



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

April 15, 2019

Factual Report

METEOROLOGY

WPR19LA066

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A. ACCIDENT

Location: Ellensburg, Washington
Date: January 17, 2019
Time: 1645 Pacific standard time (PST)
0045 Universal Coordinated Time (UTC) January 18, 2019
Airplane: Piper PA-23-250; Registration: N14372

B. METEOROLOGIST

Don Eick
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Operational Factors Division (AS-30)
National Transportation Safety Board

C. SUMMARY

On January 17, 2019, about 1645 Pacific standard time, a Piper PA23-250 airplane, N14372, impacted the ground near Ellensburg, Washington. The commercial pilot was fatally injured, and the airplane was destroyed. The airplane was registered to and operated by the pilot as a Title 14 *Code of Federal Regulations* Part number 91 personal flight. Visual meteorological conditions existed at the accident site about the time of the accident, and no flight plan had been filed. The flight originated from Bowers Field Airport (ELN), Ellensburg, Washington about 1631 and was destined for McAllister Field Airport (YKM), Yakima, Washington

D. 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 from the Washington D.C. office, collecting data from official National Weather Service (NWS) sources including the Weather Prediction Center (WPC) and the National Center for Environmental Information (NCEI). All times are Pacific standard time (PST) based upon the 24-hour clock, local time is -8 hours from UTC, and UTC=Z. NWS airport and 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. Directions are referenced to true north and distances in nautical miles. Heights are in feet (ft) above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The accident site was estimated at latitude 46.947222° N and longitude 120.51277° W, at an elevation of 1,445 ft.

E. WEATHER INFORMATION

1.0 Synoptic Conditions

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) located in College Park, Maryland. These are the base products used in describing weather features and in the creation of forecasts and warnings. 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 northwest section of the NWS Surface Analysis Chart for 1600 PST with the accident site is included as figure 1. The chart depicted a low pressure system at 985-hectopascals (hPa)¹ off of Vancouver Island, British Columbia with a dissipating occluded frontal system stretching east-southeast across Vancouver Island into eastern Washington. A second low pressure system at 1006-hPa was located at the former triple point², with the occluded front becoming a dissipating cold front that extended into Idaho. A trough of low pressure extended from the first low pressure system and paralleled the occluded front to the south from off the Pacific Ocean into northwest Washington to the west of the accident site, with an increasing pressure gradient noted in the isobars along the Pacific northwest coast. Further north of the of the dissipating occluded and cold front over British Columbia into Idaho and Montana a stationary front was depicted and was expected to be the primary boundary across the region. A high pressure system at 1009-hPa was located on the Washington and Oregon border immediately south of the accident site. The accident site was located south of the dissipating occluded front in an area of a weak pressure gradient or a col, a saddle point or neutral point typically between two high and low pressure areas.

The station models on the chart surrounding the accident site depicted calm to light winds of 5 knots or less, overcast clouds, with temperatures in the low to mid 30’s degrees Fahrenheit (F), with dew point temperatures in the low 30’s to high 20’s °F, or temperature-dew spreads of 4 °F or less. Several stations west, northeast, and east of the accident site reported snow showers, and a station south of the accident site report visibility restricted in mist or fog. Strong sustained southerly winds of 20 to 25 knots were noted over the coastal sections of western Oregon and Washington.

¹ Hectopascals (hPa) is the new standard term for reporting sea level pressure and is interchangeable with the term millibar (mb) with the same units. Standard sea level pressure is 1013.25-hPa.

² A triple point is where the occluded front, cold front, and warm front intersect.

