



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

January 19, 2018

Weather Study

METEOROLOGY

ANC18FA003

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A. ACCIDENT

Location: Near Russian Mission, Alaska
Date: October 16, 2017
Time: 1430 Alaska daylight time
2230 Coordinated Universal Time (UTC)
Airplane: Cessna 210-5, registration: N8347Z

B. METEOROLOGIST

Paul Suffern
Senior Meteorologist
Operational Factors Division (AS-30)
National Transportation Safety Board

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) Meteorologist did not travel for this investigation and gathered 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 daylight time (AKDT) on October 16, 2017, and are based upon the 24-hour clock, where local time is -8 hours from UTC, and UTC=Z. 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 61.640° N, longitude 161.446° W, at an approximate elevation of 10 feet (ft).

D. WEATHER 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, 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 Surface Analysis Chart

The NWS NCEP/Ocean Prediction Center (OPC) Surface Analysis Chart for 1600 AKDT is provided as figure 1 with the approximate location of the accident site marked within the red circle. The chart depicted a surface low pressure center northwest of the accident site in Norton Sound with a pressure of 1002-hectopascals (hPa). A frontal boundary stretched from Norton Sound northwestward across the Bering Sea and into eastern Russia. Another surface low pressure center at 979-hPa associated with an occluded frontal system was located along the western Aleutian Island Chain to the southwest of the accident site.

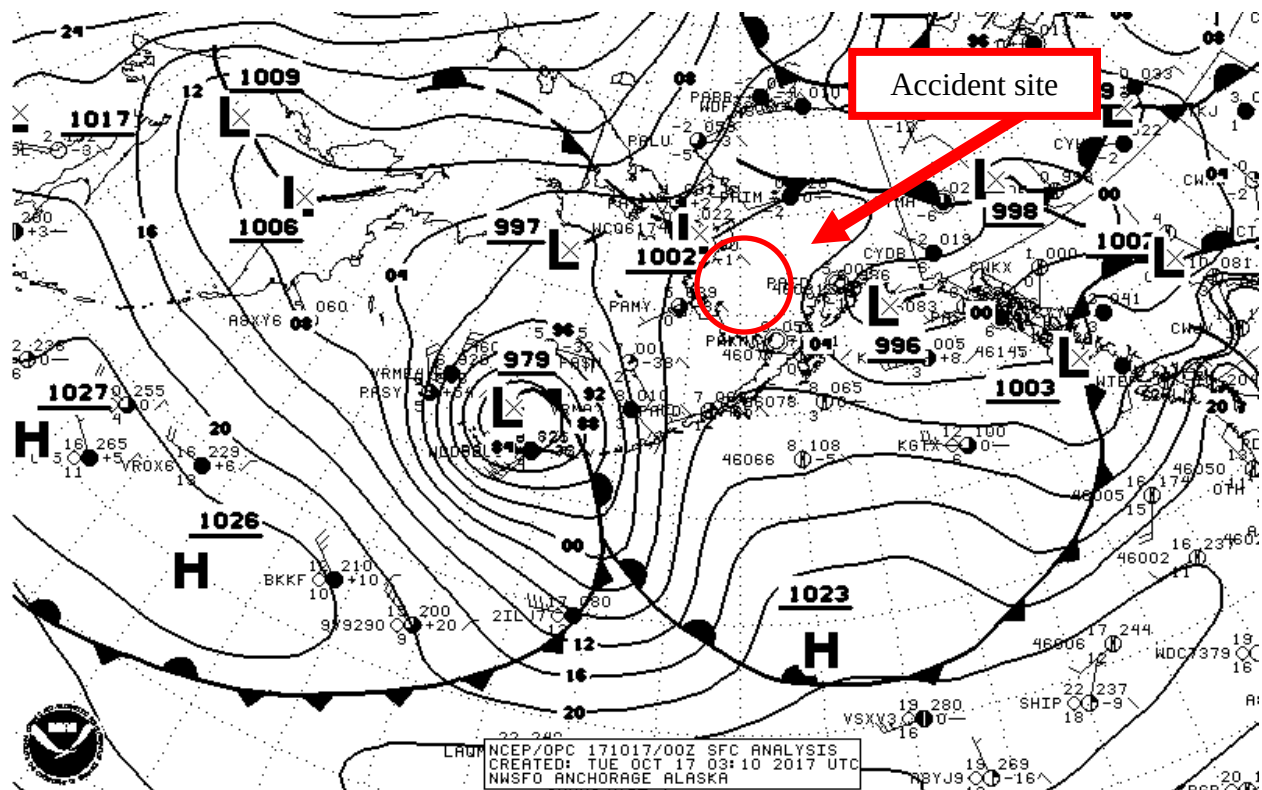


Figure 1 – NCEP/OPC Surface Analysis Chart for 1600 AKDT

1.2 Upper Air Charts

The NCEP/OPC Constant Pressure Charts for 1600 AKDT at 500-hPa is presented in figure 2. A mid-level trough¹ was located just west of the accident site in southwestern Alaska. Troughs can act to allow for increased vertical motion and the development of clouds and precipitation, if sufficient moisture is present.

¹ Trough – An elongated area of relatively low atmospheric pressure or heights.

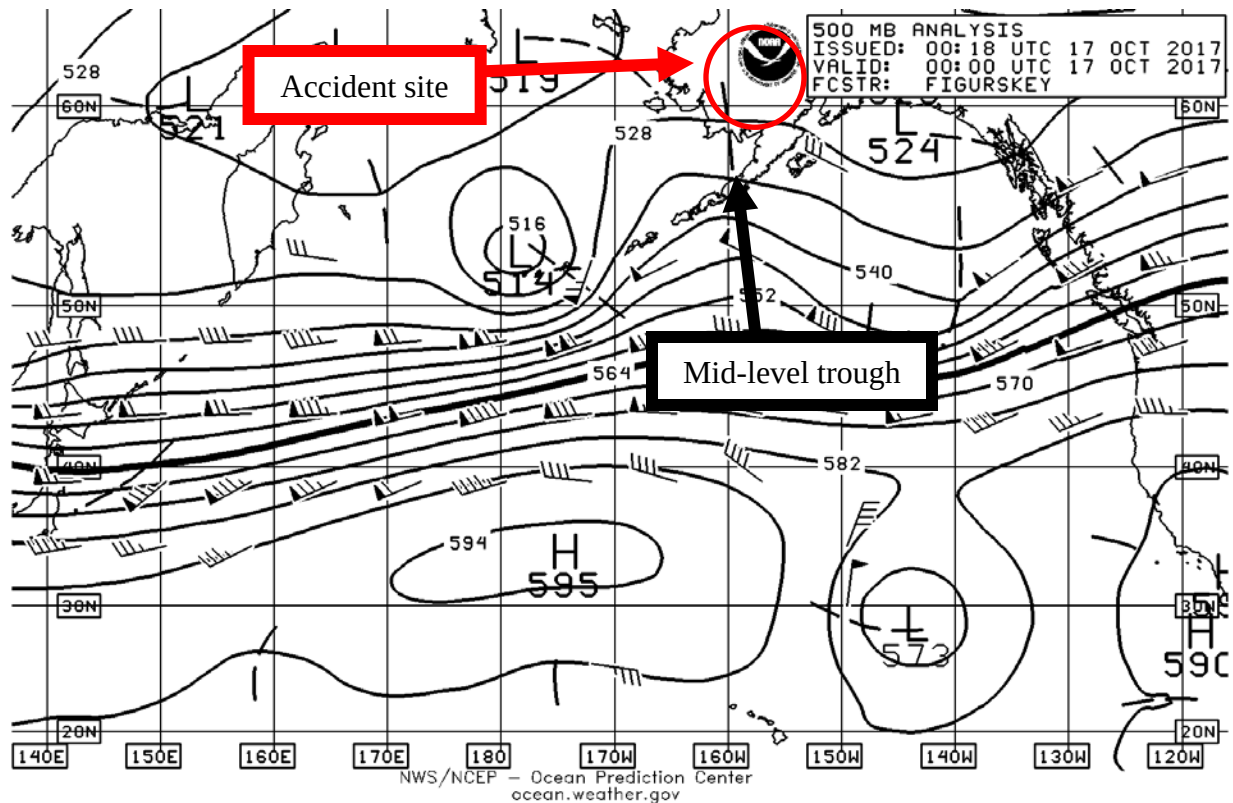


Figure 2 – NWS 500-hPa Constant Pressure Chart for 1600 AKDT

2.0 Surface Observations

The area surrounding the accident site was documented using official Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). Figure 3 is a sectional chart with the accident site and the closest weather reporting locations marked.

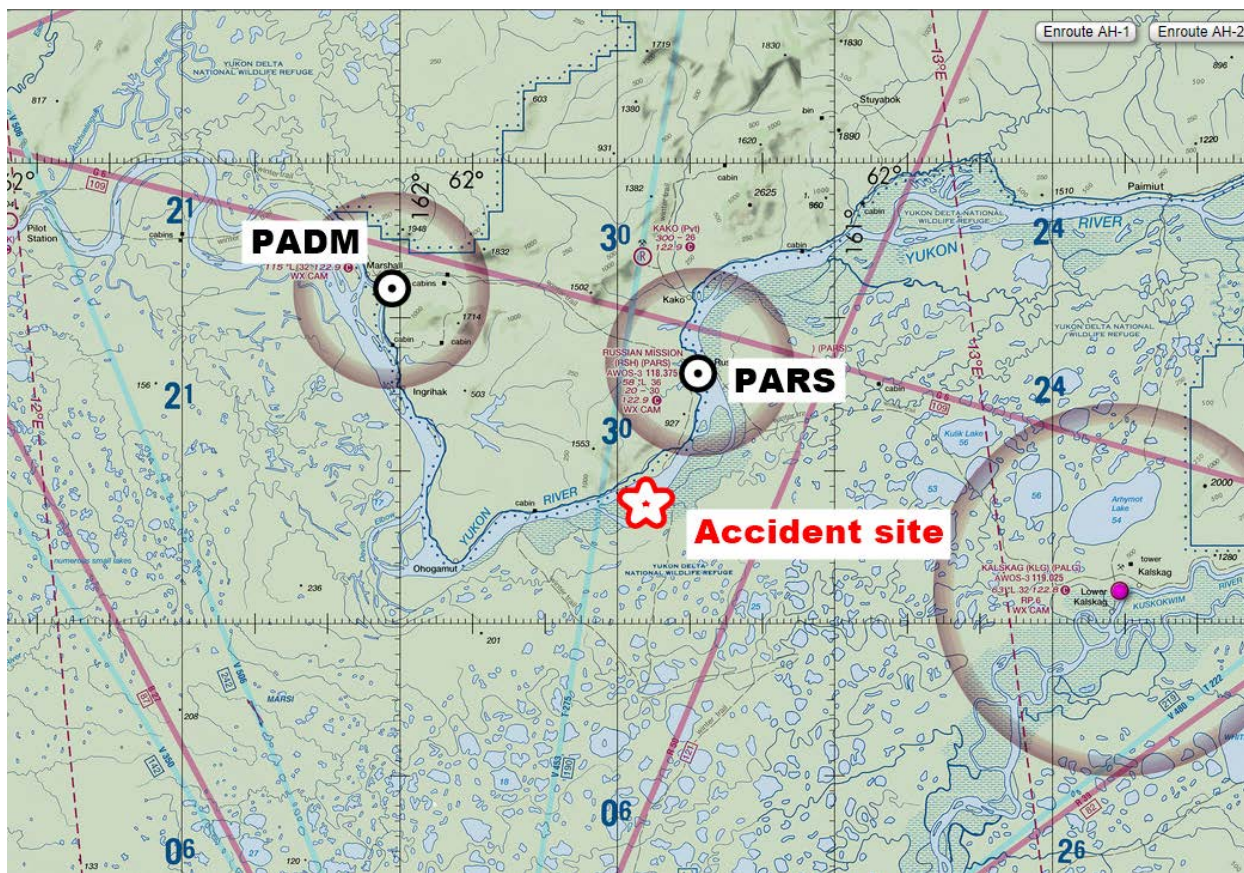


Figure 3 – Sectional chart of accident area with the location of the accident site and surface observation sites

Russian Mission Airport (PARS) was the closest airport with official weather observations. PARS had an Automated Weather Observing System (AWOS²) whose reports were not supplemented. PARS was located 9 miles north-northeast of the accident site, at an elevation of 58 ft, and had a 13° easterly magnetic variation³ (figure 3). The following raw observations were taken and disseminated during the times surrounding the accident:⁴

[1256 AKDT] METAR PARS 162056Z AUTO 00000KT 10SM FEW003 BKN028 OVC037
02/02 A2967 RMK AO2 SLP053 T00220017 51005 FZRANO \$=

[1313 AKDT] SPECI PARS 162113Z AUTO 00000KT 10SM BKN003 OVC028 02/02
A2967 RMK AO2 FZRANO \$=

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. Based on the isogonic lines from the sectional.

