the surface. The precipitable water value was 0.22 inches.

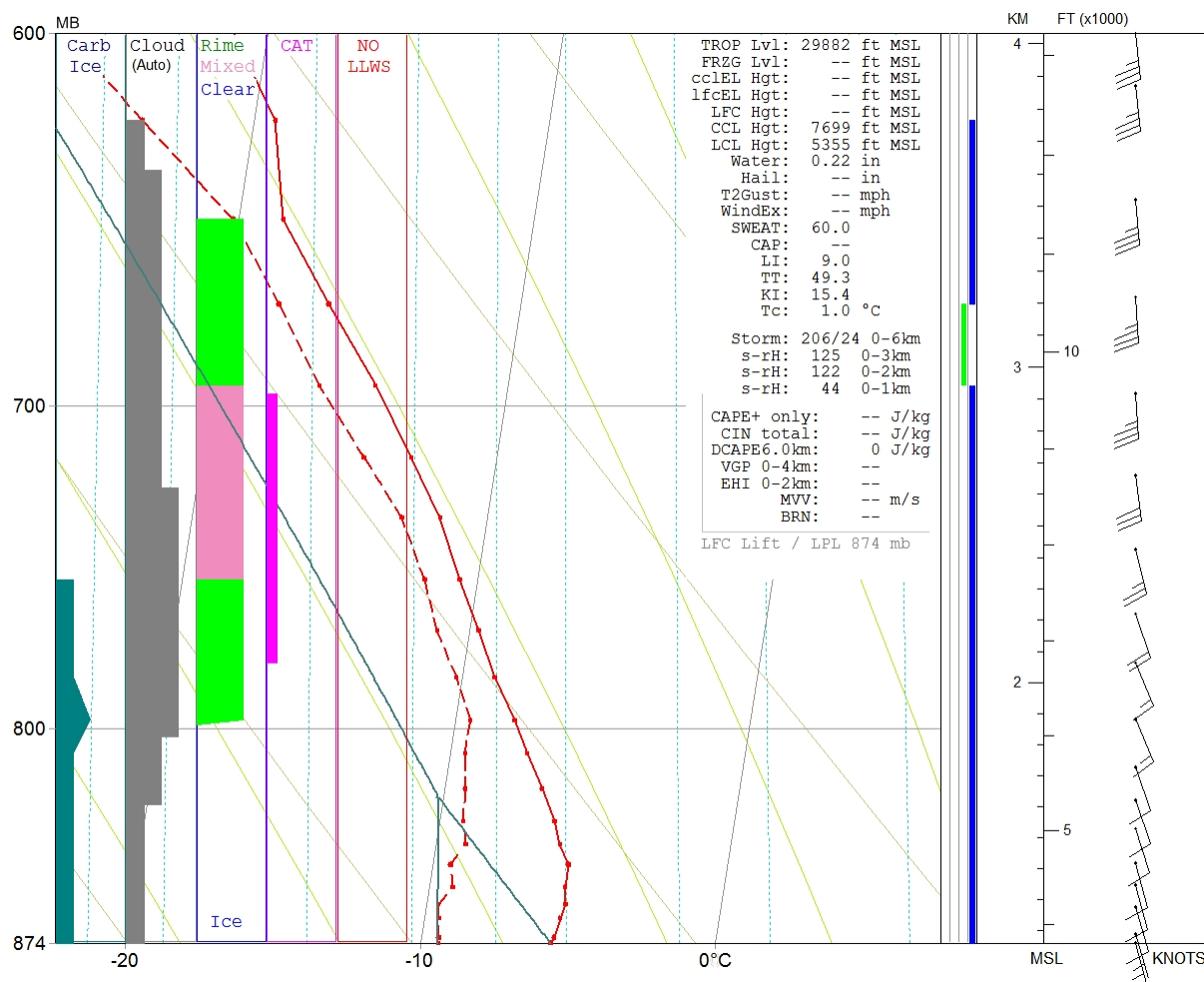


Figure 3 – 1200 AKST GDAS sounding for the accident site

⁸ 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.

⁹ RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania.

¹⁰ Lifting Condensation Level (LCL) - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

¹¹ Convective Condensation Level (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.

The 1200 AKST GDAS sounding indicated a relatively moist conditionally unstable environment from the surface through 13,000 feet msl. RAOB indicated that clouds were likely from the surface through 12,000 feet msl. Given the wind flowing over the terrain with the terrain acting as a lifting mechanism, clouds and light precipitation would be expected. Icing conditions were likely from 6,000 through 11,000 feet msl as indicated by RAOB.

The sounding wind profile indicated a surface wind from 166° at 6 knots with the wind increasing to 20 knots by 7,000 feet msl while remaining out of the south-southeast. The wind continued to increase in speed through 13,000 feet to near 35 knots with the wind remaining out of the south. No low-level wind shear (LLWS) was identified by RAOB between the surface and 13,000 feet msl, but there was a layer of clear air turbulence possible from 7,000 feet through 10,000 feet. Given the vertical environment of the lowest 2,000 feet msl, LLWS would not be expected near the surface, but some gusty wind conditions could be expected along and near the mountainous terrain at the accident time.

5.0 Satellite Data

Visible and infrared data from the Geostationary Operational Environmental Satellite number 15 (GOES-15) data was obtained from an archive at the Space Science Engineering Center (SSEC) at the University of Wisconsin-Madison (UW) in Madison, Wisconsin, and processed using the Safety Board's Man-computer Interactive Data Access System (McIDAS) software. Visible and infrared imagery (GOES-15 band 1 and 4) at wavelengths of 0.65 microns (μm) and 10.7 μm retrieved brightness temperatures for the scene. Satellite imagery surrounding the time of the accident, from 1000 AKST through 1400 AKST at approximately 15-minute intervals, were reviewed and the closest images to the time of the accident are documented here.

Figures 4, 5, and 6 present the GOES-15 infrared imagery from 1130, 1200, and 1230 AKST at 4X magnification. Inspection of the infrared imagery indicated an enhanced bands (greens and blues, higher cloud tops) were moving northward across the accident site at the accident time. Lower cloud tops were located over Fairbanks Airport (PAFA), Alaska. Based on the brightness temperatures above the accident site and the vertical temperature profile provided by the 1200 AKST GDAS sounding, the approximate cloud-top heights over the accident site were 25,000 feet at 1200 AKST.