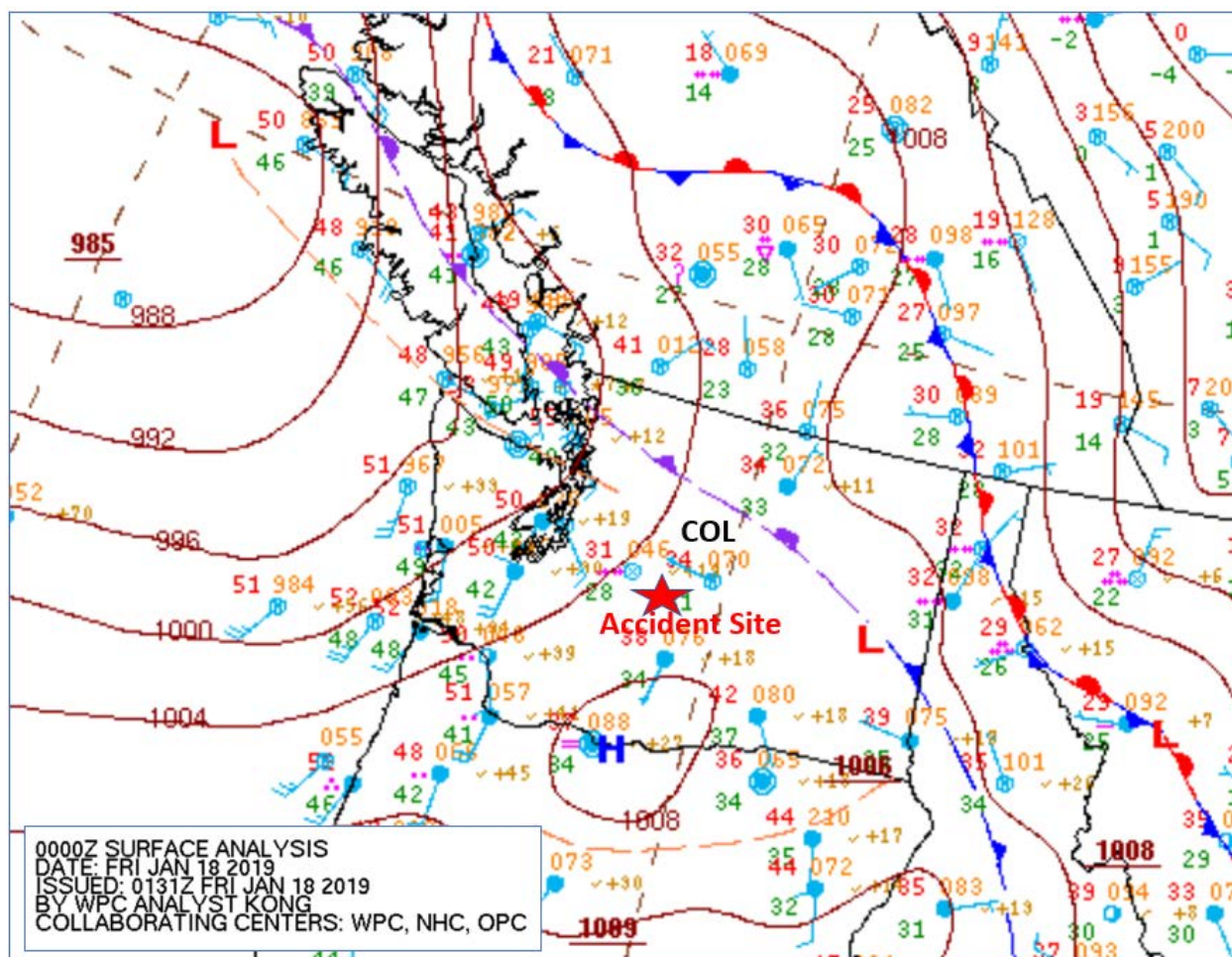


Figure 1 - Northwest section of the NWS Surface Analysis Chart for 1600 PST

1.2 National Composite Radar Image

The NWS National Composite Radar Mosaic for 1645 PST was obtained from NCEI archive data and is included as figure 2 with the accident site and departure and destination airports noted. The image depicted several areas of echoes associated with rain and snow showers extending over and north of the Ellensburg area and another area immediately south of the accident site between Yakima. Very light intensity echoes were identified within 5 miles east and south of the accident site.

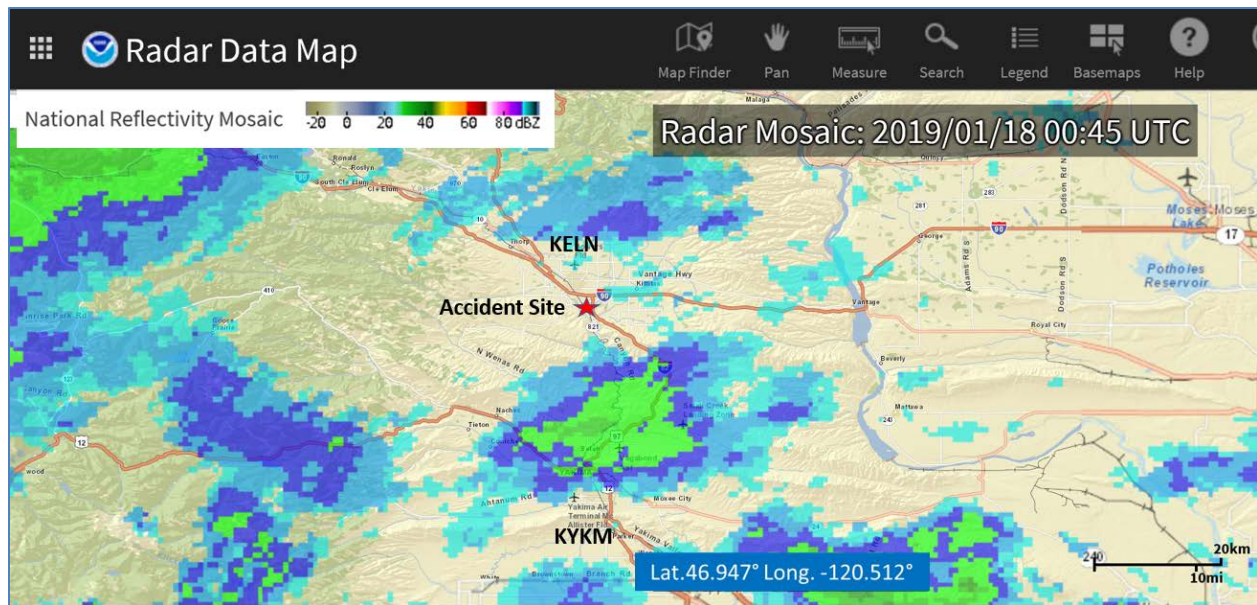
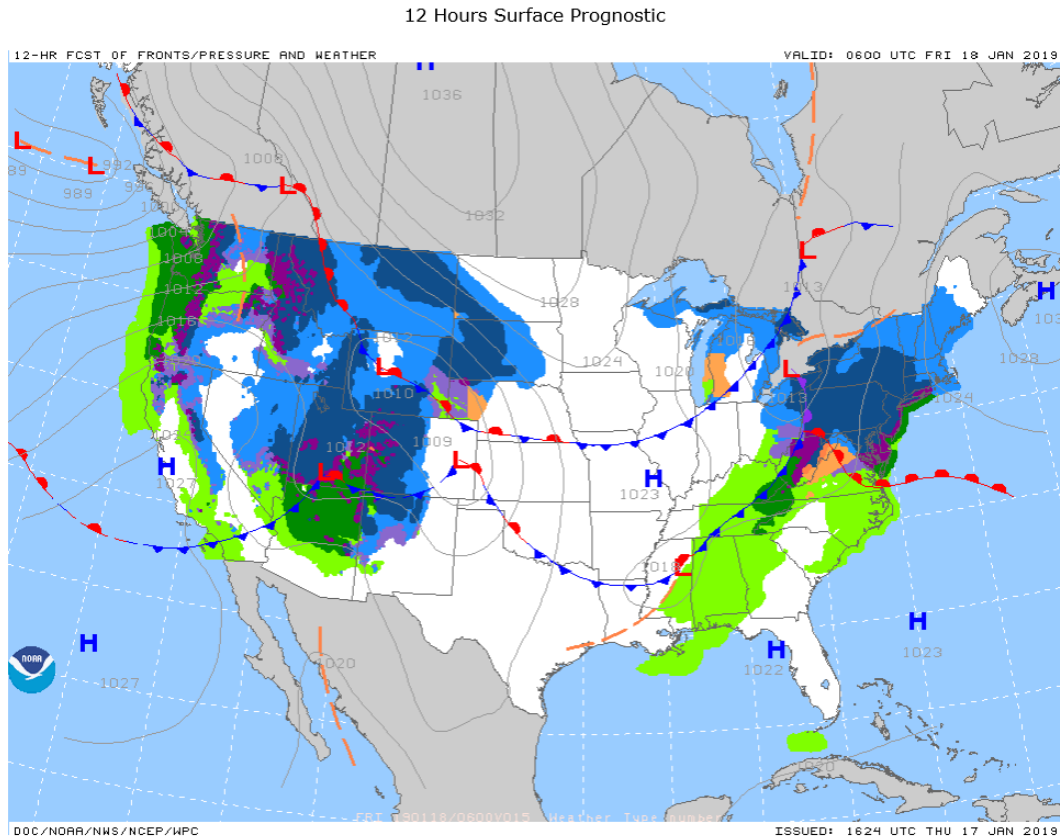