⁴ Bolded sections in this report highlight information that directly reference the weather conditions that affected the accident location around the accident time.

[1334 AKDT] SPECI PARS 162134Z AUTO 00000KT 10SM SCT003 OVC026 02/02
A2968 RMK AO2 FZRANO \$=

[1356 AKDT] METAR PARS 162156Z AUTO 13003KT 10SM SCT003 BKN026 03/02
A2967 RMK AO2 SLP053 T00280017 \$=

**[1405 AKDT] SPECI PARS 162205Z AUTO 18005KT 10SM BKN003 BKN026 03/02
A2968 RMK AO2 \$=**

**[1413 AKDT] SPECI PARS 162213Z AUTO 14003KT 10SM SCT003 SCT026 BKN036
03/02 A2968 RMK AO2 \$=**

ACCIDENT TIME 1430 AKDT

**[1446 AKDT] SPECI PARS 162246Z AUTO 17004KT 10SM -RA FEW010 BKN023 OVC034
03/01 A2968 RMK AO2 RAB32 P0000 \$=**

**[1456 AKDT] METAR PARS 162256Z AUTO 17003KT 10SM FEW010 BKN023 OVC029
03/02 A2967 RMK AO2 RAB32E50 SLP053 P0000 T00280017 \$=**

[1512 AKDT] SPECI PARS 162312Z AUTO 00000KT 10SM SCT023 BKN038 03/01
A2967 RMK AO2 \$=

[1556 AKDT] METAR PARS 162356Z AUTO 17005KT 10SM SCT031 04/02 A2967 RMK
AO2 RAB26E38 SLP050 P0000 60000 T00390017 10039 21017 58003 \$=

PARS weather observation at 1405 AKDT, automated, wind from 180° at 5 knots, 10 miles visibility or greater, broken ceiling⁵ at 300 ft above ground level (agl), broken skies at 2,600 ft agl, temperature of 3° Celsius (C), dew point temperature of 2° C, and an altimeter setting of 29.68 inches of mercury. Remarks: automated station with a precipitation discriminator, maintenance is needed on the system.

PARS weather observation at 1413 AKDT, automated, wind from 140° at 3 knots, 10 miles visibility or greater, scattered clouds at 300 ft agl, scattered clouds at 2,600 ft agl, broken ceiling at 3,600 ft agl, temperature of 3° C, dew point temperature of 2° C, and an altimeter setting of 29.68 inches of mercury. Remarks: automated station with a precipitation discriminator, maintenance is needed on the system.

PARS weather observation at 1446 AKDT, automated, wind from 170° at 4 knots, 10 miles visibility or greater, light rain, few clouds at 1,000 ft agl, broken ceiling at 2,300 ft agl, overcast skies at 3,400 ft agl, temperature of 3° C, dew point temperature of 1° C, and an altimeter setting of 29.68 inches of mercury. Remarks: automated station with a precipitation discriminator, rain began at 1432 AKDT, a trace of precipitation since 1356 AKDT, maintenance is needed on the system.

⁵ Ceiling is defined as the lowest layer of clouds reported as broken or overcast, or the vertical visibility into a surface based obscuration.

PARS weather at 1456 AKDT, automated, wind from 170° at 3 knots, 10 miles visibility or greater, few clouds at 1,000 ft agl, broken ceiling at 2,300 ft agl, overcast skies at 2,900 ft agl, temperature of 3° C, dew point temperature of 2° C, and an altimeter setting of 29.67 inches of mercury. Remarks: automated station with a precipitation discriminator, rain began at 1432 AKDT, rain ended at 1450 AKDT, sea level pressure 1005.3 hPa, a trace of precipitation since 1356 AKDT, temperature 2.8° C, dew point temperature 1.7° C, maintenance is needed on the system.

Marshall Don Hunter Sr. Airport (PADM) was the next closest airport with official weather observations and was located 2 miles southeast of Marshall, Alaska. PADM had an AWOS whose reports were not supplemented. PADM was located 21 miles northwest of the accident site, at an elevation of 115 ft, and had a 13° easterly magnetic variation (figure 3). The following observations were taken and disseminated during the times surrounding the accident:

[0856 AKDT] METAR PADM 161656Z AUTO 08003KT 9SM -SN FEW021 SCT028 OVC034
M01/M01 A2965 RMK AO2 UPB47E49SNE06B49 SLP049 P0000
T10111011 FZRANO=

[0956 AKDT] METAR PADM 161756Z AUTO 06004KT 10SM SCT022 BKN030 M02/M03
A2965 RMK AO2 UPB03E14SNE03 SLP049 P0000 60000 T10221028
10000 21022 50001 FZRANO=

[1015 AKDT] SPECI PADM 161815Z AUTO 00000KT 10SM FEW022 BKN028 M02/M03
A2965 RMK AO2 FZRANO=

[1056 AKDT] METAR PADM 161856Z AUTO 08003KT 10SM OVC028 M01/M01 A2965
RMK AO2 SLP050 T10061011 FZRANO=

[1156 AKDT] METAR PADM 161956Z AUTO 00000KT 10SM OVC026 02/01 A2966 RMK
AO2 SLP051 T00170011 FZRANO=

**[1256 AKDT] METAR PADM 162056Z AUTO 00000KT 10SM BKN028 OVC034 04/02
A2966 RMK AO2 SLP052 T00390022 53004=**

**[1356 AKDT] METAR PADM 162156Z AUTO 25004KT 10SM BKN027 OVC035 03/02
A2967 RMK AO2 RAB34E56 SLP054 P0000 T00280017=**

ACCIDENT TIME 1430 AKDT

**[1456 AKDT] METAR PADM 162256Z AUTO 20005KT 10SM OVC029 03/01 A2967 RMK
AO2 RAB33E51 SLP054 P0000 T00330006=**

**[1556 AKDT] METAR PADM 162356Z AUTO 00000KT 10SM OVC027 03/00 A2966 RMK
AO2 SLP053 60000 T00330000 10044 21028 50001=**

[1656 AKDT] METAR PADM 170056Z AUTO 34004KT 10SM OVC023 04/00 A2966 RMK
AO2 RAB26E40 SLP052 P0000 T00390000=

[1725 AKDT] SPECI PADM 170125Z AUTO 17004KT 10SM SCT021 04/M01 A2965
RMK AO2=

PADM weather observation at 1256 AKDT, automated, wind calm, 10 miles visibility or greater, broken ceiling at 2,800 ft agl, overcast skies at 3,400 ft agl, temperature of 4° C, dew point temperature of 2° C, and an altimeter setting of 29.66 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure 1005.2 hPa, temperature 3.9° C, dew point temperature 2.2° C, 3-hourly pressure increase of 0.4 hPa.

PADM weather observation at 1356 AKDT, automated, wind from 250° at 4 knots, 10 miles visibility or greater, broken ceiling at 2,700 ft agl, overcast skies at 3,500 ft agl, temperature of 3° C, dew point temperature of 2° C, and an altimeter setting of 29.67 inches of mercury. Remarks: automated station with a precipitation discriminator, rain began at 1334 AKDT, rain ended at 1356 AKDT, sea level pressure 1005.4 hPa, a trace of precipitation since 1256 AKDT, temperature 2.8° C, dew point temperature 1.7° C.

PADM weather at 1456 AKDT, automated, wind from 200° at 5 knots, 10 miles visibility or greater, overcast ceiling at 2,900 ft agl, temperature of 3° C, dew point temperature of 1° C, and an altimeter setting of 29.67 inches of mercury. Remarks: automated station with a precipitation discriminator, rain began at 1433 AKDT, rain ended at 1451 AKDT, sea level pressure 1005.4 hPa, a trace of precipitation since 1356 AKDT, temperature 3.3° C, dew point temperature 0.6° C.

PADM weather observation at 1556 AKDT, automated, wind calm, 10 miles visibility or greater, overcast ceiling at 2,700 ft agl, temperature of 3° C, dew point temperature of 0° C, and an altimeter setting of 29.66 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure 1005.3 hPa, 6-hourly precipitation of a trace, temperature 3.3° C, dew point temperature 0.0° C, 6-hourly maximum temperature of 4.4° C, 6-hourly minimum temperature of -2.8° C, 3-hourly pressure increase of 0.1 hPa.

The observations from PARS and PADM surrounding the accident time indicated mainly MVFR⁶ conditions with brief LIFR⁷ conditions at PARS with a ceiling at 300 ft agl with the rain shower activity moving from southwest to northeast across the area (section 5.4) between 1403 and 1413 AKDT. Only trace amounts of precipitation were observed with the rain shower activity around the accident time.

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 ft agl and/or 3 to 5 miles visibility.

⁷ Low Instrument Flight Rules (LIFR) – Refers to the general weather conditions pilots can expect at the surface. LIFR criteria means a ceiling below 500 ft agl and/or less than 1 mile visibility.

3.0 Upper Air Data

A Global Data Assimilation System (GDAS) computer model upper air sounding for the accident site was generated for 1300 AKDT with the upper air sounding base elevation at 466 ft. The 1300 AKDT sounding was plotted on a standard Skew-T log P diagram⁸ with the derived stability parameters included in figure 4 (with data from the surface to 600-hPa, or ~14,000 ft msl.) This sounding data was analyzed utilizing the RAOB⁹ software package. The sounding depicted the lifted condensation level (LCL)¹⁰ at 2,105 ft msl and a convective condensation level (CCL)¹¹ of 3,341 ft. The freezing level was located at 1,433 ft. The precipitable water value was 0.31 inches.

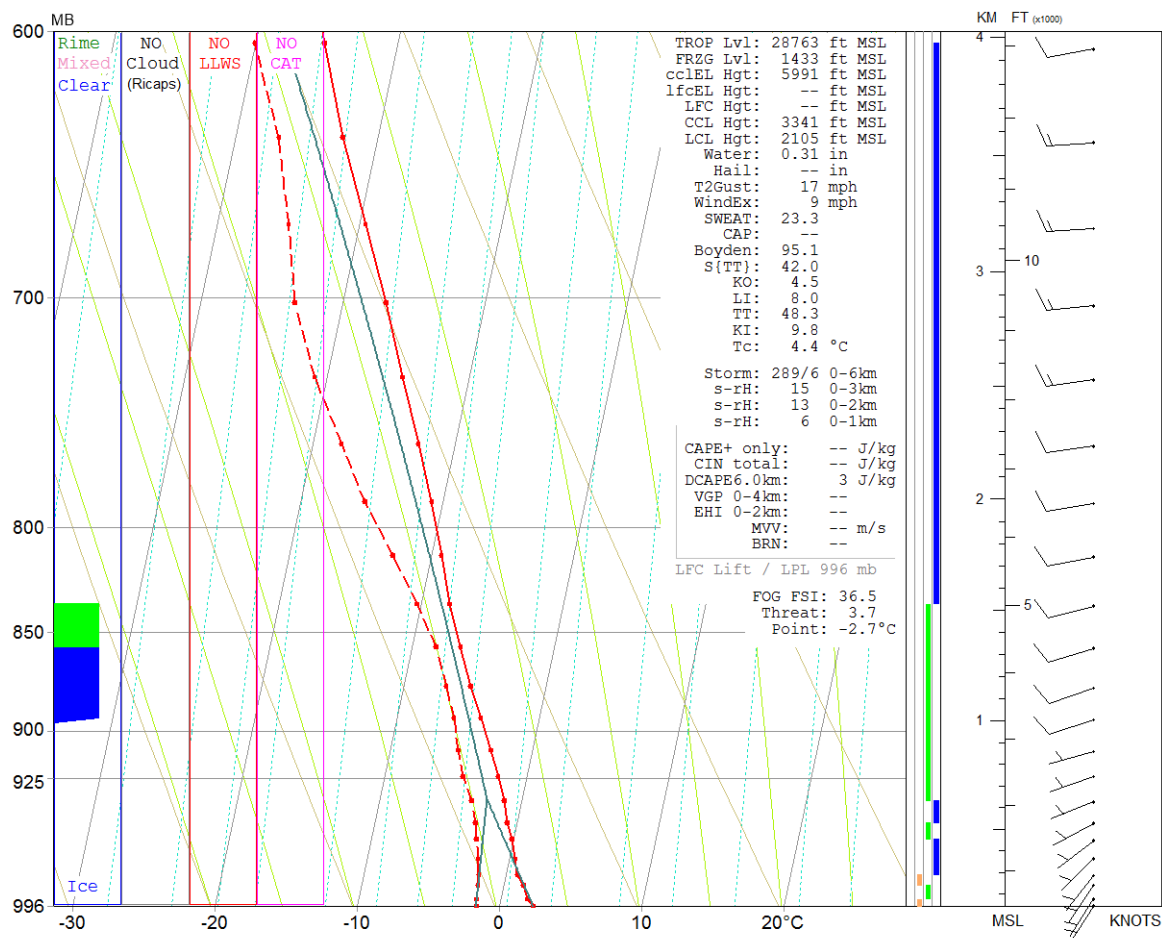


Figure 4 – 1300 AKDT GDAS sounding

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 1300 AKDT GDAS sounding indicated a mostly conditionally unstable layer between the surface and 5,000 ft. Between 5,000 and 14,000 ft the atmosphere was stable. Rain shower activity was visible on the weather radar imagery (section 5.4), and precipitation fell at both of the closest official surface reporting stations (section 2.0) at the accident time. RAOB did not indicate that clouds were likely from the surface through 14,000 ft. Icing conditions were indicated by RAOB between 3,000 and 5,000 ft.