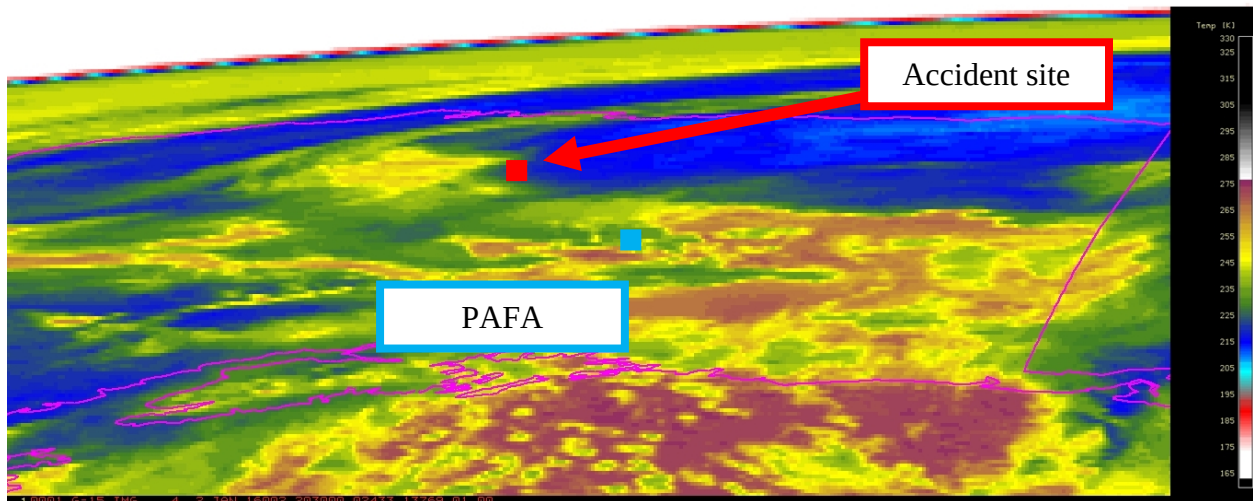


Figure 4 – GOES-15 infrared image at 1130 AKST

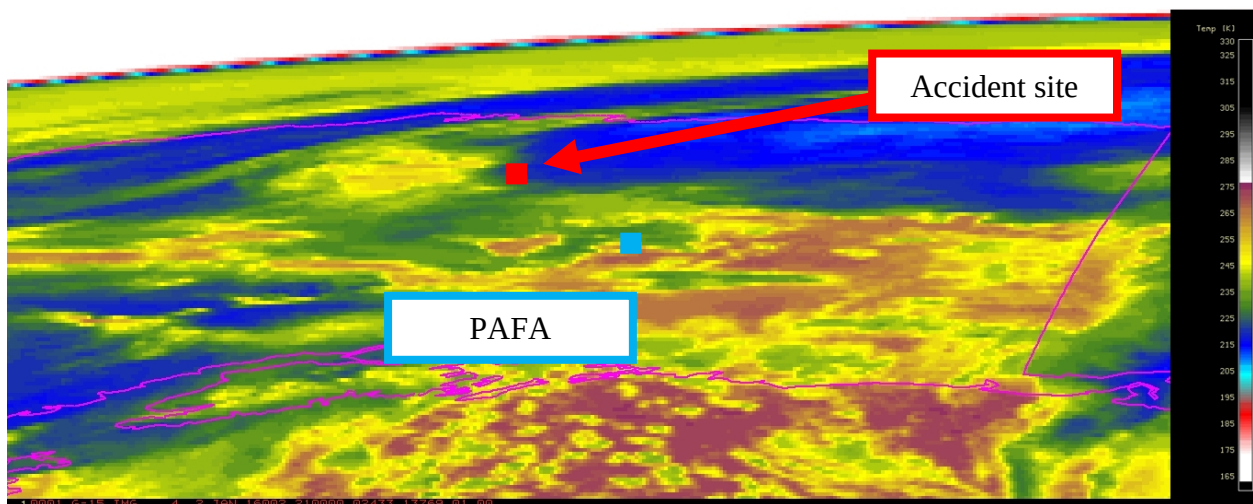


Figure 5 – GOES-15 infrared image at 1200 AKST

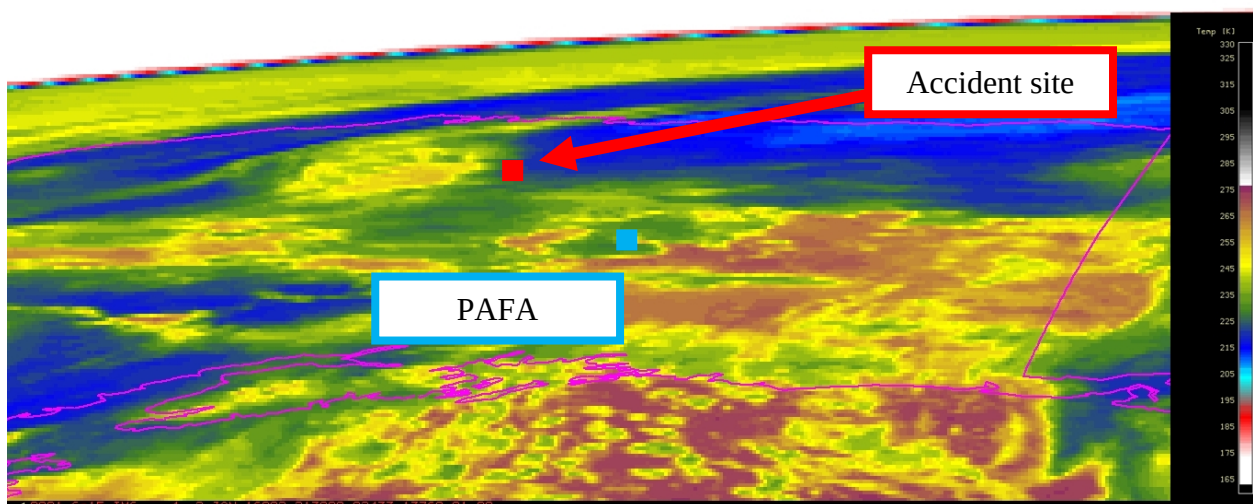


Figure 6 – GOES-15 infrared image at 1230 AKST

6.0 Radar Imagery Information

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)¹² was from Pedro Dome (PAPD), near Fairbanks, Alaska, located over 200 miles south-southeast of the accident site. Level II and III archive radar data was obtained from the NCEI utilizing the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software. No precipitation targets were located above the accident site at the accident time or at any time surrounding the accident day. Given the distance from PAPD to the accident site, no precipitation targets would be expected above the accident site.

7.0 Pilot Reports

All pilot reports (PIREPs) were reviewed close to the accident site from around three hours prior to the accident time to around two hours after the accident time for below FL200¹³ and the PIREPs are provided below:

SCC UA /OV SCC180045/TM 1808/FL170/TP B737/SK TOP180/TA M07/IC MOD RIME 180-170/RM DURD //ZAN=

SCC UA /OV SCC /TM 1821 /FL000 /TP B737 /RM BA FAIR-GOOD RY 5=

FAI UA /OV FAI250060/TM 1830/FL200/TP B190/SK TOP250/TA M40/TB CONT LGT CHOP 200-250/IC LGT RIME 200-240/RM DURC //ZAN=

FAI UA /OV FAI240080/TM 1852/FL100/TP C208/SK TOP100/RM //ZAN=

FAI UA /OV FAI /TM 1909 /FL060 /TP DHC8 /TB MOD 060-030 /RM DURD=

FAI UA /OV FAI-FAI240030 /TM 1920 /FL065 /TP PA31 /TB MOD CHOP BLO 050=

FAI UA /OV FAI-FAI360030 /TM 1945 /FL070 /TP C208 /TB MOD CHOP BLO 050 /RM SMOOTH AT 070=

FAI UA /OV FAI310050 /TM 1954 /FL050 /TP C208 /WV 180050KT=

FAI UA /OV FAI307070/TM 2138/FL090/TP PA31/TA M18/IC LGT MIX/RM ZAN=

Routine pilot report (UA); 45 miles from Deadhorse, Alaska, on the 180° radial; Time – 0908 AKST (1808Z); Altitude – 17,000 feet msl; Type aircraft – Boeing 737; Sky – Tops at FL180; Temperature -7° C; Icing – Moderate rime between FL180 and 17,000 feet msl; Remarks – During descent.

Routine pilot report (UA); Over Deadhorse, Alaska; Time – 0921 AKST (1821Z); Altitude – Surface; Type aircraft – Boeing 737; Remarks – Braking action fair to good on runway 5.

¹² 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.

¹³ Flight Level – A Flight Level (FL) is a standard nominal altitude of an aircraft, in hundreds of feet. This altitude is calculated from the International standard pressure datum of 1013.25 hPa (29.92 inHg), the average sea-level pressure, and therefore is not necessarily the same as the aircraft's true altitude either above mean sea level or above ground level.

Routine pilot report (UA); 60 miles from Fairbanks, Alaska, on the 250° radial; Time – 0930 AKST (1830Z); Flight level – FL200; Type aircraft – Beechcraft 1900; Sky – Tops at FL250; Temperature -40° C; Turbulence – Continuous light chop between FL200 and FL250; Icing – Light rime between FL200 and FL240; Remarks – During climb.

Routine pilot report (UA); 80 miles from Fairbanks, Alaska, on the 240° radial; Time – 0952 AKST (1852Z); Altitude – 10,000 feet msl; Type aircraft – Cessna 208; Sky – Tops at 10,000 feet.

Routine pilot report (UA); Over Fairbanks, Alaska; Time – 1009 AKST (1909Z); Altitude – 6,000 feet msl; Type aircraft – De Havilland Canada DHC-8; Turbulence – Moderate between 6,000 and 3,000 feet; Remarks – During descent.

Routine pilot report (UA); 30 miles from Fairbanks, Alaska, on the 240° radial; Time – 1020 AKST (1920Z); Altitude – 6,500 feet msl; Type aircraft – Piper PA-31 Navajo; Turbulence – Moderate chop below 5,000 feet msl.

Routine pilot report (UA); Between Fairbanks, Alaska, and 30 miles from Fairbanks, Alaska, on the 360° radial; Time – 1045 AKST (1945Z); Altitude – 7,000 feet msl; Type aircraft – Cessna 208; Turbulence – Moderate chop below 5,000 feet msl; Remarks – Smooth at 7,000 feet. This PIREP was provided by the accident aircraft after takeoff from Fairbanks, heading northward to Anaktuvuk Pass.

Routine pilot report (UA); 50 miles from Fairbanks, Alaska, on the 310° radial; Time – 1054 AKST (1954Z); Altitude – 5,000 feet msl; Type aircraft – Cessna 208; Wind – From 180° at 50 knots.

Routine pilot report (UA); 70 miles from Fairbanks, Alaska, on the 307° radial; Time – 1238 AKST (2138Z); Altitude – 9,000 feet msl; Type aircraft – Piper PA-31 Navajo; Temperature – -18° C; Icing – Light mix.