Figure 2 - National Composite Radar Mosaic over the area for 1645 PST

1.3 12-hour Surface Prognostic Chart

The 12-hour NWS Surface Prognostic Chart valid for 2200 PST is included as figure 3. The chart depicted the low pressure system off Vancouver Island with the occluded front completely dissipated. A trough of low pressure oriented north-to-south over central Washington and Oregon in the vicinity of the accident site. A large area of mixed precipitation extended over the region with scattered rain and snow over the region, with coverage less than 50% of the area.



2.0 Observations

The surrounding area was documented using Meteorological Aerodrome Reports (METAR) and Specials observations (SPECI). The area had a magnetic variation of 16° East based on the sectional chart for the area. Cloud heights are reported in height above ground level (agl) in the following section.

2.1 Bower Field Airport (KELN), Ellensburg, Washington

The closest observation site was from Bower Field Airport (KELN), Ellensburg, Washington, the departure site located approximately 5 miles north of the accident site at an elevation of 1,763 ft. The airport had a federally installed and maintained Automated Surface Observation System (ASOS), which was not augmented by any human observers. The following conditions were reported surrounding the time of the accident:

KELN weather observation at 1553 PST, automated, wind calm, visibility 4 miles in haze, ceiling overcast at 1,700 ft, temperature 3° Celsius (C), dew point temperature 0° C, altimeter 29.69 inches of mercury (Hg). Remarks: automated observation system with a precipitation discriminator, sea level pressure 1006.5-hPa, 6-hour ice accretion 0.01 inches, temperature 2.8° C, dew point 0.0° C, 6-hour maximum temperature 3.9° C, 6-hour minimum temperature 1.1° C, 3-hour pressure tendency risen 1.7-hPa.

KELN weather observation at 1653 PST, automated, wind from 140° at 4 knots, visibility 4 miles in mist, ceiling overcast at 1,700 ft, temperature 2° C, dew point temperature 0° C, altimeter 29.71 inches of Hg. Remarks: automated observation system with a precipitation discriminator, sea level pressure 1007.5-hPa, temperature 2.2° C, dew point 0.0° C.

The general flight categories³ color coded and raw observations surrounding the period were as follows:

VFR METAR KELN 170553Z AUTO 32004KT 10SM OVC048 01/M02 A2977 RMK AO2 SLP095 T00111022 10017 20006 58019

VFR METAR KELN 170653Z AUTO 00000KT 6SM UP OVC039 01/M02 A2975 RMK AO2 UPB52 SLP089 P0000 T00111022

MVFR SPECI KELN 170715Z AUTO 21003KT 2SM -SN BR BKN030 OVC037 01/M02 A2975 RMK AO2 UPE0655SNB0655 P0000 T00061017

IFR SPECI KELN 170719Z AUTO 18003KT 1 3/4SM -SN BR BKN028 OVC037 01/M02 A2975 RMK AO2 UPE0655SNB0655 P0001 T00061017

IFR SPECI KELN 170738Z AUTO 00000KT 1SM -SN BR VV018 01/M02 A2974 RMK AO2 UPE0655SNB0655 P0002 T00061017

IFR SPECI KELN 170749Z AUTO 00000KT 1 1/4SM -SN BR FEW009 OVC017 01/M01 A2974 RMK AO2 UPE0655SNB0655 P0003

IFR METAR KELN 170753Z AUTO 00000KT 1 1/4SM -SN BR FEW009 OVC017 00/M01 A2973 RMK AO2 UPE0655SNB0655 SLP082 P0003 T00001011 400221044