The 1300 AKDT GDAS sounding wind profile indicated a surface wind from 210° at 4 knots with the wind becoming westerly by 14,000 ft. The wind speed increased from 5 to 10 knots below 5,000 ft to a west wind between 10 and 15 knots at 14,000 ft. RAOB did not indicate the possibility of any low-level wind shear or turbulence.

4.0 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 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-15 bands 1 and 4) at wavelengths of 0.65 microns (μm) and 10.7 μm , respectively, were retrieved. Satellite imagery surrounding the time of the accident from 1200 AKDT through 1700 AKDT, at approximately 15-minute intervals were reviewed, and the closest images to the time of the accident were documented.

Figures 5 and 6 present the GOES-15 visible imagery from 1430 and 1445 AKDT at 2X magnification with the accident site highlighted with a red square. Inspection of the visible imagery indicated scattered cumuliform cloud cover over the accident site at the accident time.

Figure 7 presents the GOES-15 infrared imagery from 1430 AKDT at 6X magnification with the accident site highlighted with a red square. Inspection of the infrared imagery indicated cloud cover over the accident site at the accident time. The lower brightness temperatures (green and blue colors, higher cloud tops) were located over the Aleutian Island Chain. The brightness temperature above the accident site at the accident time was -5°C and with the vertical temperature profile provided by the 1300 AKDT GDAS sounding, the approximate cloud-top heights over the accident site would have been 4,000 ft. It should be noted these figures have not been corrected for any parallax error.

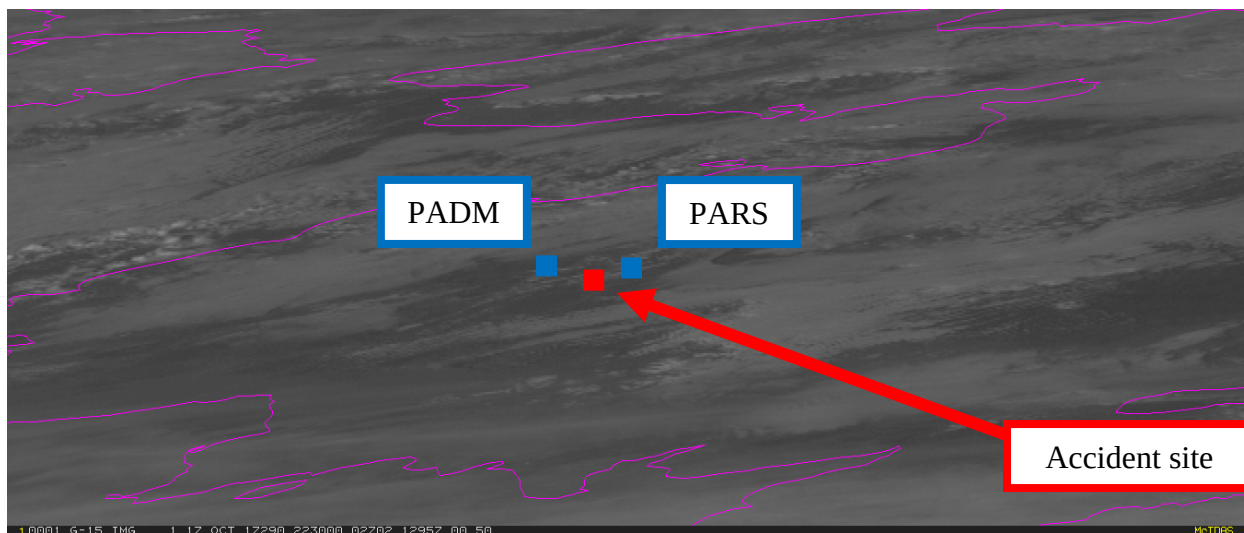


Figure 5 – GOES-15 visible image at 1430 AKDT

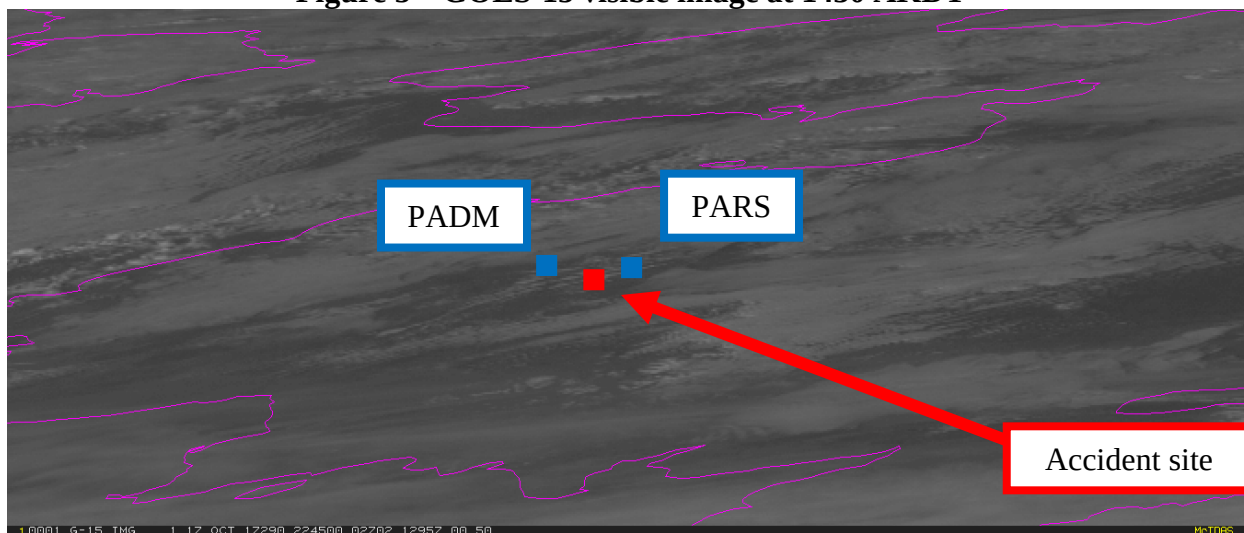


Figure 6 – GOES-15 visible image at 1445 AKDT

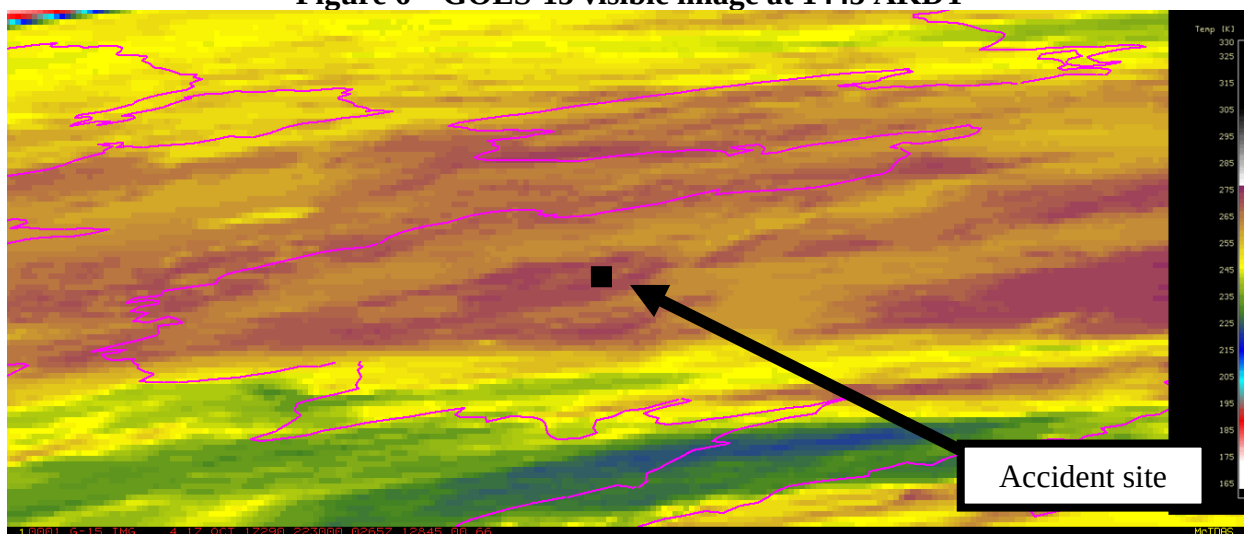


Figure 7 – GOES-15 infrared image at 1430 AKDT

5.0 Radar Imagery Information

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)¹² was from near Bethel, Alaska (PABC), located 52 miles south-southwest of the accident site with an antenna elevation of 162 ft. Level II archive radar data was obtained from the NCDC using the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software.

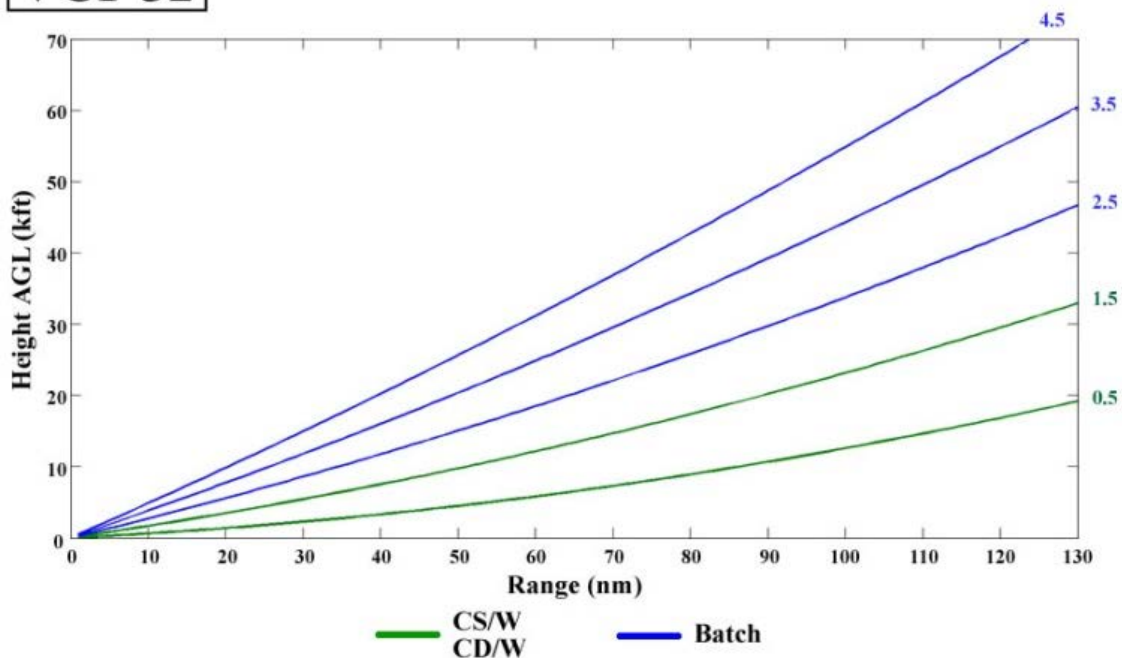
5.1 Volume Scan Strategy

The WSR-88D is a computer-controlled radar system, which automatically creates a complete series of specific scans in a specific sequence known as a volume scan. Individual elevation scans are immediately available on the WSR-88D's Principle Users Processor (PUP). Products that require data from multiple elevation scans are not available until the end of the five to ten-minute volume scan.

The WSR-88D operates in several different scanning modes, identified as Mode A and Mode B. Mode A is the precipitation scan and has two common scanning strategies. The most common is where the radar makes 9 elevation scans from 0.5° to 19.5° about every six minutes. This particular scanning strategy is documented as volume coverage pattern 221 (VCP-221). Mode B is the clear-air mode, where the radar makes 5 elevation scans during a ten-minute period, and is documented as volume coverage pattern 32 (VCP-32). During the period surrounding the accident, the PABC WSR-88D radar was operating in the clear-air mode (Mode B, VCP-32). The following chart provides an indication of the different elevation angles in this VCP, and the approximate height and width of the radar beam with distance from the radar site.