8.0 SIGMET and CWSU Advisory

No SIGMET was valid for the accident site at the accident time.

No meteorological impact statement (MIS) or CWSU Advisory (CWA) was valid for the accident site at the accident time for below 10,000 feet msl.

9.0 AIRMETs and Area Forecast

The Area Forecast issued by the NWS Alaska Aviation Weather Unit (AAWU) at 0648 AKST for the north slopes of the Brooks Range, including the accident site forecasted scattered clouds at 6,000 feet msl with a broken ceiling at 8,000 feet and tops to FL200 with cirrus above. Occasional broken ceiling to 6,000 feet msl was forecast with light snow as well (figures 7, 9, and 11). No significant turbulence or icing was forecast for the accident site with Anaktuvuk Pass forecast to be VFR until 1600 AKST:

FAAK59 PAWU 021548 AAA

FA9W

FAIC FA 021544 AMD

AK NRN HLF...

.
AIRMETS VALID UNTIL 022115

CB IMPLY POSSIBLE SEV OR GREATER TURB SEV ICE LLWS AND IFR CONDS.
NON MSL HEIGHTS NOTED BY AGL OR CIG.

.
NORTH SLOPES OF BROOKS RANGE FH...VALID UNTIL 030100

...CLOUDS/WX...

SCT060 BKN080 TOP FL200 CI ABV. OCNL BKN060 -SN.

E PIPELINE INCRG SFC WINDS SE G25KT.

OTLK VALID 030100-030700...VFR OCNL MVFR CIG.

PASSES...ANAKTUVUK...ATIGUN...VFR.

...TURB...

NIL SIG.

...ICE AND FZLVL...

NIL SIG. FZLVL SFC.

.
The Area Forecast issued 3 minutes after the accident time, at 1208 AKST, included an AIRMET for mountain obscuration due to clouds and precipitation and the AIRMET was valid at the accident site (figures 8, 10, and 12). This later Area Forecast mentioned scattered clouds at 1,500 feet agl, a broken ceiling at 2,500 feet agl, and overcast skies at 3,500 feet agl with several clouds above through FL300, and an occasional visibility between 3 and 5 miles with light snow showers west of Anaktuvuk Pass. Isolated broken ceiling at 1,500 feet agl and visibility below 3 miles in light snow, blowing snow, and mist was also forecast west of Anaktuvuk Pass. VFR conditions were forecast for the rest of the north slopes of Brooks Range forecast area with channeled terrain surface winds from the south at 20 knots and gusts to 30 knots:

FAAK59 PAWU 022108

FA9W

FAIC FA 022115

AK NRN HLF...

.
AIRMETS VALID UNTIL 030515

CB IMPLY POSSIBLE SEV OR GREATER TURB SEV ICE LLWS AND IFR CONDS.
NON MSL HEIGHTS NOTED BY AGL OR CIG.

.
NORTH SLOPES OF BROOKS RANGE FH...VALID UNTIL 030900

...CLOUDS/WX...

*****AIRMET MT OBSC***MTS OCNL OBSC IN CLDS/PCPN. NC...**

W PAKP SCT015 BKN025 OVC035 AGL SEPD LYRS ABV TO FL300.

OCNL VIS 3-5SM -SHSN. ISOL BKN015 AGL/VIS BLW 3SM -SN BLSN BR.
 ELSW FEW035 SCT-BKN050 SEPD LYRS ABV TO FL300.
 ISOL BKN035 AGL/VIS 5SM -SHSN.
 THRU CHanneled TRRN SFC WND S 20G30 KTS.
 OTLK VALID 030900-031500...VFR. VCY MTS AREAS MVFR VIS BLSN.
 PASSES...ANAKTUVUK...VFR. WDLY SCT MVFR CIG SHSN.
 ATIGUN...MVFR CIG. ISOL SHSN.
 ...TURB...
 ISOL MOD TURB BLW 050.
 ...ICE AND FZLVL...
 W PAKP ISOL MOD ICEIC 040-100. ELSW NIL SIG. FZLVL SFC.

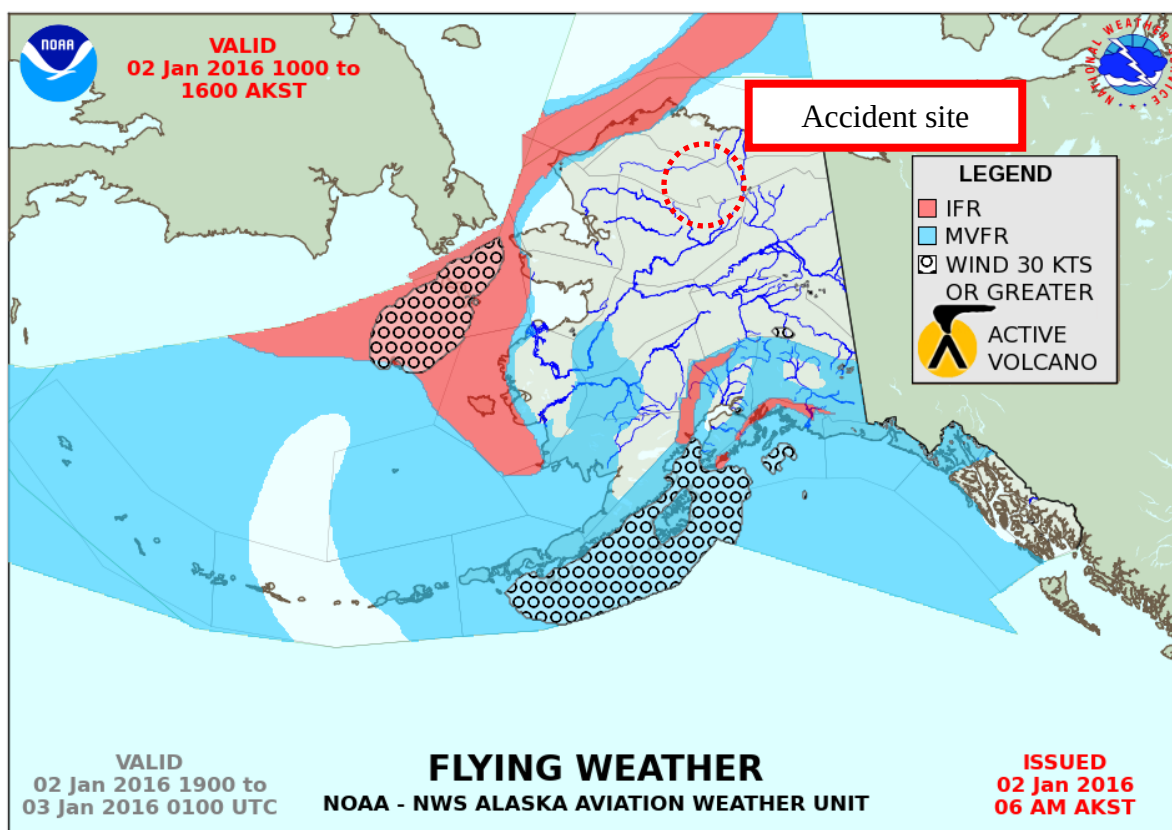


Figure 7 – AAWU IFR and MVFR weather chart issued at 0600 AKST valid from 1000 through 1600 AKST