IFR SPECI KELN 170817Z AUTO 00000KT 1 1/2SM -SN BR SCT003 BKN010 OVC036 01/M02 A2971 RMK AO2 P0001 T00061017

IFR SPECI KELN 170824Z AUTO 00000KT 1 3/4SM -SN BR SCT003 BKN015 OVC036 00/M02 A2971 RMK AO2 P0001 T00001017

IFR SPECI KELN 170836Z AUTO 30003KT 2SM -SN BR BKN015 OVC034 00/M02 A2970 RMK AO2 P0001 T00001017

IFR SPECI KELN 170844Z AUTO 00000KT 2 1/2SM -SN BR SCT015 OVC035 00/M02 A2969 RMK AO2

IFR METAR KELN 170853Z AUTO 31003KT 2 1/2SM -SN BR FEW015 OVC035 00/M02 A2968 RMK AO2 SLP066 P0001 60004 T00001017 58022

IFR SPECI KELN 170915Z AUTO 31004KT 2SM -SN BR SCT005 SCT017 OVC034 01/M01 A2968 RMK AO2 P0001 T00061011

IFR SPECI KELN 170917Z AUTO 31004KT 2SM -SN BR BKN005 OVC034 01/M01 A2968 RMK AO2 P0001 T00061011

LIFR SPECI KELN 170933Z AUTO 34004KT 2 1/2SM -SN BR OVC004 01/M01 A2967 RMK AO2 P0001 T00061011

LIFR METAR KELN 170953Z AUTO 33004KT 2 1/2SM -SN BR BKN004 OVC032 01/M01 A2966 RMK AO2 SLP058 P0001 T00061011

LIFR SPECI KELN 171010Z AUTO 34003KT 1 3/4SM -SN BR BKN004 OVC032 01/M01 A2966 RMK AO2 P0000 T00061011

LIFR SPECI KELN 171027Z AUTO 32004KT 2SM -SN BR OVC004 01/M01 A2966 RMK AO2 P0001

³ 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.

**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.

LIFR SPECI KELN 171038Z AUTO 31004KT 1 3/4SM -SN BR OVC004 01/M01 A2965 RMK AO2 P0001 T00061006
LIFR METAR KELN 171053Z AUTO 31003KT 1SM -SN BR OVC004 01/M01 A2965 RMK AO2 SLP053 P0002 T00111006
LIFR SPECI KELN 171101Z AUTO 32003KT 3/4SM -SN BR BKN004 OVC009 01/M01 A2965 RMK AO2 P0001 T00111006
LIFR SPECI KELN 171112Z AUTO 00000KT 3/4SM -SN BR SCT004 OVC010 01/M01 A2964 RMK AO2
LIFR SPECI KELN 171123Z AUTO 34003KT 3/4SM -SN BR FEW004 OVC008 01/M01 A2963 RMK AO2 P0004 T00111011
LIFR METAR KELN 171153Z AUTO 00000KT 3/4SM -SN BR VV009 01/00 A2962 RMK AO2 SLP042 P0008 60015 70015 T00110000 10017 20000 58021
LIFR SPECI KELN 171214Z AUTO 00000KT 3/4SM -SN BR VV010 01/M01 A2961 RMK AO2 P0002 T00111006

LIFR SPECI KELN 171222Z AUTO 00000KT 1/2SM SN FG FEW004 OVC009 01/M01 A2961 RMK AO2 P0003 T00111006
LIFR SPECI KELN 171239Z AUTO 00000KT 1/2SM SN FG VV005 01/M01 A2961 RMK AO2 P0005
LIFR METAR KELN 171253Z AUTO 00000KT 3/4SM -SN BR VV005 01/M01 A2961 RMK AO2 SLP039 P0007 T00111006
LIFR SPECI KELN 171308Z AUTO 23003KT 3/4SM -SN BR SCT004 BKN008 OVC020 01/M01 A2961 RMK AO2 P0001 T00061006
IFR METAR KELN 171353Z AUTO 00000KT 1SM -SN BR BKN013 OVC018 01/M01 A2960 RMK AO2 SLP037 P0006 T00061006
IFR SPECI KELN 171405Z AUTO 00000KT 1SM -SN BR FEW003 OVC016 01/M01 A2960 RMK AO2
LIFR SPECI KELN 171419Z AUTO 00000KT 1SM -SN BR BKN003 BKN018 OVC024 01/M01 A2961 RMK
LIFR METAR KELN 171453Z AUTO 04004KT 1SM -SN BR BKN003 OVC011 01/M01 A2959 RMK AO2 SLP034 P0004 60017 T00111011 56008
LIFR SPECI KELN 171504Z AUTO 05005KT 1 1/2SM -SN BR BKN003 OVC022 01/M01 A2959 RMK AO2 P0000 T00111011
IFR SPECI KELN 171507Z AUTO 07003KT 2SM -SN BR SCT003 OVC026 01/M01 A2959 RMK AO2 P0000 T00111006
IFR SPECI KELN 171525Z AUTO 19004KT 2 1/2SM -SN BR FEW003 BKN010 OVC035 01/M01 A2961 RMK AO2 P0000 T00061006
MVFR SPECI KELN 171537Z AUTO 00000KT 3SM -SN BR SCT003 BKN010 OVC022 01/M01 A2960 RMK AO2 P0000 T00061006
LIFR SPECI KELN 171544Z AUTO 00000KT 3SM -SN BR BKN004 OVC010 01/M01 A2961 RMK AO2 P0000 T00061006
LIFR METAR KELN 171553Z AUTO 00000KT 3SM BR OVC004 01/M01 A2961 RMK AO2 SNE45 SLP039 P0000 T00061011
LIFR SPECI KELN 171603Z AUTO 00000KT 2SM BR OVC003 01/M01 A2960 RMK AO2 T00061006
LIFR SPECI KELN 171629Z AUTO 08003KT 3SM BR OVC003 01/M01 A2961 RMK AO2 T00111011
LIFR METAR KELN 171653Z AUTO 11004KT 6SM BR BKN003 OVC035 01/M01 A2960 RMK AO2 SLP036 11000 T00111006
VFR SPECI KELN 171700Z AUTO 00000KT 6SM BR SCT003 OVC037 01/M01 A2961 RMK AO2
LIFR SPECI KELN 171730Z AUTO 00000KT 3SM BR BKN004 OVC036 01/M01 A2962 RMK AO2
LIFR METAR KELN 171753Z AUTO 00000KT 2 1/2SM BR OVC004 01/M01 A2963 RMK AO2 CIG 002V005 SLP046 60017 I6000 T00111006 10011 20006 53011
LIFR SPECI KELN 171830Z AUTO 03003KT 3SM BR OVC002 02/M01 A2964 RMK AO2 11001 T00171006
MVFR SPECI KELN 171846Z AUTO 00000KT 7SM SCT003 OVC026 02/00 A2964 RMK AO2 11001 T00220000