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.

VCP 32



VCP-32 Clear-air Mode Scan Strategy

5.2 Beam Height Calculation

Assuming standard refraction¹³ of the WSR-88D 0.95° wide radar beam, the following table shows the approximate beam height and width¹⁴ information¹⁵ of the radar display over the site of the accident. The heights have been rounded to the nearest 10 ft.

ANTENNA ELEVATION	BEAM CENTER	BEAM BASE	BEAM TOP	BEAM WIDTH
0.5°	4,870 ft	2,310 ft	7,430 ft	5,120 ft

Based on the beam heights, the 0.5° elevation scan depicted the conditions between 2,310 ft and 7,430 ft msl above the accident site.

¹³ Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

¹⁴ Beam width – A measure of the angular width of a radar beam.

¹⁵ Beamwidth values are shown for legacy resolution products. Super resolution products would have an effective beamwidth that would be approximately half these values.

5.3 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors¹⁶ it is a function of the drop size distribution, number of particles per unit volume, physical state (ice or water), shape, and aspect. Reflectivity is normally displayed in decibels (dBZ¹⁷), and is a general measure of echo intensity. FAA Advisory Circular AC 00-24C, “Thunderstorms,” dated February 19, 2013, also defines the echo intensity levels and weather radar echo intensity terminology associated with those levels. For dBZ values less than 30 the weather radar echo intensity terminology should be “light.” For dBZ values between 30 and 40, the terminology should be “moderate.” “Heavy” terminology is used for dBZ values greater than 40 dBZ but less than 50 dBZ, inclusive. Finally, any dBZ values above 50 dBZ shall be described as “extreme.” From the NWS, precipitation conditions at the surface can be inferred from VIP Levels described in the chart below:

- VIP 1 (Level 1, 18-30 dBZ) - Light precipitation
- VIP 2 (Level 2, 30-38 dBZ) - Light to moderate rain.
- VIP 3 (Level 3, 38-44 dBZ) - Moderate to heavy rain.
- VIP 4 (Level 4, 44-50 dBZ) - Heavy rain
- VIP 5 (Level 5, 50-57 dBZ) - Very heavy rain; hail possible.
- VIP 6 (Level 6, >57 dBZ) - Very heavy rain and hail; large hail possible.

5.4 Base Reflectivity

Figures 8, 9, and 10 present the PABC WSR-88D base reflectivity images for the 0.5° elevation scans initiated at 1422, 1432, and 1441 AKDT with a resolution of 0.5° X 250 m. There were 5 to 15 dBZ reflectivity targets above the accident site at 1422 and 1432 AKDT (figures 8 and 9) with those dBZ targets and associated rain shower activity moving to the northeast of the accident site by 1441 AKDT (figure 10). The area of rain showers was moving from southwest to northeast with time and moved over and past the accident site between 1402 and 1442 AKDT (attachment 1). There were no lightning strikes at or near the accident site at the accident time.¹⁸

¹⁶ Hydrometeors are any product of condensation or sublimation of atmospheric water vapor, whether formed in the free atmosphere or at the earth’s surface; also, any water particles blown by the wind from the earth’s surface. Hydrometeors are classified as; (a) Liquid or solid water particles suspended in the air: cloud, water droplets, mist or fog. (b) Liquid precipitation: drizzle and rain. (c) Freezing precipitation: freezing drizzle and freezing rain. (d) Solid (frozen) precipitation: ice pellets, hail, snow, snow pellets, and ice crystals. (e) Falling particles that evaporate before reaching the ground: virga. (f) Liquid or solid water particles lifted by the wind from the earth’s surface: drifting snow, blowing snow, blowing spray. (g) Liquid or solid deposits on exposed objects: dew, frost, rime, and glazed ice.

¹⁷ 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.

¹⁸ A review of Earth Networks Total Lightning network was done.

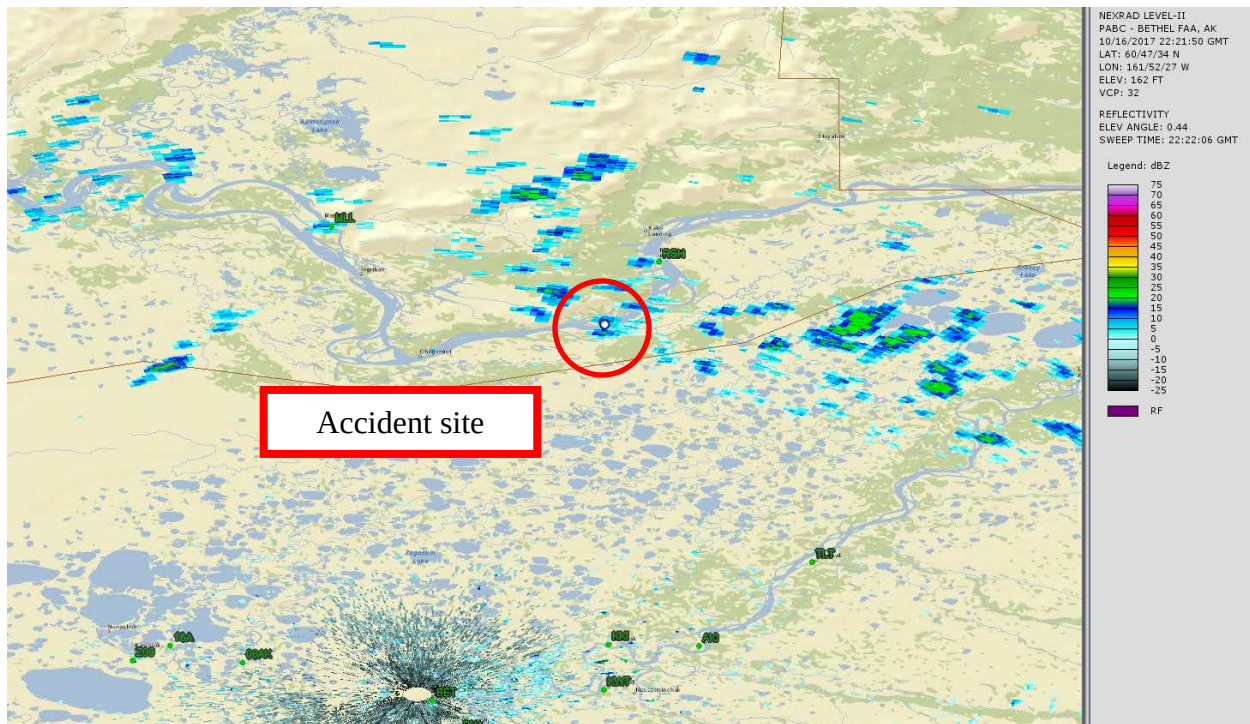


Figure 8 – PABC WSR-88D reflectivity for the 0.5° elevation scan initiated at 1422 AKDT

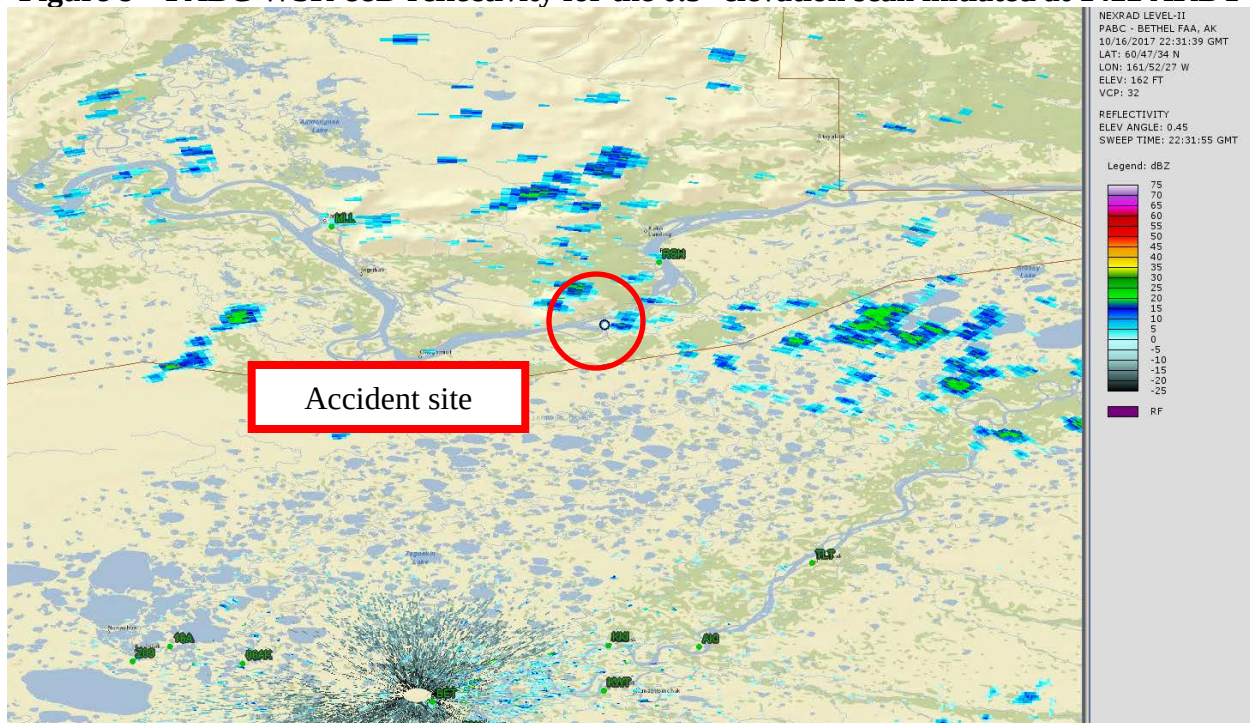


Figure 9 – PABC WSR-88D reflectivity for the 0.5° elevation scan initiated at 1432 AKDT

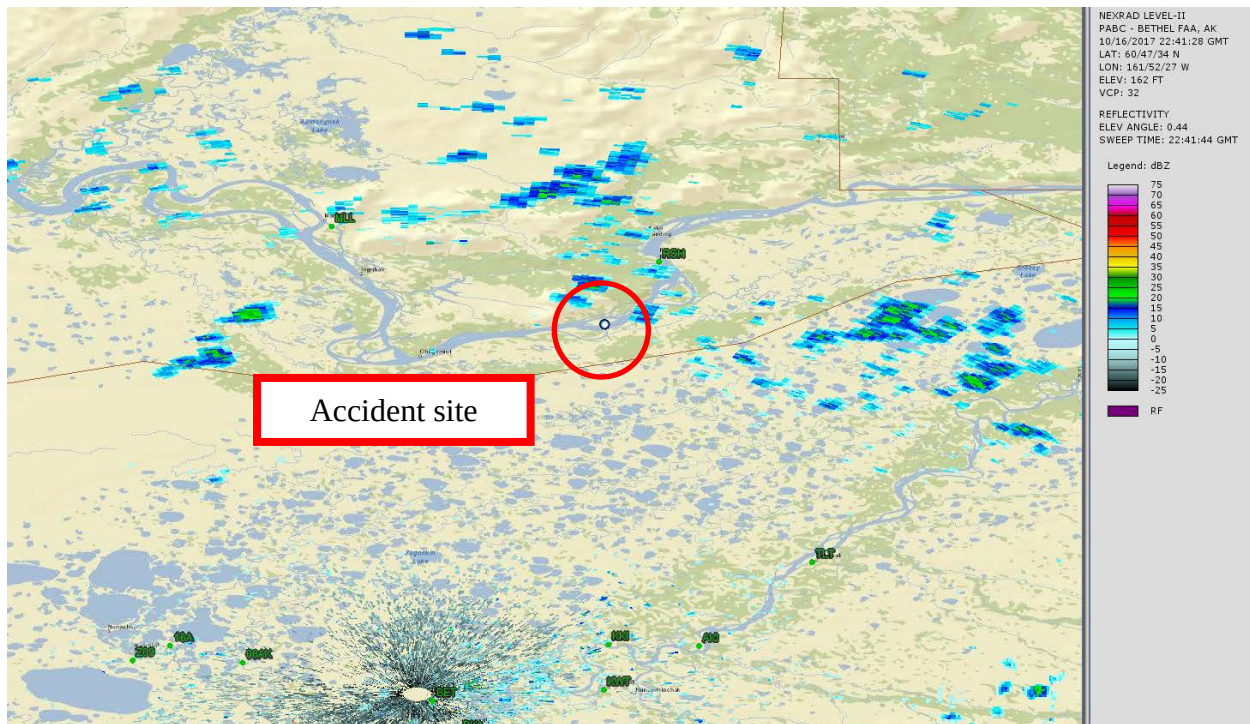


Figure 10 – PABC WSR-88D reflectivity for the 0.5° elevation scan initiated at 1441 AKDT

6.0 Pilot Reports¹⁹

All pilot reports (PIREPs) for the state of Alaska from about three hours prior to the accident time to about three hours after the accident time were reviewed. The only PIREP for below FL180²⁰ and within 200 miles of the accident site is provided below in raw code and decoded:

ANI UA /OV ANI/TM 2312/FL040/TP C208/SK OVC007 /TOP040/TA M04/IC LGT RIME/RM ZAN=

Routine pilot report (UA); Over Aniak, Alaska; Time – 1512 AKDT (2312Z); Altitude – 4,000 ft; Type aircraft – Cessna 208; Sky – Overcast ceiling at 700 ft with tops at 4,000 ft; Temperature – -4° C; Icing – Light rime; Remarks – Taken by Anchorage Air Route Traffic Control Center (ZAN).