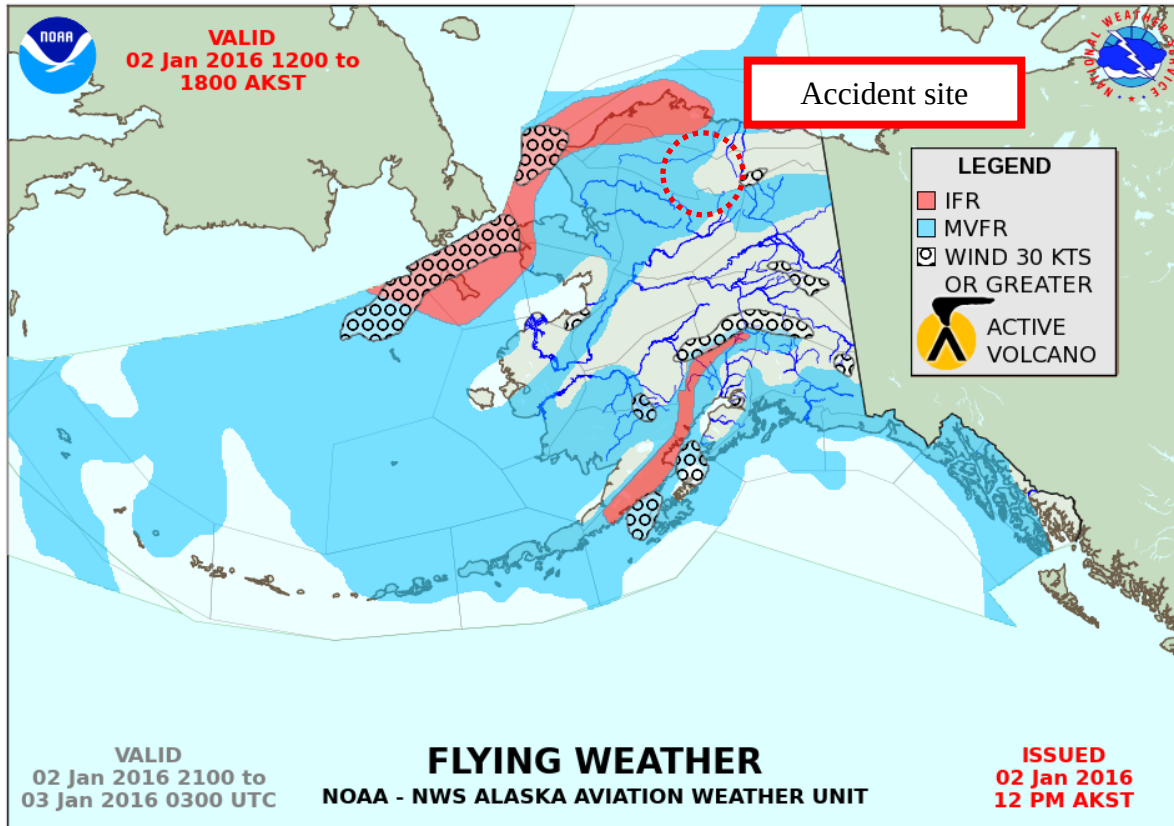


Figure 8 – AAWU IFR and MVFR weather chart issued at 1200 AKST valid from 1200 through 1800 AKST

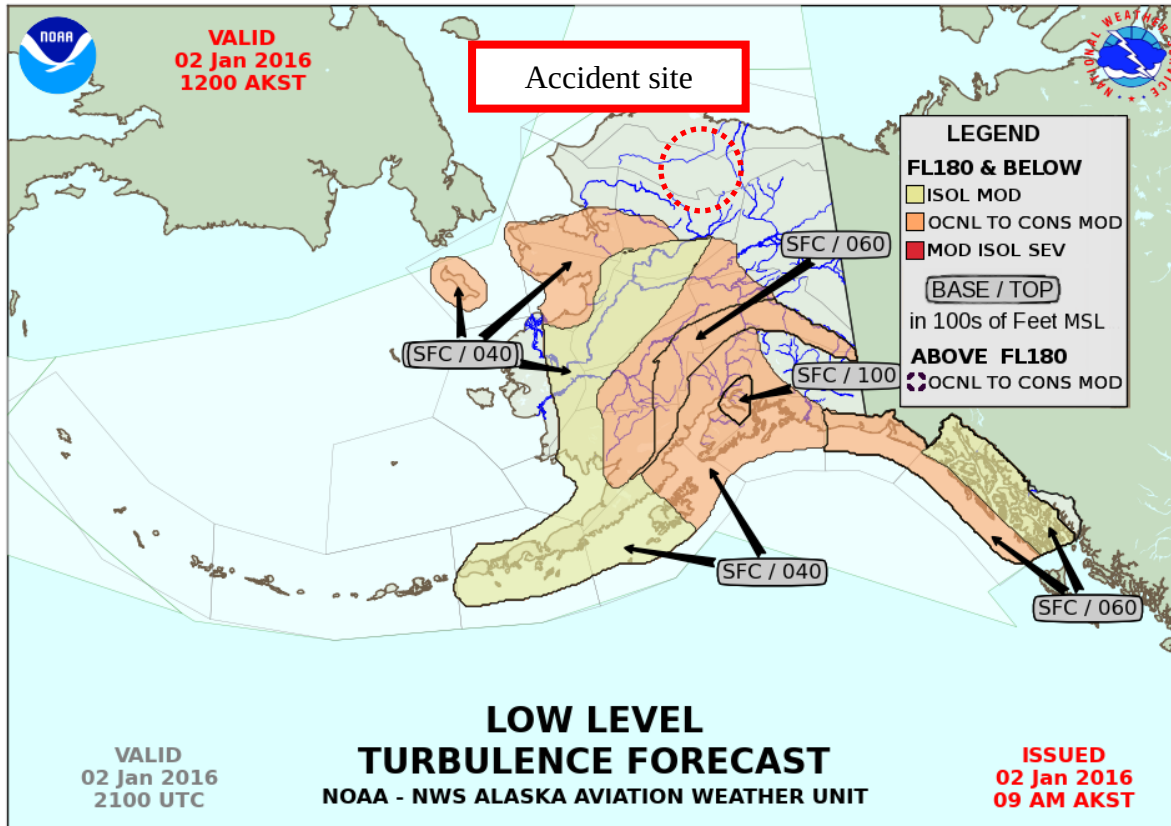


Figure 9 – AAWU low-level turbulence forecast issued at 0900 AKST valid for 1200 AKST

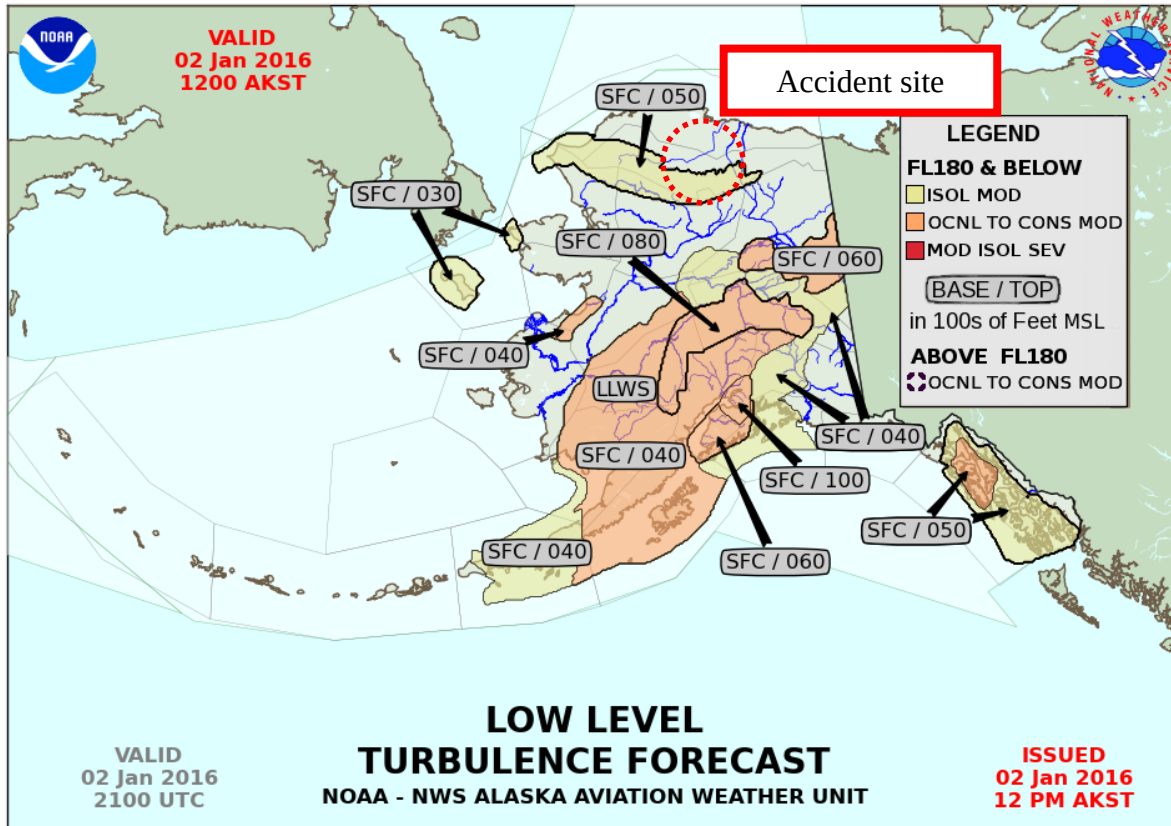


Figure 10 – AAWU low-level turbulence forecast issued at 1200 AKST valid for 1200 AKST