MVFR METAR KELN 171853Z AUTO 00000KT 10SM SCT003 OVC026 02/00 A2964 RMK AO2 SLP049 11001 T00220000
MVFR KELN 171953Z AUTO 00000KT 10SM FEW018 OVC026 03/00 A2964 RMK AO2 SLP050 T00280000
MVFR METAR KELN 171953Z AUTO 00000KT 10SM FEW018 OVC026 03/00 A2964 RMK AO2 SLP050 T00280000
MVFR METAR KELN 172053Z AUTO 00000KT 8SM OVC024 03/00 A2964 RMK AO2 SLP049 I3001 T00280000 50003

MVFR METAR KELN 172153Z AUTO 00000KT 9SM OVC026 03/00 A2964 RMK AO2 SLP049 T00330000
MVFR SPECI KELN 172253Z AUTO 16004KT 9SM OVC020 03/00 A2966 RMK AO2 SLP057 T00280000
MVFR METAR KELN 172253Z AUTO 16004KT 9SM OVC020 03/00 A2966 RMK AO2 SLP057
MVFR METAR KELN 172353Z AUTO 00000KT 4SM HZ OVC017 03/00 A2969 RMK AO2 SLP065 I6001
 T00280000 10039 20011 53017

Accident 0045Z

MVFR METAR KELN 180053Z AUTO 14004KT 4SM BR OVC015 02/00 A2971 RMK AO2 SLP075 T00220000
MVFR SPECI KELN 180112Z AUTO 13003KT 4SM BR OVC014 02/00 A2971 RMK AO2 T00170000
MVFR SPECI KELN 180153Z AUTO 04003KT 6SM BR BKN014 OVC025 02/00 A2972 RMK AO2 SLP078
MVFR METAR KELN 180153Z AUTO 04003KT 6SM BR BKN014 OVC025 02/00 A2972 RMK AO2 SLP078
 T00220000
MVFR SPECI KELN 180203Z AUTO 08003KT 7SM SCT014 OVC023 02/00 A2973 RMK AO2 T00220000
MVFR SPECI KELN 180211Z AUTO 00000KT 8SM BKN014 OVC023 02/00 A2973 RMK AO2 T00220000
MVFR METAR KELN 180253Z AUTO 10003KT 9SM OVC016 02/00 A2974 RMK AO2 SLP085 T00220000
 51017
MVFR METAR KELN 180353Z AUTO 00000KT 10SM OVC015 02/00 A2977 RMK AO2 SLP095 T00220000
MVFR METAR KELN 180453Z AUTO 00000KT 7SM OVC016 02/00 A2980 RMK AO2 SLP105 T00220000
MVFR METAR KELN 180553Z AUTO 36004KT 9SM OVC017 02/00 A2983 RMK AO2 SLP115
 T00220000 10028 20017 52028

A review of the observations on January 17, 2019 indicated that the IFR to LIFR conditions prevailed with snow and mixed freezing precipitation with temperatures at or slight above freezing overnight and into the early morning hours, with the snow ended around 0745 PST. The LIFR and IFR conditions due to low ceilings and fog and mist continued through 1030 PST, with MVFR conditions prevailing at the time of the accident with ceilings between 1,400 and 2,000 ft with multiple layers of clouds being reported, and visibility of 4 miles in mist.

2.2 Yakima Air Terminal/McAllister Field (YKM), Yakima, Washington

The planned destination was Yakima Air Terminal/McAllister Field (YKM), Yakima, Washington, approximately 28 miles south of KELN. The airport listed an elevation of 1,099 ft and had an ASOS and was augmented by air traffic control tower personnel through a Limited Aviation Weather Reporting System (LAWRS) agreement. At the approximate time of the accident KYKM reported the following conditions:

KYKM weather observation at 1653 PST, wind calm, visibility 10 miles or more, ceiling overcast at 1,300 ft agl, temperature 3° C, dew point 1° C, altimeter 29.74 inches of Hg. Remarks: automated observation system with a precipitation discriminator, sea-level pressure 1008.0-hPa, temperature 3.3° C, dew point 1.1° C.

The general flight categories and raw observations disseminated during the period were as follows:

IFR METAR KYKM 171853Z 00000KT 4SM BR BKN005 02/01 A2968 RMK AO2 SLP059 T00170006
IFR KYKM 171953Z 02003KT 6SM BR BKN005 03/01 A2967 RMK AO2 SLP057 T00280006
IFR METAR KYKM 171953Z 02003KT 6SM BR BKN005 03/01 A2967 RMK AO2 SLP057 T00280006
MVFR SPECI KYKM 172000Z 00000KT 7SM FEW003 OVC022 03/01 A2967 RMK AO2 T00280006
IFR SPECI KYKM 172045Z 00000KT 9SM BKN005 OVC021 03/01 A2967 RMK AO2 T00280011
IFR METAR KYKM 172053Z 00000KT 9SM BKN005 BKN021 OVC037 03/01 A2967 RMK AO2 SLP055
 T00280011 50005
IFR METAR KYKM 172153Z 00000KT 9SM BKN006 BKN080 04/02 A2968 RMK AO2 SLP058 T00390017

MVFR SPECI KYKM 172213Z 28003KT 7SM SCT008 BKN016 03/02 A2968 RMK AO2 T00330017
MVFR SPECI KYKM 172249Z 25003KT 7SM OVC014 03/01 A2970 RMK AO2
MVFR METAR KYKM 172253Z 25003KT 7SM OVC014 03/01 A2970 RMK AO2 SLP065 T00280011
MVFR METAR KYKM 172353Z 19004KT 9SM OVC012 03/01 A2973 RMK AO2 SLP076 T00330011
 10044 20011 53018
Accident 0045Z
MVFR METAR KYKM 180053Z 00000KT 10SM OVC013 03/01 A2974 RMK AO2 SLP080 T00330011
MVFR SPECI KYKM 180137Z 12003KT 10SM SCT010 BKN018 OVC080 03/01 A2975 RMK AO2