7.0 SIGMET and CWSU Advisories

No SIGMETs valid for the accident site at the accident time.

No Center Weather Service Unit (CWSU) Center Weather Advisories (CWA)s were valid for the accident site at the accident time. No CWSU Meteorological Impact Statements (MIS)s were valid for the accident site at the accident time.

¹⁹ Only pilot reports with the WMO header UBAK** identifier were considered.

²⁰ Flight Level – A Flight Level (FL) is a standard nominal altitude of an aircraft, in hundreds of ft. 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.

8.0 AIRMETs

The Alaska Aviation Weather Unit (AAWU) issued AIRMET Sierra at 1206 AKDT for IFR conditions along the Yukon Valley with ceilings below 1,000 ft agl and visibilities below 1 mile. Improving ceiling and visibility conditions were forecast into the evening hours (figure 11):

```
WAAK48 PAWU 162006
WA80
ANCS WA 162015
AIRMET SIERRA FOR IFR AND MT OBSC VALID UNTIL 170415
.
COPPER RIVER BASIN AC
MTS OCNL OBSC IN CLDS/SHSN. NC.
.
KUSKOKWIM VLY AF
MTS OCNL OBSC CLDS. NC.
.
YKN-KUSKOKWIM DELTA AG
ALG YUKON VLY CIG BLW 010/VIS BLW 1SM BR. IMPR.
.
BRISTOL BAY AH
ALUTN MTS OCNL OBSC IN CLDS. NC.
.
AK PEN AI
MTS OCNL OBSC IN CLDS/PCPN. NC.
.
UNIMAK PASS TO ADAK AJ
SPRDG E TO PAKO MTS OBSC IN CLDS/PCPN. DTRT.
.
ADAK TO ATTU AK
W AMCHITKA SPRDG E MTS OBSC IN CLDS/PCPN. DTRT.
.
=ANCT WA 162015
AIRMET TANGO FOR TURB/STG SFC WINDS VALID UNTIL 170415
.
AK PEN AI
TIL 05Z PASD W OCNL MOD TURB FL280-FL360. WKN.
.
UNIMAK PASS TO ADAK AJ
W PAAK SUSTAINED SFC WINDS 30KT. NC.
.
UNIMAK PASS TO ADAK AJ
TIL 05Z PAKO E OCNL MOD TURB FL280-FL360. WKN.
.
ADAK TO ATTU AK
VCY KISKA E SPRDG E SUSTAINED SFC WINDS 30KT. DTRT.
```

Figure 11 – AIRMET valid at the accident time

9.0 AAWU Graphics

The AAWU icing forecast, flying weather, low-level turbulence, and surface chart forecast graphics valid around the accident time are provided in figures 12 through 15. The AAWU graphics depicted that no icing or turbulence conditions were forecast around the accident time for the accident area (figures 12 and 14). The accident site was located in an area of forecast IFR conditions with MVFR conditions forecast for most of the rest of southwestern Alaska (figure 13). The AAWU surface chart valid at 1600 KDT (figure 15) forecast areas of fog for the accident site and most of the rest of southwestern Alaska.

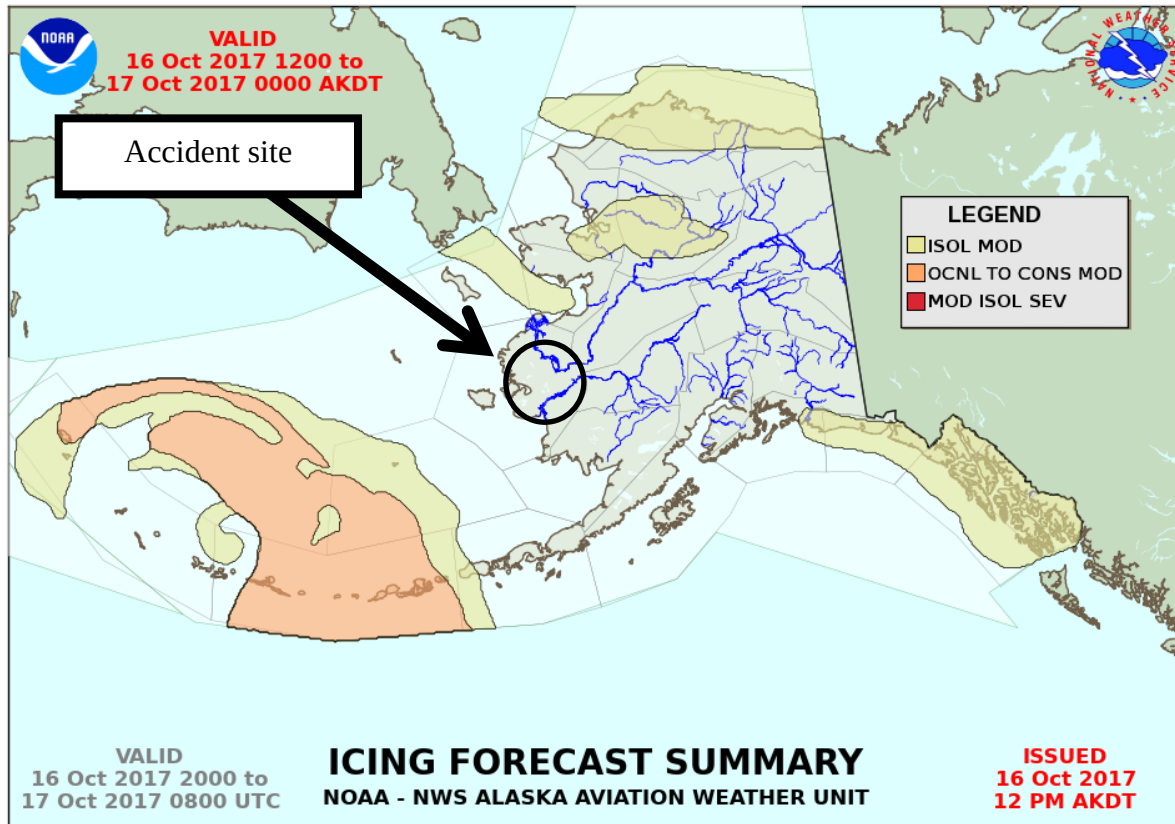


Figure 12 – Icing Forecast Summary graphic from the AAWU valid between 1200 AKDT on October 16 and 0000 AKDT on October 17 and graphic was issued at 1200 AKDT on October 16

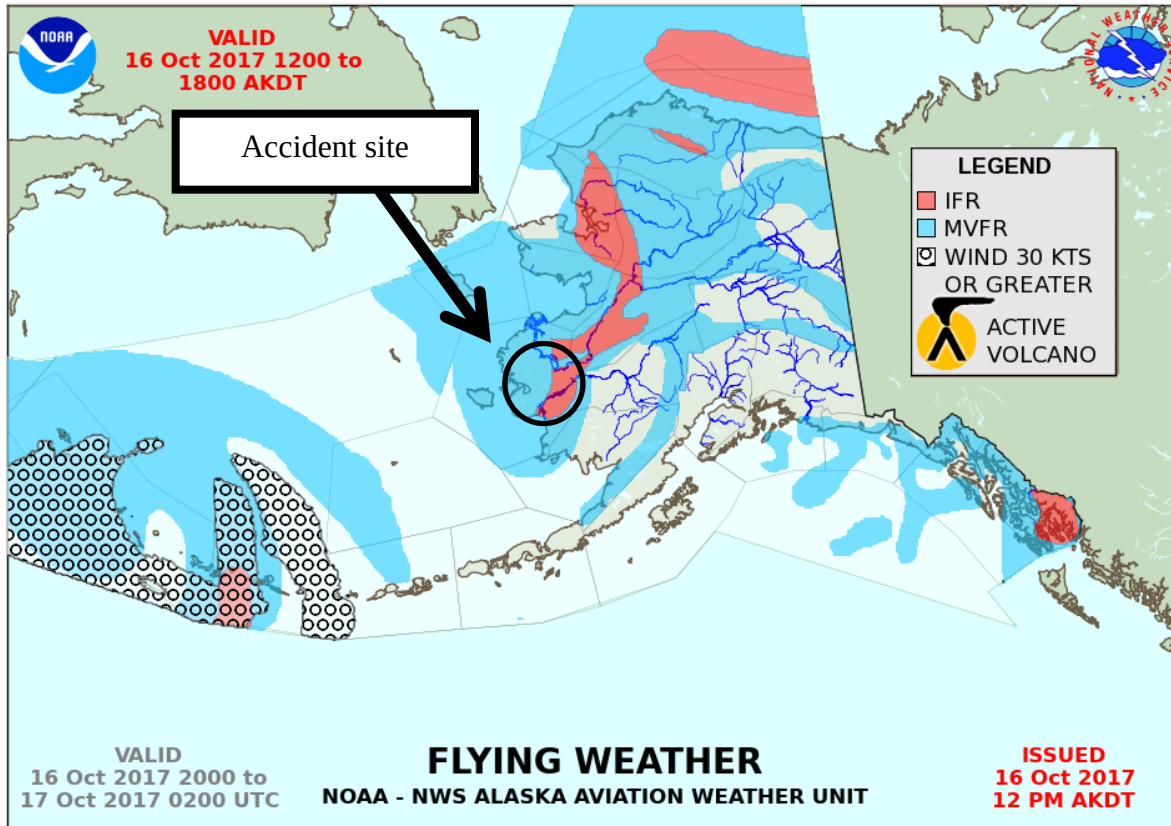


Figure 13 – Flying Weather graphic from the AAWU valid between 1200 and 1800 AKDT and graphic was issued at 1200 AKDT

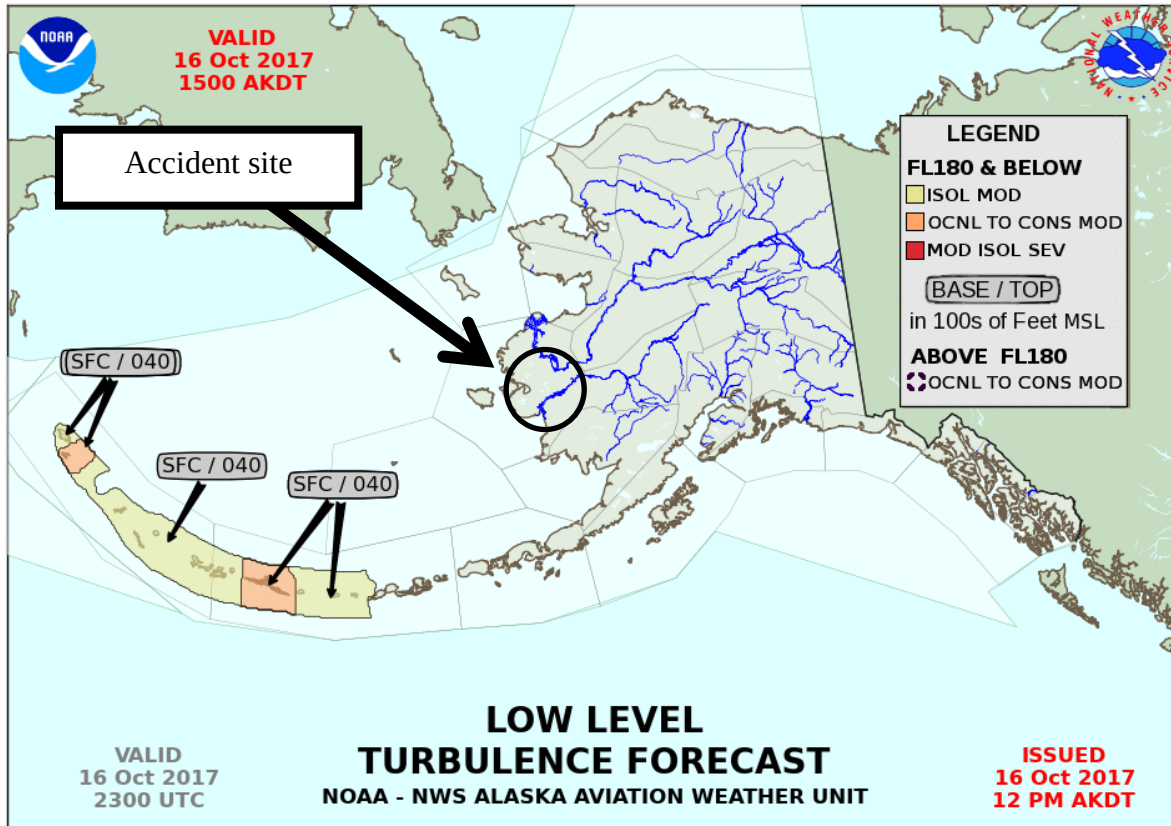


Figure 14 – Low-Level Turbulence Forecast graphic from the AAWU valid at 1500 AKDT and graphic was issued at 1200 AKDT