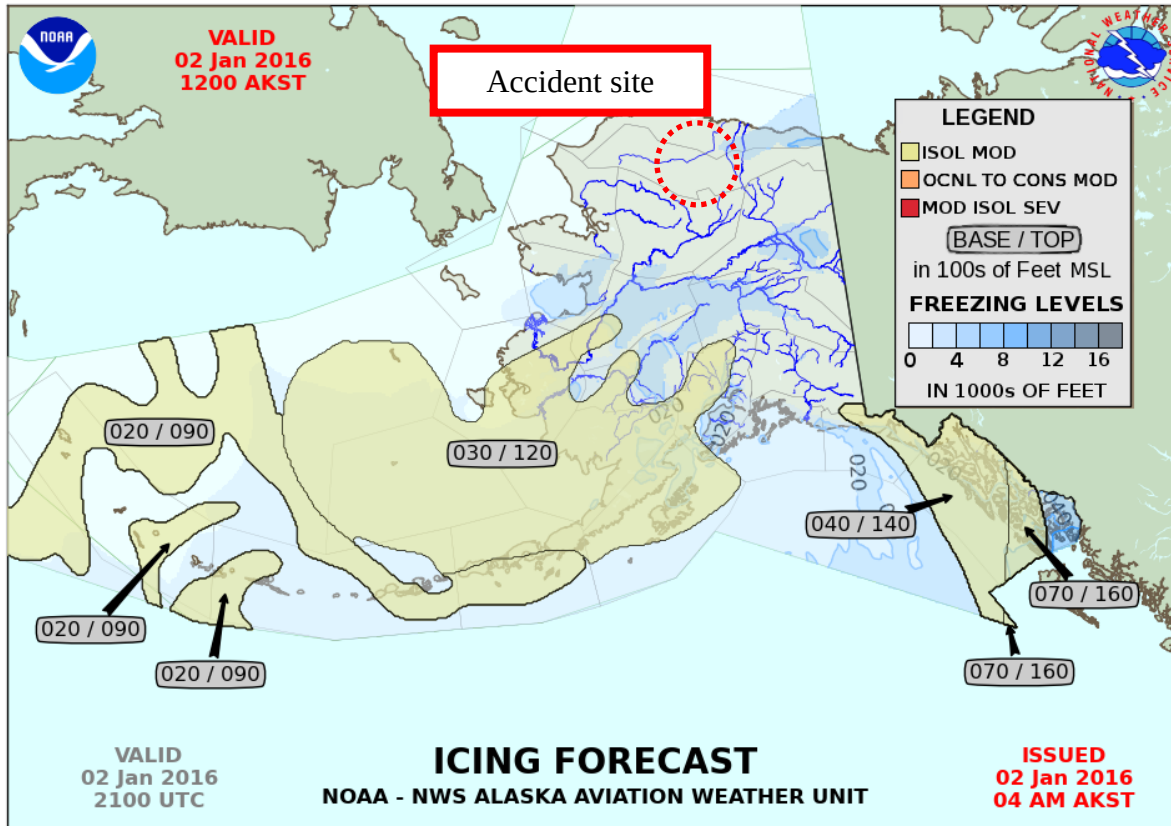


Figure 11 – AAWU icing forecast issued at 0400 AKST valid for 1200 AKST

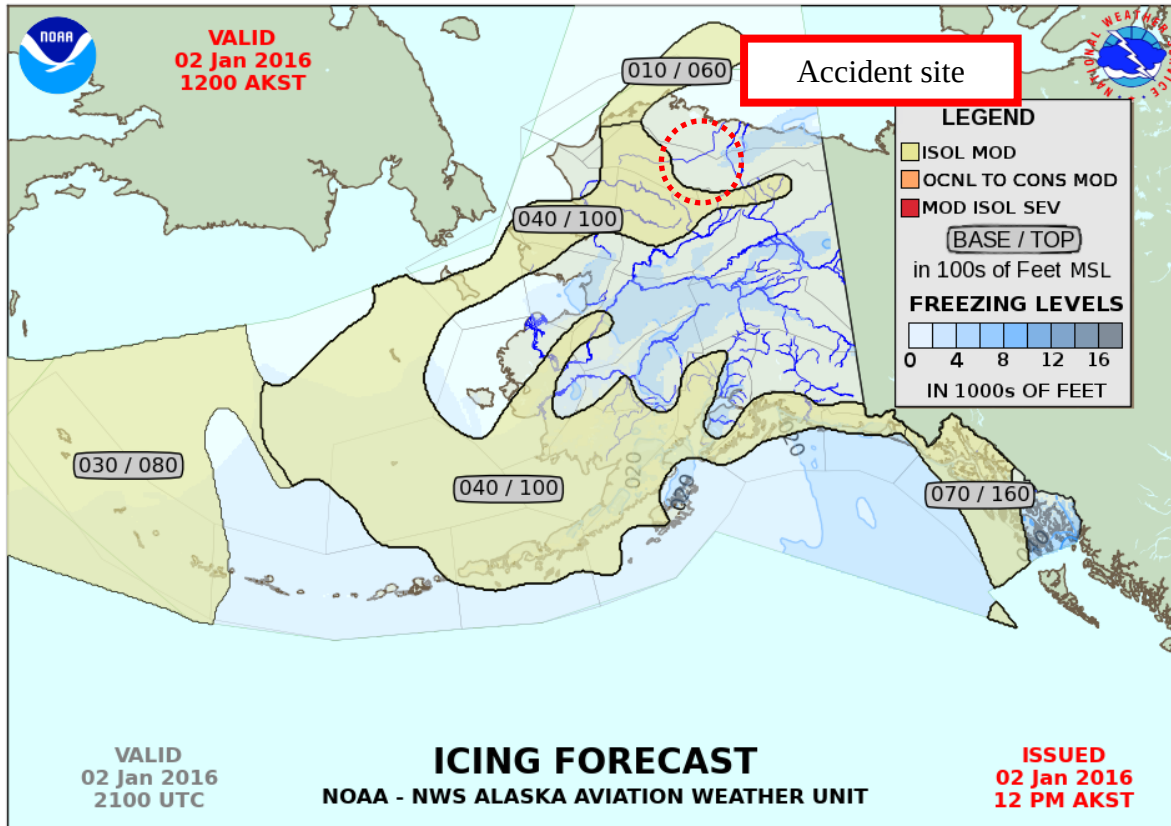


Figure 12 – AAWU icing forecast issued at 1200 AKST valid for 1200 AKST

10.0 Terminal Aerodrome Forecast

PABT was the closest site with a NWS TAF. The TAF valid at the time of the accident was issued at 0838 AKST and was valid for a 24-hour period beginning at 0900 AKST. The TAF for PABT was as follows:

TAF PABT 021738Z 0218/0318 05011KT P6SM FEW070 OVC090
FM022100 02010KT 4SM -SN BKN015 OVC025
 FM030300 35005KT P6SM VCSH SCT040 BKN080
 FM031200 VRB04KT 1 1/2SM BR BKN015=

The forecast expected wind from 020° at 10 knots, 4 miles visibility, light snow, a broken ceiling at 1,500 feet agl, and overcast skies at 2,500 feet agl.

11.0 National Weather Service Area Forecast Discussion

The National Weather Service Office in Fairbanks, Alaska, issued the following Area Forecast Discussion at 0208 AKST (closest AFD to the accident time), which discussed upslope flow over the Brooks Range mountains helping to cause snow:

FXAK69 PAFG 021108
 AFDAFG

NORTHERN ALASKA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE FAIRBANKS AK
208 AM AKST SAT JAN 2 2016

.DISCUSSION...

00Z MODELS INITIALIZED WELL AGAINST THE 00Z ANALYSIS AND VERIFIED WELL AGAINST THE 06Z ANALYSIS. MODEL SPREAD IS MINIMAL THROUGH THE SHORT TERM AND IS REASONABLE THROUGH BOTH THE MID TERM AND LONG TERM. ACTIVE PATTERN WILL CONTINUE OVER NORTHERN ALASKA WITH LARGE AMPLITUDE RIDGE PARKED OVER WESTERN NORTH AMERICA REMAINING PARKED IN PLACE THROUGH THE WEEKEND AND BUILDING NORTH AND WEST WITH 546 DAM RIDGE AT 500 HPA CENTERED OVER THE YUKON BY TUESDAY OF NEXT WEEK. THE UPPER LEVEL LOW OVER BRISTOL BAY WILL DRIFT NORTH AND WEST TO NEAR NUNIVAK ISLAND OVER THE WEEKEND AND REPOSITION AND WEAKENS OVER THE CENTRAL BERING SEA AS THE UPPER LEVEL OVER RIDGE BUILDS NORTH AND WEST.