MVFR SPECI KYKM 180153Z 00000KT 10SM BKN010 BKN018 OVC090 03/01 A2976 RMK AO2 SLP088
 T00280011
MVFR METAR KYKM 180153Z 00000KT 10SM BKN010 BKN018 OVC090 03/01 A2976 RMK AO2 SLP088
 T00280011
IFR SPECI KYKM 180227Z 00000KT 10SM OVC009 02/01 A2978 RMK AO2 T00220011
MVFR SPECI KYKM 180243Z 00000KT 10SM SCT009 OVC015 02/01 A2978 RMK AO2 T00220006
MVFR METAR KYKM 180253Z 00000KT 10SM FEW009 OVC015 02/01 A2979 RMK AO2 SLP096 T00170006
 53019
MVFR SPECI KYKM 180313Z 00000KT 8SM OVC014 02/01 A2980 RMK AO2 T00170006
MVFR METAR KYKM 180353Z 21004KT 6SM BR OVC012 02/01 A2981 RMK AO2 SLP106 T00170006
MVFR METAR KYKM 180453Z 29003KT 8SM OVC011 02/01 A2984 RMK AO2 CIG 009V014 SLP114
 T00170006

A review of the observations also indicated IFR conditions prevailed during the morning through 1413 PST, with MVFR conditions with ceiling overcast between 1,200 to 1,400 ft agl at the time of the accident.

2.3 METAR Display

A depiction of the METAR observations from the NWS Aviation Weather Center (AWC) website⁴ at 1600 and 1700 PST are included below as figures 4 and 5 with the approximate accident site noted by a red star. The displays indicated MVFR conditions prevailing over the region with ceilings overcast between 1,200 to 1,700 ft, with the exception of Stampede Pass (KSMP) ASOS located 36 miles west-northwest of the accident site at an elevation of 3,967 ft which reported LIFR conditions during the period with visibility 1/4 to 1/2 mile in light to moderate snow, with sky obscured with vertical visibility of 200 ft agl.