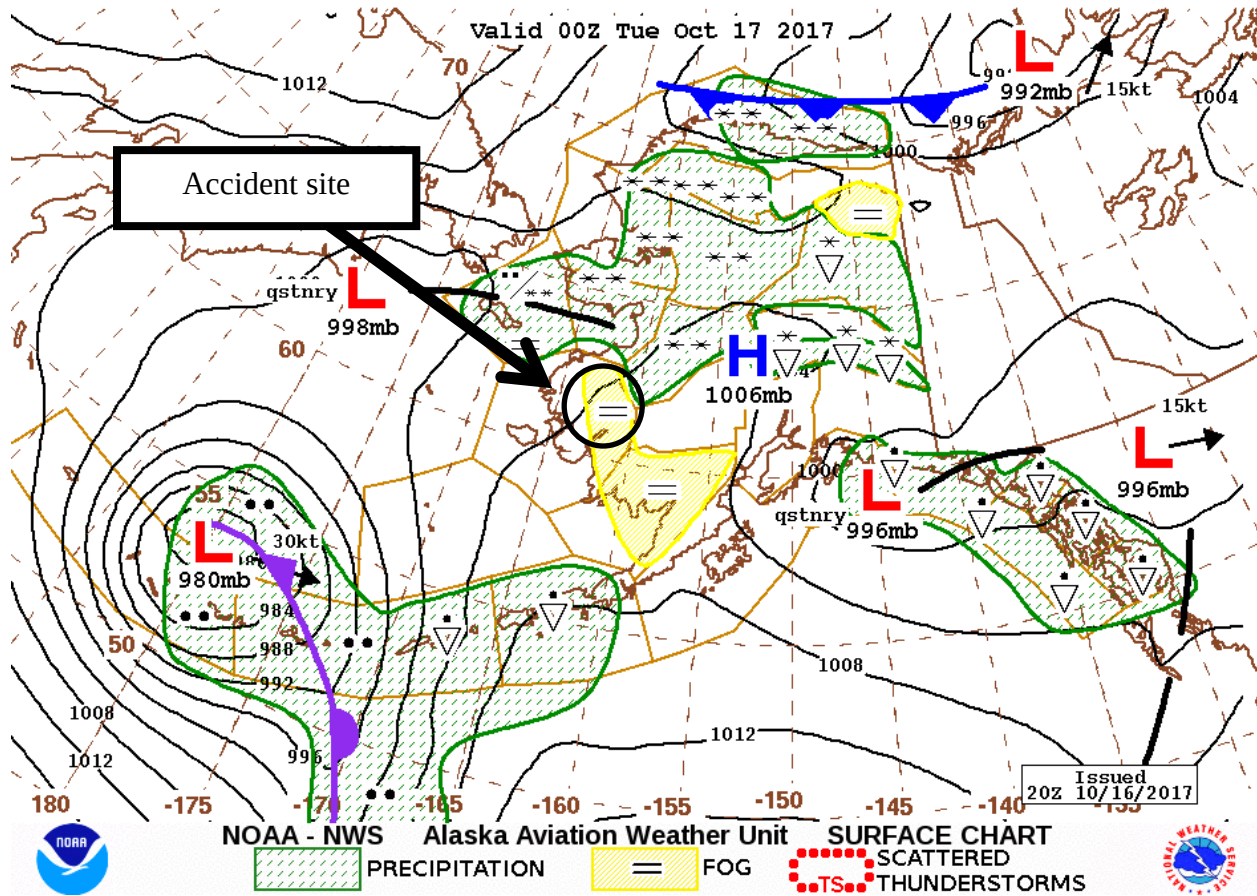


Figure 15 – AAWU Surface Chart valid at 1600 AKDT and graphic was issued at 1200 AKDT

10.0 Area Forecast

The Area Forecast issued at 1206 AKDT, and valid at the accident time, indicated that AIRMET for IFR conditions was current (section 8.0), broken to overcast ceiling at 300 ft with cloud tops at 10,000 ft and visibilities below 1 mile in mist with improving conditions forecast into the afternoon and evening hours (figure 16):

```

FAAK58 PAWU 162006
FA8W
ANCC FA 162015
AK SRN HLF EXCP SE AK...
.
AIRMETS VALID UNTIL 170415
CB IMPLY POSSIBLE SEV OR GREATER TURB SEV ICE LLWS AND IFR CONDS.
NON MSL HEIGHTS NOTED BY AGL OR CIG.
.
KUSKOKWIM VLY AF...VALID UNTIL 170800
...CLOUDS/WX...
***AIRMET MT OBSC***MTS OCNL OBSC CLDS. NC...
FEW003 BKN045 TOP 100 FEW LYRS ABV. VCY PANI ISOL CIGS BLW 010/VSBY
BLW 1SM FZFG.
OTLK VALID 170800-171400...VFR.
...TURB...
NIL SIG.
...ICE AND FZLVL...
NIL SIG. FZLVL BLW 010.
.
YKN-KUSKOKWIM DELTA AG...VALID UNTIL 170800
...CLOUDS/WX...
***AIRMET IFR***ALG YUKON VLY CIG BLW 010/VIS BLW 1SM BR. IMPR...
ALG YUKON VLY BKN-OVC003 TOP 100/VIS BLW 1SM BR.
ELSW SCT020 BKN040 BKN100. ISOL OVC020 5SM -SHSN BR.
OTLK VALID 170800-171400...VFR.
...TURB...
NIL SIG.
...ICE AND FZLVL...
NIL SIG. FZLVL 015.
.
BRISTOL BAY AH...VALID UNTIL 170800
...CLOUDS/WX...
***AIRMET MT OBSC***ALUTN MTS OCNL OBSC IN CLDS. NC...
VCY PAKN OVC002 TOP 100 VIS BLW 1SM BR. OCNL SCT002 BKN015 4SM BR.
ELSW SCT015 BKN030 TOP 100. OCNL BKN-OVC015 5SM BR.
OTLK VALID 170800-171400...ALUTN MTS MVFR CIG. ELSW VFR.
ELSW VFR.

```

Figure 16 – Area Forecast valid at the accident time

11.0 Terminal Aerodrome Forecast

Bethel Airport, (PABE), located 53 miles south-southwest of the accident was the closest site with a NWS Terminal Aerodrome Forecast (TAF) as well as being the intended destination location. The TAF valid at the time of the accident was issued at 1259 AKDT and was valid for a 21-hour period beginning at 1300 AKDT. The TAF for PABE was as follows:

```

PABE 162059Z 1621/1718 19006KT 3/4SM BR VV002
TEMPO 1621/1622 P6SM NSW FEW002 SCT045
FM162200 18006KT P6SM BKN045
FM170800 07007KT P6SM FEW045=

```

The forecast valid for 1400 AKDT and beyond expected a wind from 180° at 6 knots, greater than 6 miles visibility, and a broken ceiling at 4,500 ft agl.

12.0 NWS Area Forecast Discussion

The NWS Office in Anchorage, Alaska, issued the following Area Forecast Discussion (AFD) at 0846 AKDT (closest AFD to the accident time). The AFD discussed isolated to scattered rain showers continuing along the western coast of Alaska through the evening hours:

FXAK68 PAFC 161246
AFDAFC

Southcentral and Southwest Alaska Forecast Discussion
National Weather Service Anchorage AK
446 AM AKDT Mon Oct 16 2017

.ANALYSIS AND UPPER LEVELS...

The remnants of an upper low is over the Kenai Peninsula with a weak ridge over southwest Alaska. There are some lingering showers over Prince William Sound and the Gulf Of Alaska. The circulation of the vortex is discernible from the Middleton Island radar this morning. There is an upper level low over the northwest Bering Sea. The jet stream over the northern Pacific continues to barrel across the region. There is a weak shortwave over the central/western Aleutians moving rapidly eastward.

&&

.MODEL DISCUSSION...

For the first 24 hr period, the mass fields amongst the NAM/GFS/ECMWF/GEM are similar. As time elapses, the model consensus quickly erodes. Compounding the magnitude of the uncertainty is the fact that the run to run continuity with both the GFS and the NAM has been below average. The focal point for this morass is the low that moves over the Aleutians on Tuesday. The ECMWF brings the track of the low more to the south, while the Canadian GEM and the GFS are both pinging into a more northerly track. Additionally, the pace of the storms motion and the possible development of a triple point low are at stake. While there is high confidence of another low impacting the North Pacific and Gulf of Alaska early this week, there is still some degree of uncertainty about the evolution and the morphology of the low itself.

&&

.AVIATION...

PANC...VFR conditions and light winds will persist.

&&

.SHORT TERM FORECAST SOUTHCENTRAL ALASKA (Days 1 and 2)...

Partly cloudy to mostly clear skies and cold northerly flow continue across the mainland will continue through the middle of the week. A weak vertically stacked low near Middleton Island is

spreading bands of clouds across most of Southcentral Alaska, but shower activity is confined largely to the north Gulf coast. This low will drift eastward through tonight, allowing cloudiness to gradually diminish across most of the forecast area. Gusty offshore winds will continue around Prince William Sound, with lighter winds and colder temperatures inland. With clearing skies, each night is still expected to be a few degrees cooler than the previous, as a cooler airmass continues to move into the area from the north. There has been a bit of a shift in the models in regards to a low moving into the southern Gulf on Tuesday afternoon. The general trend has been for a slightly stronger and more northerly track. Thus the morning forecast reflects a bit more in the way of wind and weather from Kodiak through the offshore zones. Nevertheless, even with this new trend, the only impact for the southern mainland will probably be a renewed push of offshore (northerly) winds by midweek, with plenty of sunshine to go around.

&&

.SHORT TERM FORECAST SOUTHWEST ALASKA (Days 1 through 3)...

Isolated to scattered rain showers will continue along the western coast of Alaska through this evening as an area of low pressure over the Gulf of Anadyr continues to pump moisture toward Southwest Alaska. As the low pressure system continues to dissipate this evening, the influx of moisture will likely come to an end and colder air out of the arctic will descend across Southwest Alaska. The jet stream will remain well south of Southwest Alaska which will keep any low pressure systems that develop over the northern Pacific Ocean will quickly be shunted into the Gulf of Alaska and away from region. Temperatures will gradually cool off several degrees over the next several days to more seasonable temperatures.

&&

.SHORT TERM FORECAST BERING SEA/ALEUTIANS (Days 1 through 3)...

An active pattern will be observed along the Aleutian Islands and southern Bering Sea over the next several days as the jet stream over the northern Pacific Ocean will spin up multiple low pressure systems. The first system is an area of low pressure currently located near Shemya. Based on Satellite imagery, the low is in the process of intensifying and will track just north of the western and central Aleutians throughout the day. By tonight, a potent triple point low looks to spin up not too far from Dutch Harbor but models are struggling very much with this feature. It's tough to tell how much impact on winds this feature will have but based on the jet stream, it looks like the triple point low will quickly become the dominant low with the low currently near Shemya fizzling out. Storm force winds and possibly a lightning strike or two will be possible this afternoon on the back side of the low. This complex system will quickly move into the Gulf of Alaska late Tuesday night with multiple low centers as triple point lows continue to form along the frontal boundary. A separate frontal

boundary will enter the western Bering Sea Wednesday afternoon but this one should be much weaker than the system currently pushing through the western Bering Sea.

&&

.LONG TERM FORECAST (Days 3 through 7)...

The mid to long term forecast beginning Tuesday night shows an active storm track that will primarily stay south of the southern mainland. This will bring more rain and winds to the Aleutians through much of the week. There remains disagreement for the exact track and timing of the low that moves through late in the week but all guidance keeps it south of the southern mainland until the weekend. That would leave mainly dry and cold for the southern mainland until Saturday where there becomes a fair amount of uncertainty as to what the low will do as it moves toward the Gulf.