SECOND SHORTWAVE CURRENTLY MOVING ONSHORE ALONG THE SOUTH COAST OF ALASKA WILL CONTINUE TO PUSH NORTH AND WILL BE ALONG THE ALASKA RANGE THIS MORNING. A 65 KT JET MAX AT 850 MB COMBINED WITH STRONG DOWNWARD FORCING WITH MOUNTAIN WAVE BREAKING WILL PRODUCE WARNING LEVEL WIND GUSTS ALONG THE NORTH SLOPES AND NEAR THE PASSES OF THE ALASKA RANGE IN ZONES 225 AND 226 WHERE HIGH WIND WARNINGS HAVE BEEN HOISTED. EXPECT ADVISORY LEVEL WIND GUSTS NEAR DELTA JUNCTION IN ZONE 223 AND ALONG THE ALASKA RANGE IN ZONE 227 WHERE ADVISORIES ARE ONGOING. WINDS ALREADY INCREASING AND EXPECTED TO CONTINUE TROUGH LATE TONIGHT. CHINOOK FLOW WILL KEEP SOUTHERN PORTIONS OF THE CENTRAL AND EASTERN INTERIOR DRY. 925 MB WINDS WILL CONTINUE TO INCREASE OVER SUMMITS ESPECIALLY OVER THE CENTRAL AND WESTERN INTERIOR WHERE BLOWING SNOW WILL LIKELY DROP VISIBILITY HOWEVER ADVISORY LEVEL GUSTS NOT EXPECTED ATTM.

MOISTURE ALONG THE FRONT CONTINUES TO MOVE NORTH AND WEST OVER WESTERN ALASKA AND THE WEST COAST OF ALASKA. FORECAST SOUNDINGS CONTINUE TO INDICATE MIXED PRECIPITATION OVER WESTERN INTERIOR WEST AND NORTH OF MCGRATH AND ALONG THE WEST COAST SOUTH OF THE SEWARD PENINSULA. WINTER WEATHER ADVISORIES ISSUED FOR ZONES 214...215 AND 216 FOR SNOW...BLOWING SNOW AND FREEZING RAIN THROUGH THIS EVENING AND SUNDAY MORNING AS THE FRONT ROTATES THROUGH THE AREA. LESS THAN ONE TENTH OF AN INCH OF ICE IS EXPECTED AND AROUND 4 INCHES OF SNOW EXPECTED. **SNOW WILL INCREASE OVER THE SOUTHERN SLOPES OF THE CENTRAL AND WESTERN BROOKS RANGE WITH FAVORED UPPER LEVEL SUPPORT AND UPSLOPE WILL ENHANCE SNOWFALL TOTALS. WILL NEED TO MONITOR FOR REACHING ADVISORY LEVEL SNOWFALL TOTALS IN THESES AREAS.**

&&

.AFG WATCHES/WARNINGS/ADVISORIES...

WIND ADVISORY FOR AKZ223-AKZ227.

HIGH WIND WARNING FOR AKZ225-AKZ226.

WINTER WEATHER ADVISORY FOR AKZ213-AKZ214-AKZ215-AKZ216.

BRISK WIND ADVISORY FOR PKZ200-PKZ210-PKZ220-PKZ225-PKZ245.

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12.0 Pilot Weather Briefing and Information¹⁴

The accident pilot did not receive an archived or official weather briefing, however, the accident pilot did review the weather before the accident flight using a computer at the accident company. The FAA's Aviation Weather Cameras in Alaska north of Fairbanks were not available due to darkness before the accident flight, but the accident pilot said they would normally check the weather cameras before a flight. While enroute to PAKP, the accident pilot checked the weather for PABT and PAKP. The last METAR from PAKP the accident pilot received was the 1156 AKST/2056 UTC observation (section 3.0). While flying over the Caribou Hills, the pilot stated in an interview, that the weather began to get "fuzzy" and the airplane began to accumulate ice. The de-ice and anti-ice equipment was turned on and the deicing boots actuated. There were no visibility restrictions due to ice accumulation. The accident pilot did relay a PIREP at 1045 AKST to flight service after departing Fairbanks, and that PIREP was relayed into the NAS (section 7.0). There is no record of the accident pilot receiving or retrieving any other weather information before the accident flight.

In addition to the accident pilot, a Warbelows flight taking off from Anaktuvuk Pass prior to the accident flight passed along weather information to the accident pilot before the accident time. The pilot of the other flight closer to PAKP communicated that the weather was "pretty much as advertised." No official PIREP was taken or disseminated from this exchange of weather information. The Warbelows flight pilot further stated that they encountered flat light conditions after departing PAKP compounded by low visibility. To remain VMC the Warbelows flight had to turn towards the north side of the valley as well as initiate a climb. The Warbelows flight pilot stated that they perceived the flat light and low visibility conditions to be highly localized. As the accident flight got closer to PAKP the accident pilot noticed a 200 foot per minute descent rate and assumed it was because of the wind coming over the hills, but there was no turbulence, just a sink rate. There were overcast skies and snow covered terrain while getting closer to PAKP with what appeared to be white out conditions, with white snow, white walls, and white clouds.

¹⁴ For more information see the witness, pilot interview, and operations information contained in the docket for this accident.

13.0 Web Camera Images

Images from the FAA's Aviation Weather Cameras are shown in figures 13 through 27 along with attachments 1 through 4 providing images of the weather conditions surrounding the accident site at the accident time. The weather camera from Anaktuvuk Pass, 5 miles northeast of the accident site, showed the weather conditions surrounding the accident time with the south facing camera images provided in figures 15 through 19 with times from 1142 AKST through 1222 AKST. The horizontal visibility conditions deteriorated between 1152 and 1212 AKST with less than 2 miles visibility and ceiling conditions below 4,100 feet msl (figures 16 through 18 compared to figure 13), and snow can be seen falling in the light beam shining down towards the ground from the airport flood lamp in the foreground. Weather conditions improve slightly by 1222 AKST with visibility greater than 2 miles but less 4 miles and a broken ceiling of clouds (figure 19). The weather camera from Anaktuvuk Pass southwest facing camera images are provided in figures 22 through 27 with times from 1140 AKST through 1230 AKST. The southwest facing weather camera showed similar conditions to the south facing camera, with less than 3.5 miles visibility (with mountain as reference figure 21) and ceiling conditions below 5,000 feet msl, on the southwest facing weather camera between 1140 and 1230 AKST (figures 22 through 27). Given the weather camera conditions, there was likely a restriction to horizontal visibility during descent into Anaktuvuk Pass on the accident flight with mountain obscuration due to snow and clouds. The FAA's Aviation Weather Cameras surrounding the accident site show likely MVFR conditions at the surface with IMC likely along accident flight path into the destination airport with the worst conditions along and near the terrain at the accident time. The accident pilot did check the Anaktuvuk Pass weather cameras before taking off on the accident flight, however, it was still dark at the time of takeoff.