⁴ <https://aviationweather.gov/metar>

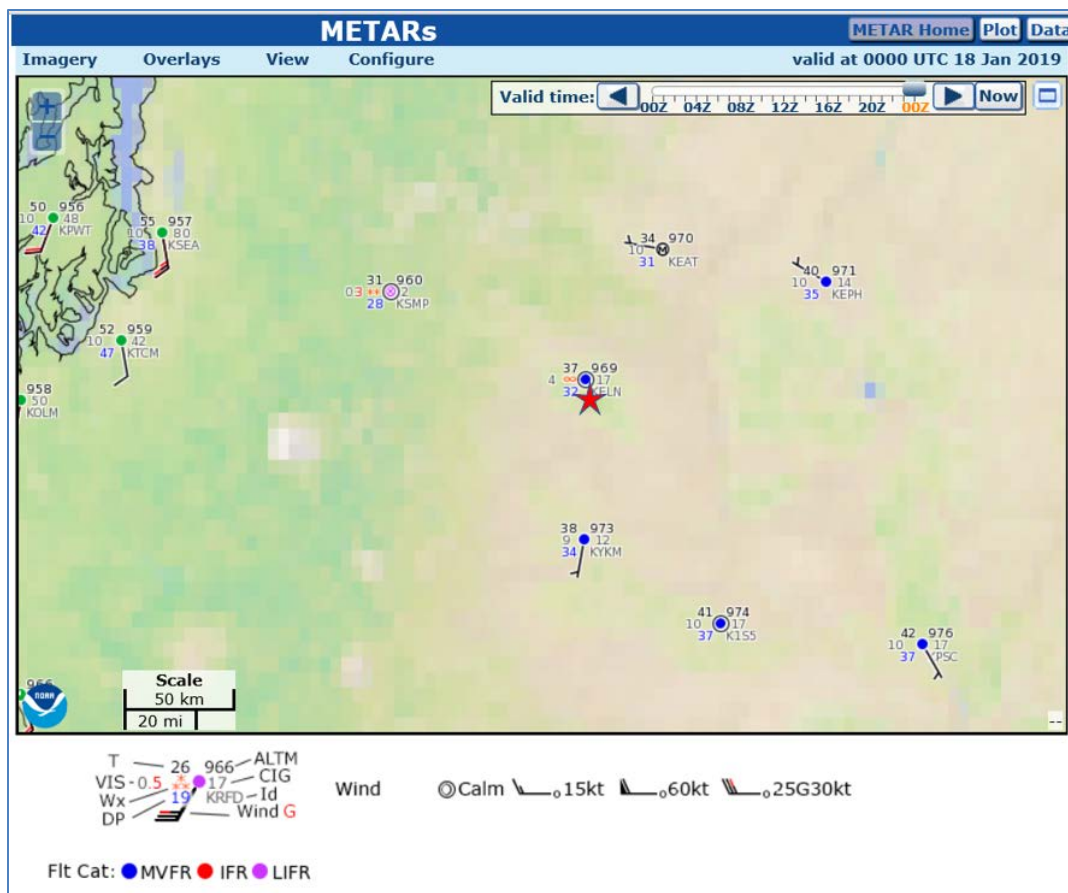


Figure 4 - NWS AWC display of METAR observations at 1600 PST

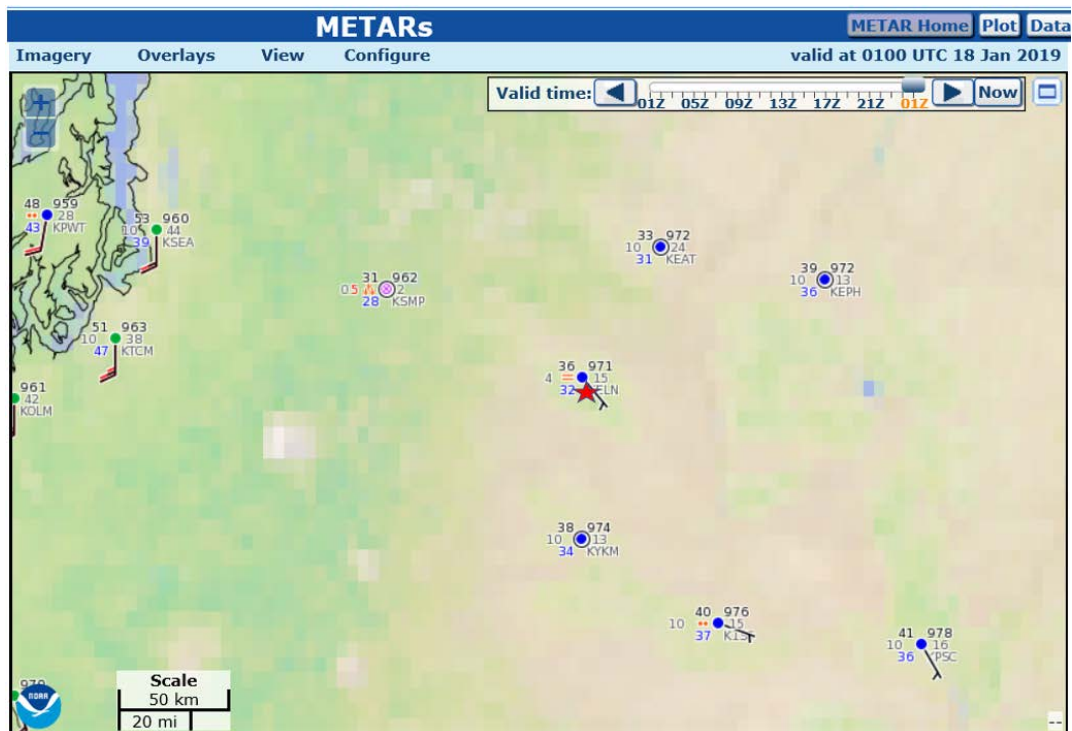


Figure 5 - NWS AWC METAR display at 1700 PST

3.0 Sounding Observation

A High Resolution Rapid Refresh (HRRR)⁵ numerical model sounding was created over the accident site for 1700 PST from archive data from the NOAA Air Resource Laboratory. The HRRR sounding was plotted on a standard skew T log P diagram⁶ from the surface to 450-hPa or approximately 20,000 ft using the complete Rawinsonde Observation RAOB program software⁷. Figure 6 is the HRRR sounding plot for 1700 PST with the models estimated surface elevation of 1,473 ft at the accident site.

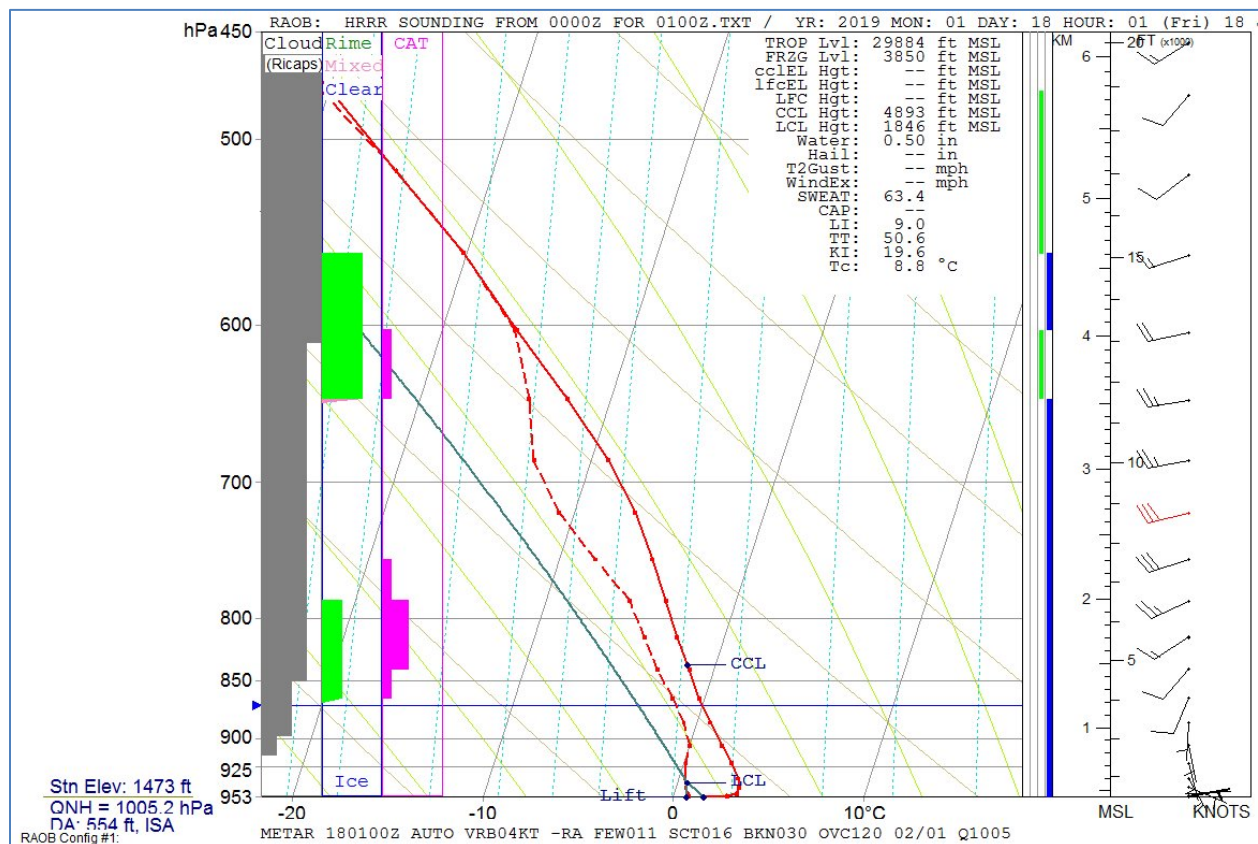


Figure 6 - HRRR numerical model sounding for 1700 PST over the accident site

The HRRR sounding depicted a surface temperature of 1.6° C (34.9° F), a dew point temperature of 0.7° C (33.3° F), with a relative humidity of 94%. A shallow surface based temperature inversion was noted to approximately 253 ft, where temperature increased with height. The lifted condensation level (LCL) was identified at 373 ft agl (1,846 ft msl), with a convective

⁵ 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.