&&

.AFC WATCHES/WARNINGS/ADVISORIES...

PUBLIC...None.

MARINE...GALE 174 175 178 413. STORM 176 and 177.

&&

\$\$

13.0 Winds and Temperature Aloft Forecast

The NWS 1201 AKDT Winds and Temperature Aloft forecast valid for the closest points to the accident site are included below:

FBAK31 KWN0 162001

FD1AK1

DATA BASED ON 161800Z

VALID 170000Z FOR USE 2000-0300Z. TEMPS NEG ABV 24000

FT 3000 6000 9000 12000 18000 24000 30000 34000 39000

BET 2507 2509-10 2509-16 2611-24 2815-32 2823-43 283154 273254 273350

The accident site was closest to the Bethel, Alaska (BET) forecast point. The 1201 AKDT BET forecast indicated a wind from 250° at 7 knots at 3,000 ft, a wind from 250° at 9 knots at 6,000 ft with a temperature of -10° C, and a wind from 250° at 9 knots at 9,000 ft with a temperature of -16° C.

14.0 Pilot Weather Briefing

The accident pilot did not receive a weather briefing from the Alaska Flight Service Station (FSS) or any Direct User Access Terminal Service. An additional archive search of ForeFlight data revealed that the accident pilot also did not gather weather information from ForeFlight before or during the accident flight. It is unknown if the accident pilot checked or received any other weather information before or during the accident flight.

15.0 Witness Information

A pilot operating along the same route as the accident pilot, but 10 minutes ahead of the accident aircraft, reported that while at 1,500 ft along the Yukon River and near the accident site, he observed variable layers of clouds with 20 miles visibility. The pilot indicated he could see fog laying on the ground and fog on the hills and over the Yukon River. In the area of the accident site, the fog was thick with no holes visible.²¹

16.0 Web Camera Images

Images from the FAA's Aviation Weather Cameras are shown in figures 17 through 30 along with attachment 2 providing images of the weather conditions surrounding the accident site at the accident time. Figure 17 indicates the web camera locations included in attachment 2. The weather cameras (figures 18 through 26) from Russian Mission, located 9 miles north-northeast of the accident site at an elevation of 49 ft (figure 18), showed the weather conditions surrounding the accident time with the south and southwest facing camera images provided in figures 19 through 26 with times at 1419, 1420, 1429, 1430, 1439, and 1440 AKDT. The camera images depicted rain shower conditions with the rain showers moving across the area with lower ceiling and visibility conditions within the rain showers beyond the visibility reference point. The Russian Mission south facing camera also indicated a lower bank of clouds towards the Yukon River, the accident site, and along the intended route towards PABE (figures 20 through 22 and attachment 2).

The weather cameras (figures 27 through 30) from Marshall, located 22 miles northwest of the accident site at an elevation of 49 ft, showed the weather conditions surrounding the accident time with the east facing camera images provided in figures 28 through 30 with times at 1426 and 1436 AKDT. The east facing camera images from Marshall also depicted rain shower conditions with the rain showers moving across the area with lower ceiling and visibility conditions within the rain showers, again beyond the visibility reference points.

The weather camera observations, surface observations (section 2.0), and weather radar data (section 5.4), indicated the accident airplane likely encountered rain shower activity and reduced ceiling and visibility conditions at the accident time.

²¹ For more information please see the NTSB Record of Conversation located in the docket for this accident.



Figure 17 – Map of the closest FAA weather camera sites and the accident site

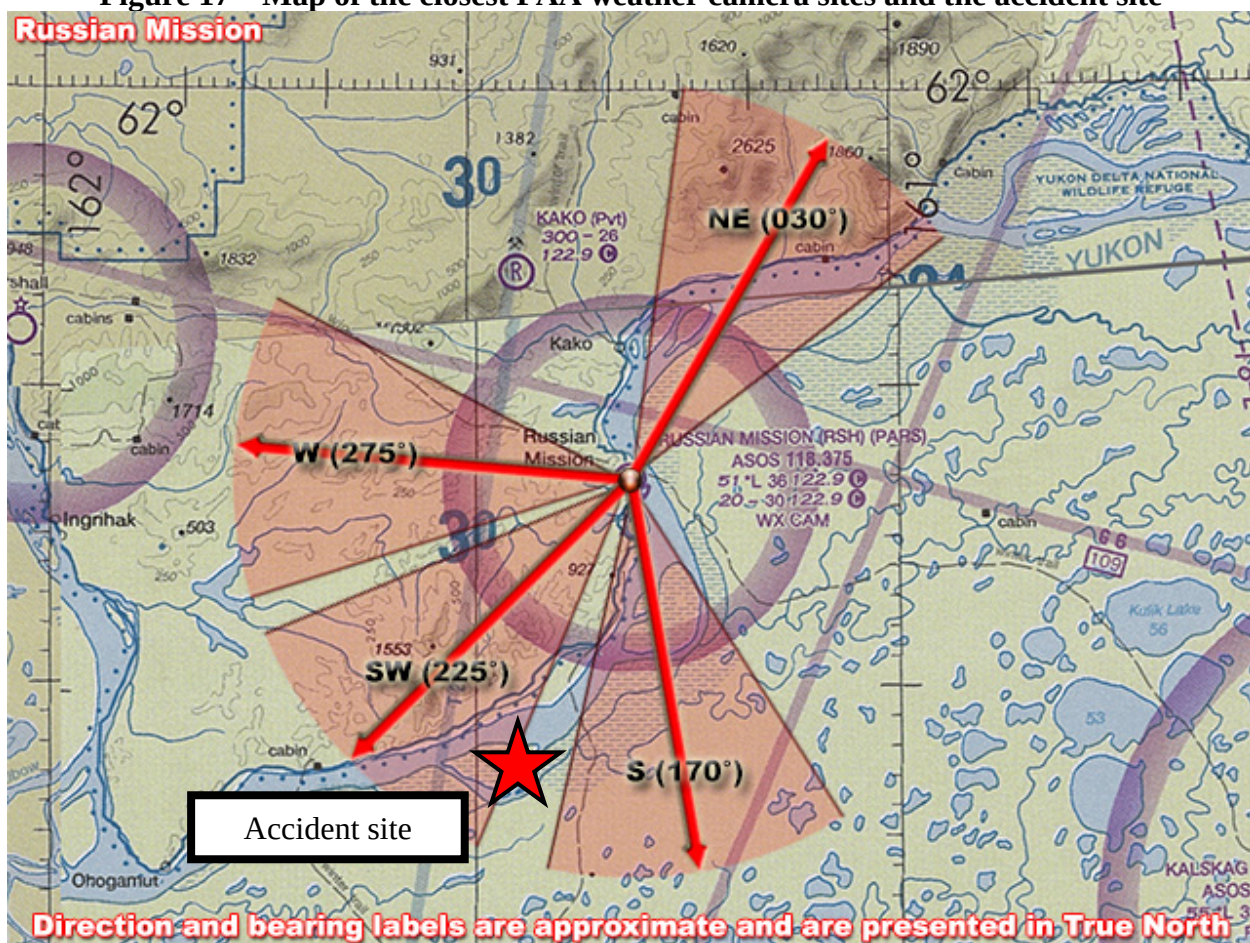


Figure 18 – FAA weather camera Russian Mission location on sectional chart with the direction the different camera angles face with the accident site marked

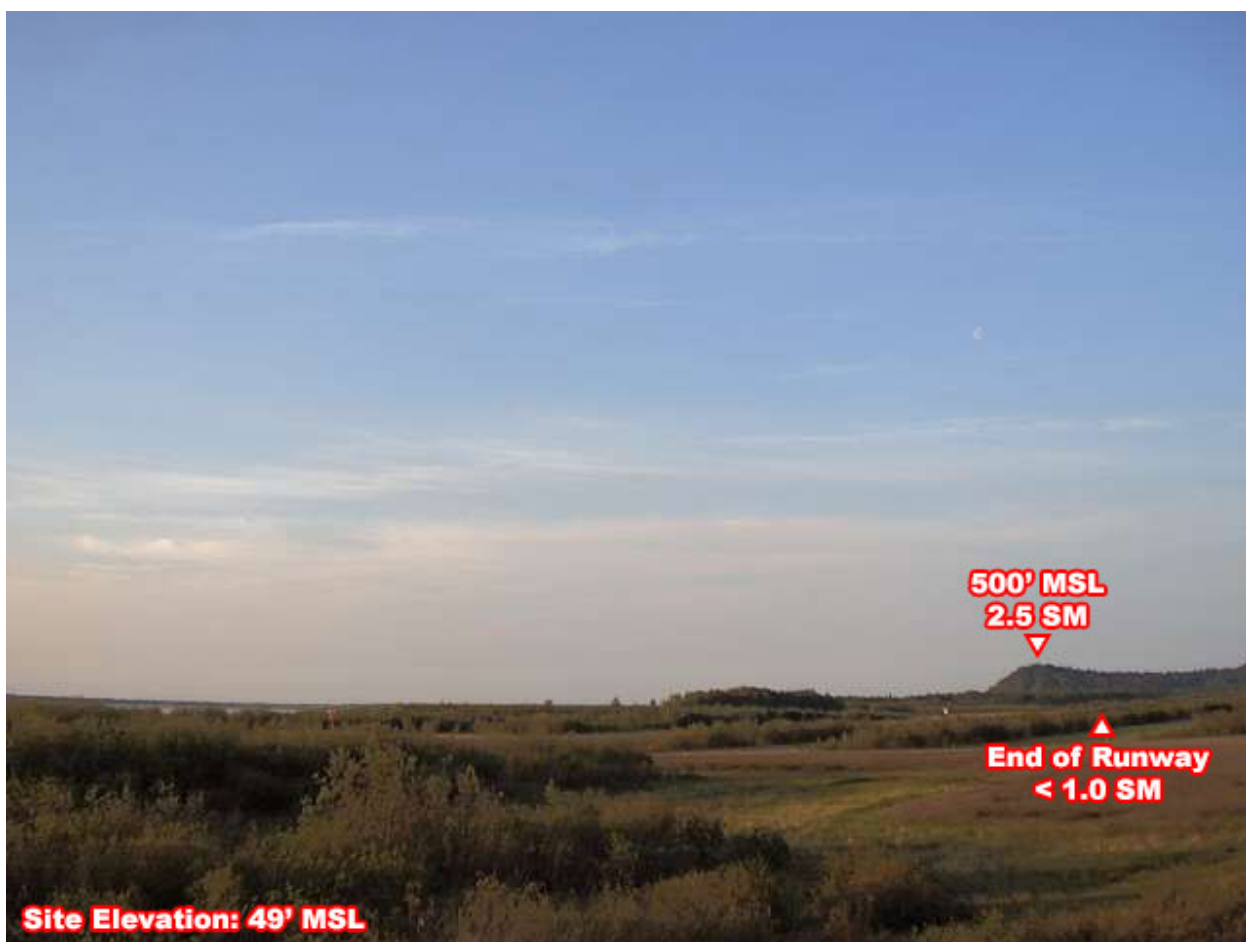


Figure 19 – FAA weather camera from Russian Mission south view from a standard clear sky weather day