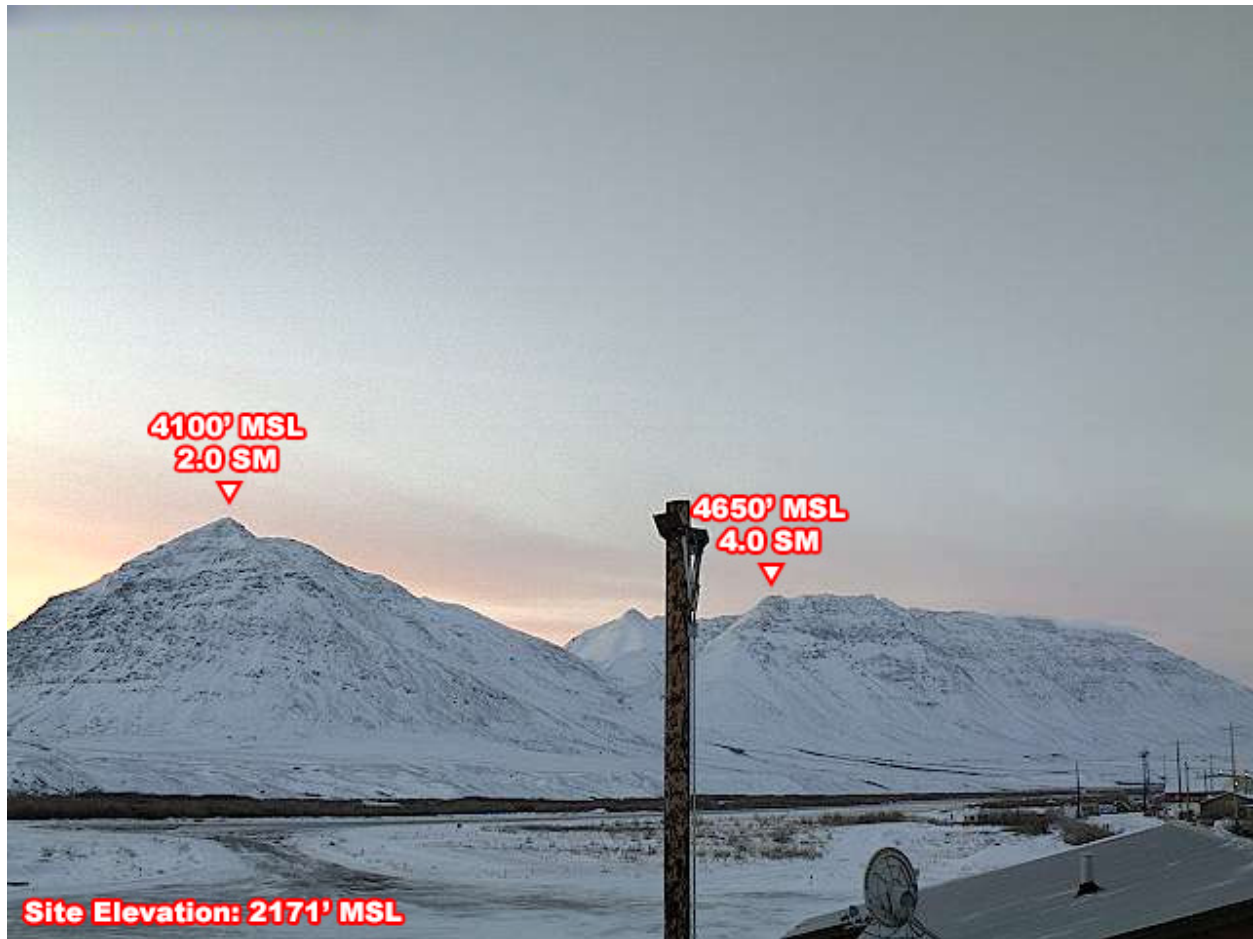


Figure 13 – FAA weather camera from Anaktuvuk Pass south looking view from a standard clear sky weather day

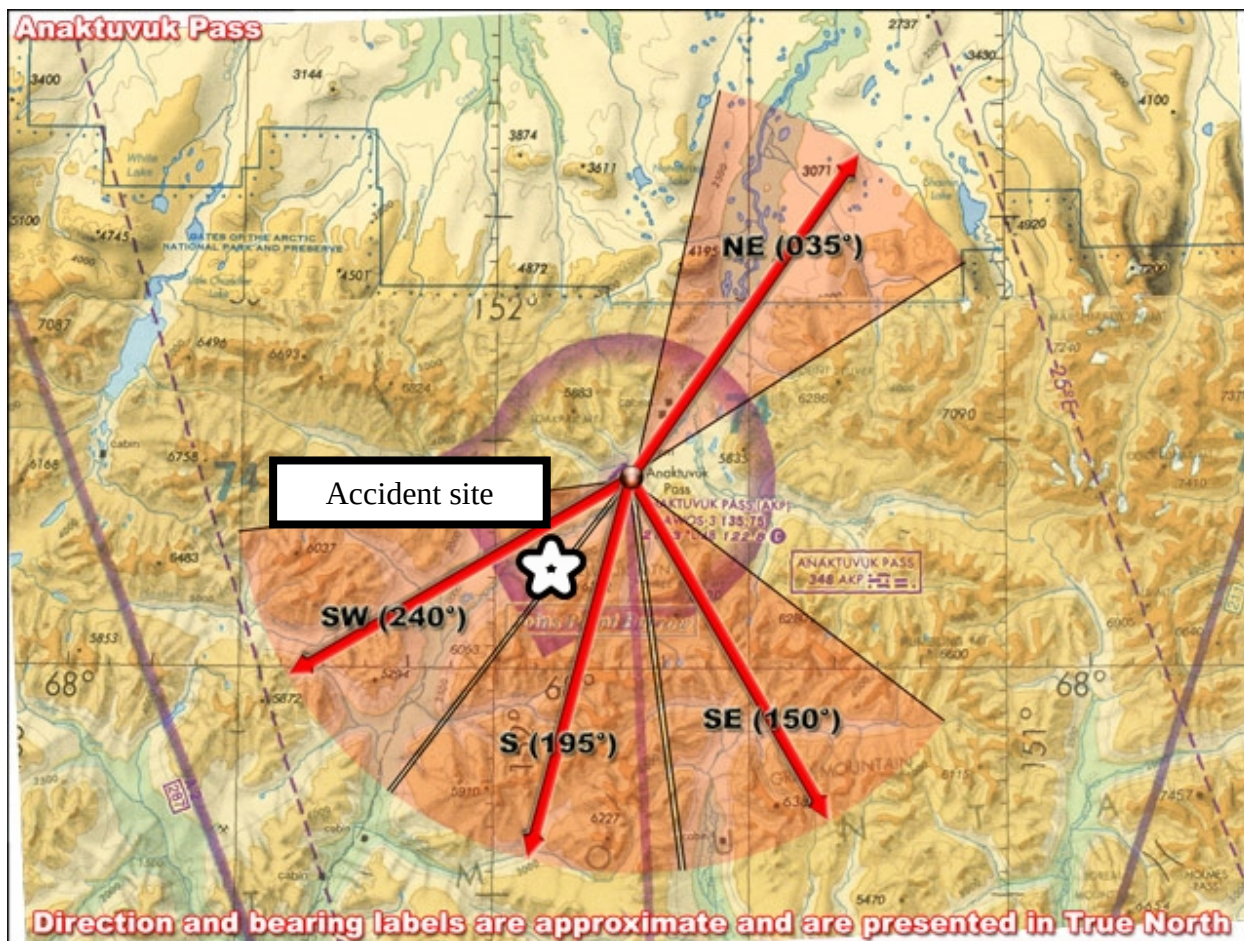


Figure 14 – FAA weather camera Anaktuvuk Pass location on sectional chart with the direction the different camera angles face with the accident site marked

Sat 02 Jan 2016 20:42:31 UTC
Sat 02 Jan 2016 11:42:31 AKST

Anaktuvuk Pass - South
See <http://avcams.faa.gov> for more information



Figure 15 – FAA weather camera from Anaktuvuk Pass south looking view from 1142 AKST

Sat 02 Jan 2016 20:52:28 UTC
Sat 02 Jan 2016 11:52:28 AKST

Anaktuvuk Pass - South
See <http://avcams.faa.gov> for more information



Figure 16 – FAA weather camera from Anaktuvuk Pass south looking view from 1152 AKST

Sat 02 Jan 2016 21:02:31 UTC
Sat 02 Jan 2016 12:02:31 AKST

Anaktuvuk Pass - South
See <http://avcams.faa.gov> for more information



Figure 17 – FAA weather camera from Anaktuvuk Pass south looking view from 1202 AKST

Sat 02 Jan 2016 21:12:31 UTC
Sat 02 Jan 2016 12:12:31 AKST

Anaktuvuk Pass - South
See <http://avcams.faa.gov> for more information



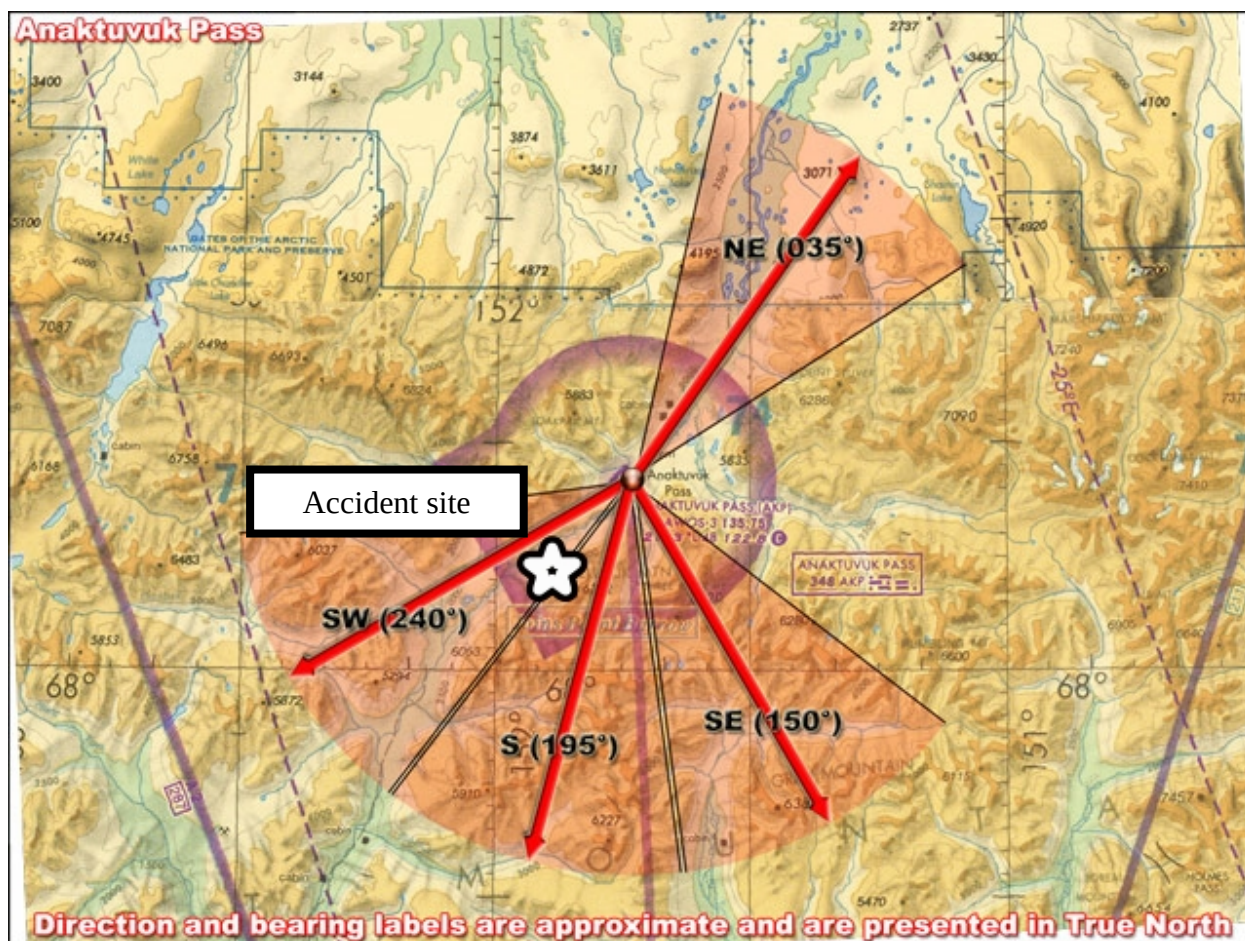
Figure 18 – FAA weather camera from Anaktuvuk Pass south looking view from 1212 AKST

Sat 02 Jan 2016 21:22:30 UTC
Sat 02 Jan 2016 12:22:30 AKST

Anaktuvuk Pass - South
See <http://avcams.faa.gov> for more information



**Figure 19 – FAA weather camera from Anaktuvuk Pass south looking view from 1222
AKST**



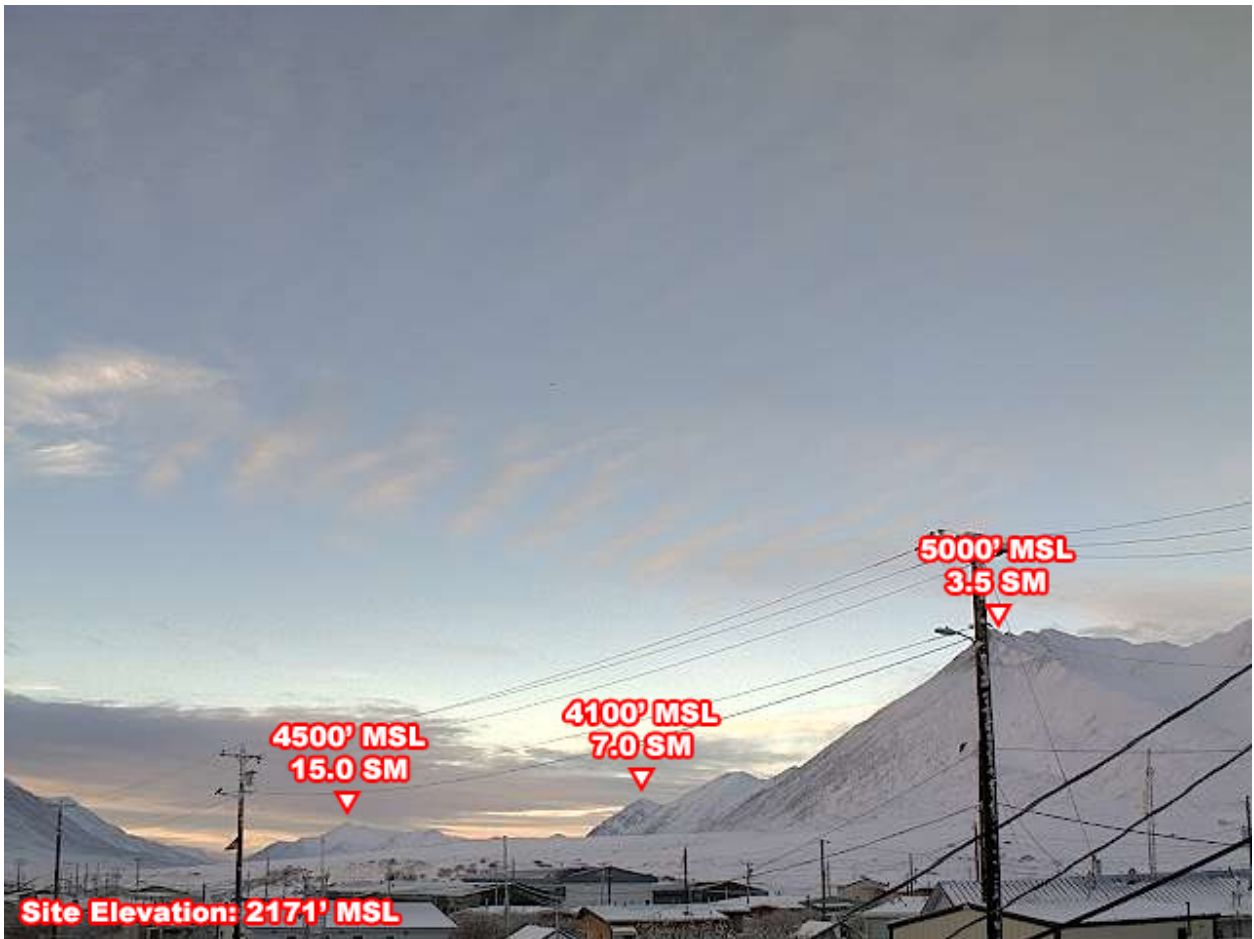


Figure 21 – FAA weather camera from Anaktuvuk Pass southwest looking view from a standard clear sky weather day

Sat 02 Jan 2016 20:40:28 UTC
Sat 02 Jan 2016 11:40:28 AKST

Anaktuvuk Pass - SouthWest
See <http://avcams.faa.gov> for more information



**Figure 22 – FAA weather camera from Anaktuvuk Pass southwest looking view from 1140
AKST**

Sat 02 Jan 2016 20:50:28 UTC
Sat 02 Jan 2016 11:50:28 AKST

Anaktuvuk Pass - SouthWest
See <http://avcams.faa.gov> for more information



**Figure 23 – FAA weather camera from Anaktuvuk Pass southwest looking view from 1150
AKST**

Sat 02 Jan 2016 21:00:30 UTC
Sat 02 Jan 2016 12:00:30 AKST

Anaktuvuk Pass - SouthWest
See <http://avcams.faa.gov> for more information



Figure 24 – FAA weather camera from Anaktuvuk Pass southwest looking view from 1200 AKST

Sat 02 Jan 2016 21:10:28 UTC
Sat 02 Jan 2016 12:10:28 AKST

Anaktuvuk Pass - SouthWest
See <http://avcams.faa.gov> for more information



**Figure 25 – FAA weather camera from Anaktuvuk Pass southwest looking view from 1210
AKST**

Sat 02 Jan 2016 21:20:29 UTC
Sat 02 Jan 2016 12:20:29 AKST

Anaktuvuk Pass - SouthWest
See <http://avcams.faa.gov> for more information



**Figure 26 – FAA weather camera from Anaktuvuk Pass southwest looking view from 1220
AKST**

Sat 02 Jan 2016 21:30:28 UTC
Sat 02 Jan 2016 12:30:28 AKST

Anaktuvuk Pass - SouthWest
See <http://avcams.faa.gov> for more information



Figure 27 – FAA weather camera from Anaktuvuk Pass southwest looking view from 1230 AKST

14.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for the accident site on January 2, 2016, indicated the following:

SUN

Begin civil twilight 1024 AKST

End civil twilight 1559 AKST

F. LIST OF ATTACHMENTS

Attachment 1 – FAA’s Aviation Web Camera images from Anaktuvuk Pass northeast facing view camera around the accident time

Attachment 2 – FAA’s Aviation Web Camera images from Anaktuvuk Pass south facing view camera around the accident time

Attachment 3 – FAA’s Aviation Web Camera images from Anaktuvuk Pass southeast facing view camera around the accident time

Attachment 4 – FAA’s Aviation Web Camera images from Anaktuvuk Pass southwest facing view camera around the accident time

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NTSB, AS-30