Mon 16 Oct 2017 22:20:09 UTC
Mon 16 Oct 2017 14:20:09 AKDT

Russian Mission - South
See <http://avcams.faa.gov> for more information



Figure 20 – FAA weather camera from Russian Mission south view from 1420 AKDT

Mon 16 Oct 2017 22:30:22 UTC
Mon 16 Oct 2017 14:30:22 AKDT

Russian Mission - South
See <http://avcams.faa.gov> for more information



Figure 21 – FAA weather camera from Russian Mission south view from 1430 AKDT

Mon 16 Oct 2017 22:40:17 UTC
Mon 16 Oct 2017 14:40:17 AKDT

Russian Mission - South
See <http://avcams.faa.gov> for more information



Figure 22 – FAA weather camera from Russian Mission south view from 1440 AKDT

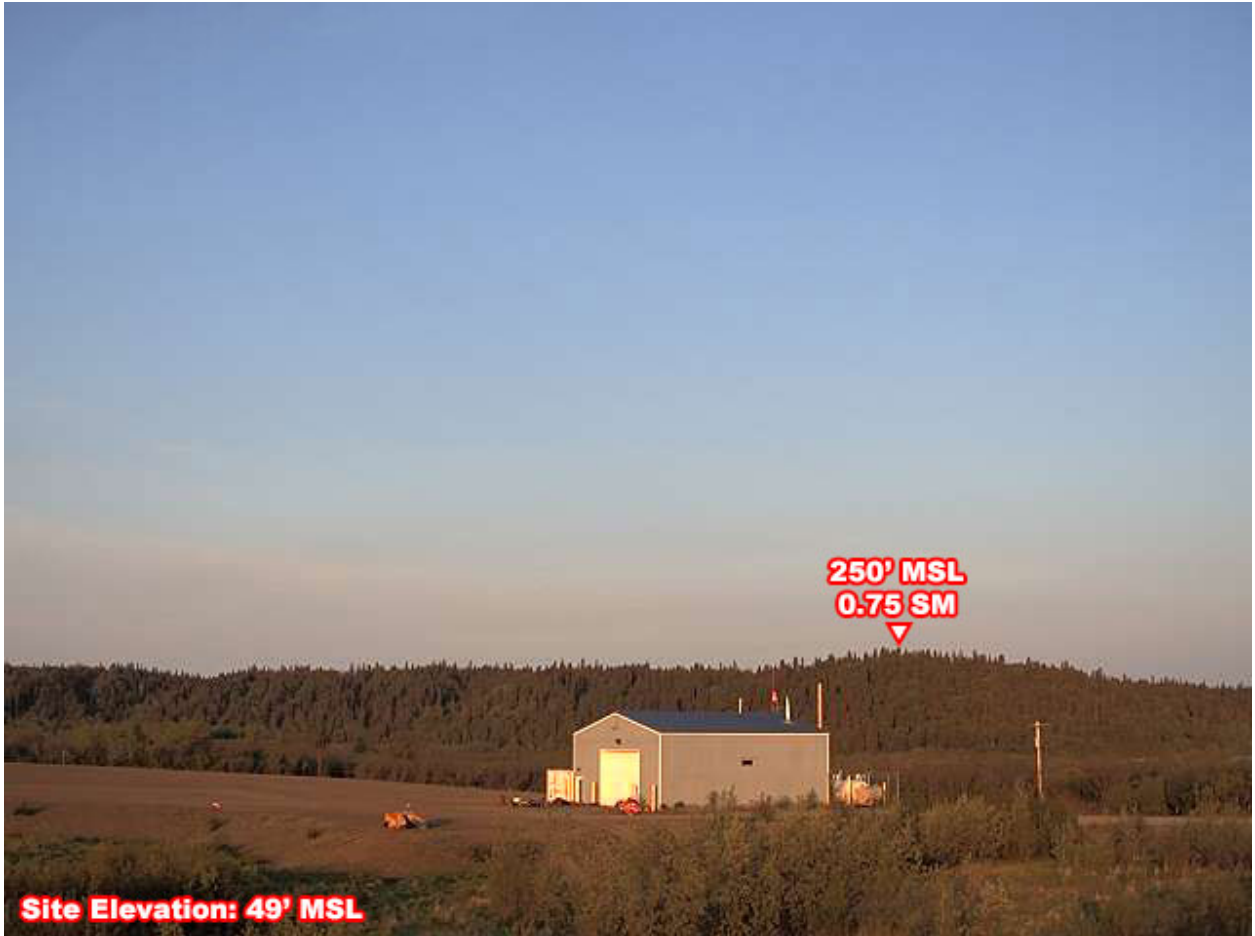


Figure 23 – FAA weather camera from Russian Mission southwest view from a standard clear sky weather day

Mon 16 Oct 2017 22:19:07 UTC
Mon 16 Oct 2017 14:19:07 AKDT

Russian Mission - SouthWest
See <http://avcams.faa.gov> for more information



Figure 24 – FAA weather camera from Russian Mission southwest view from 1419 AKDT

Mon 16 Oct 2017 22:29:08 UTC
Mon 16 Oct 2017 14:29:08 AKDT

Russian Mission - SouthWest
See <http://avcams.faa.gov> for more information



Figure 25 – FAA weather camera from Russian Mission southwest view from 1429 AKDT

Mon 16 Oct 2017 22:39:10 UTC
Mon 16 Oct 2017 14:39:10 AKDT

Russian Mission - SouthWest
See <http://avcams.faa.gov> for more information



Figure 26 – FAA weather camera from Russian Mission southwest view from 1439 AKDT

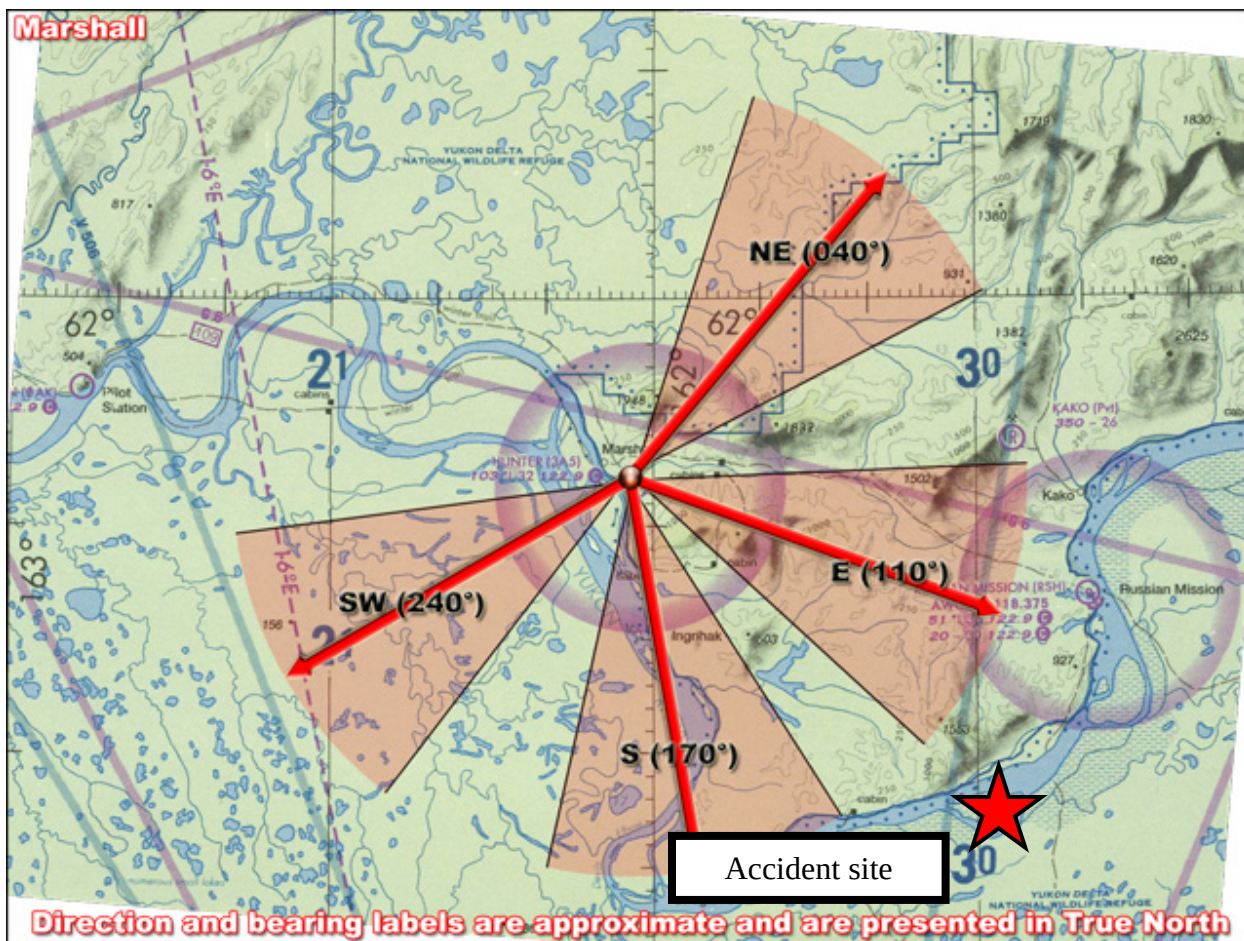


Figure 27 – FAA weather camera Marshall location on sectional chart with the direction the different camera angles face with the accident site marked

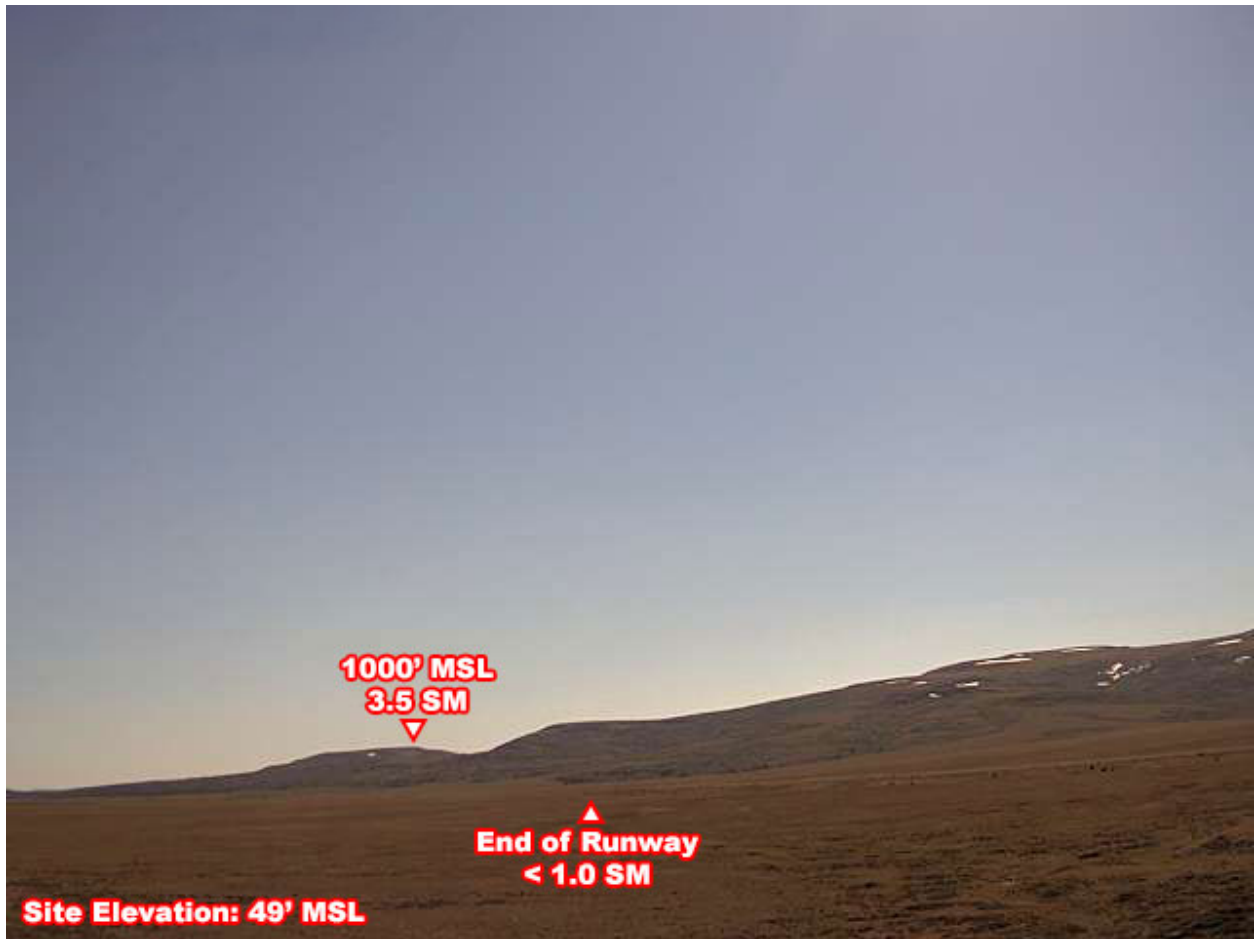


Figure 28 – FAA weather camera from Marshall east view from a standard clear sky weather day

Mon 16 Oct 2017 22:26:12 UTC
Mon 16 Oct 2017 14:26:12 AKDT

Marshall - East
See <http://avcams.faa.gov> for more information



Figure 29 – FAA weather camera from Marshall east view from 1426 AKDT

Mon 16 Oct 2017 22:36:13 UTC
Mon 16 Oct 2017 14:36:13 AKDT

Marshall - East
See <http://avcams.faa.gov> for more information



Figure 30 – FAA weather camera from Marshall east view from 1436 AKDT

17.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for the accident site on October 16, 2017, indicated the following:

SUN

Begin civil twilight	0848 AKDT
Sunrise	0933 AKDT
Accident	1430 AKDT
Sun transit	1431 AKDT
Sunset	1928 AKDT
End civil twilight	2013 AKDT

E. LIST OF ATTACHMENTS

Attachment 1 – PABC WSR-88D base reflectivity animation for the 0.5° elevation scans initiated from 1402 to 1501 AKDT

Attachment 2 – FAA’s Aviation Web Camera images from web cameras (locations seen in figure 17) surrounding the accident site

Submitted by:

Paul Suffern
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