⁶ 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.

⁷ RAOB software – The complete RAWinsonde OBServation program is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania, for plotting and analyzing upper air data.

condensation level (CCL) at 3,420 ft agl (4,893 ft msl). The RAOB program indicated multiple layers of clouds with a total overcast sky coverage with tops above 21,000 ft. The freezing level was identified at 3,850 ft msl (blue horizontal line) and the RAOB program indicated a trace to light rime type icing in-clouds and precipitation (left side green bars). The sounding was characterized as stable with a Lifted Index (LI) of +9.0, which supported nimbostratus type clouds. The precipitable water content was 0.50 inches. The tropopause was identified at about 29,900 ft with no defined jet stream over the area.

The HRRR sounding wind profile indicated light and variable surface winds with the wind from the south immediately above the surface and slowly veering to the west-southwest with height. A low-level wind maximum was identified at 8,800 ft from 260° at 30 knots (red barbs on right side), with winds below 4,000 ft less than 10 knots. The mean 0 to 6 kilometer or approximately 18,000 ft was from 245° at 15 knots. The RAOB algorithm indicated a high potential or greater than 90% of moderate turbulence between 4,000 and 6,000 ft, where the vertical wind shear was greater than 5 KT/1,000 ft.

Figure 7 is a table of the HRRR model heights, pressure, temperature (T), dew point (Td), relative humidity (RH%), and wind direction and speed, clear air turbulence (CAT), low-level wind shear (LLWS), and icing potential from the surface to 20,000 ft.

Height (ft-MSL)	Pres (hPa)	T (C)	Td (C)	RH (%)	DD / FF (deg / kts)	CAT (FAA)	LLWS	Icing - Type (AFGWC method)
1473	953	1.6	0.7	94	78 / 4			
1501	952	2.8	0.8	87	78 / 4			
1557	950	3.3	0.7	83	88 / 4		LIGHT	
1726	944	3.3	0.5	82	115 / 4		LIGHT	
1953	936	3.1	0.3	82	154 / 4			
2354	922	2.5	0.1	84	168 / 5			
2818	906	1.7	0.0	88	170 / 6			
3408	886	0.7	-0.7	90	183 / 7			
4040	865	-0.3	-1.7	90	202 / 8	LGT		TRC Rime
4778	841	-1.3	-3.0	88	219 / 12	MDT		TRC Rime
5598	815	-2.5	-4.2	88	234 / 17	MDT		TRC Rime
6540	786	-3.7	-5.6	87	244 / 24	LGT		TRC Rime
7581	755	-5.1	-8.1	79	251 / 28			
8766	721	-6.8	-10.8	73	256 / 29			
10073	685	-9.1	-13.0	73	259 / 27			
11592	645	-12.3	-14.3	85	260 / 23	LGT		LGT Mixed
13269	603	-16.1	-16.2	99	257 / 18			LGT Rime
15127	559	-20.2	-20.2	100	250 / 13			LGT Rime
17055	516	-25.1	-25.1	100	230 / 10			
18911	477	-29.9	-30.4	95	218 / 11			

Figure 7 - HRRR model sounding over the accident site for 1700 PST

4.0 Satellite Imagery

The Geostationary Operational Environmental Satellite number 17 (GOES-17) 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 (McIDAS) software. The infrared long wave imagery were obtained surrounding the time

Figure 8 is the GOES-17 infrared image at 1647 PST at 4X magnification. The satellite image depicted an extensive area of low to mid clouds over the area with the radiative cloud top temperature of 231° Kelvin or -42.16° C, which corresponded to cloud tops near 23,600 ft.



The closest Weather Surveillance Radar-1988, Doppler (WSR-88D)⁸ to the accident site was from the NWS Pendleton (KPDT), Oregon, located 102 miles southeast of the accident site. The level II archive data was obtained from the National Climatic Data Center (NCDC) using the Hierarchical Data Storage System and displayed using the NWS NEXRAD Interactive Viewer and Data Exporter software.

⁸ The WSR-88D is a S-band 10 centimeter wavelength radar with a power output of 750,000 watts, with a 28-foot parabolic antenna concentrating the energy into a 0.95° beam width. The radar produces three basic types of products: reflectivity, radial velocity, and spectral width.

minute period. Assuming standard refraction⁹ of the WSR-88D beam and the KPDX antenna height of 1,580 ft, the center of the radar beam was at approximately 13,880 ft with the beam sampling the layers between 8,740 ft and 19,020 ft over the accident site.

Air traffic control (ATC) weather display systems also use radar weather processors with the ability to determine precipitation intensity, with controllers instructed to describe the intensity to pilots based on the following table. One exception is that the centers weather and radar processor system does not display light intensity echoes below 30 dBZ. This table is also referenced for pilots in Advisory Circular AC 00-24C - "Thunderstorm".

Reflectivity (dBZ) Ranges	Weather Radar Echo Intensity Terminology
< 30 dBZ	Light
30 – 40 dBZ	Moderate
>40 – 50 dBZ	Heavy
>50 dBZ	Extreme

Figure 9 is the KPDT WSR-88D 0.5° base reflectivity image at 1646 PST and depicted a large area of 0 to 15 dBZ or very light intensity echoes over the accident site, with echoes of 25 dBZ between the accident site and the destination at KYKM.

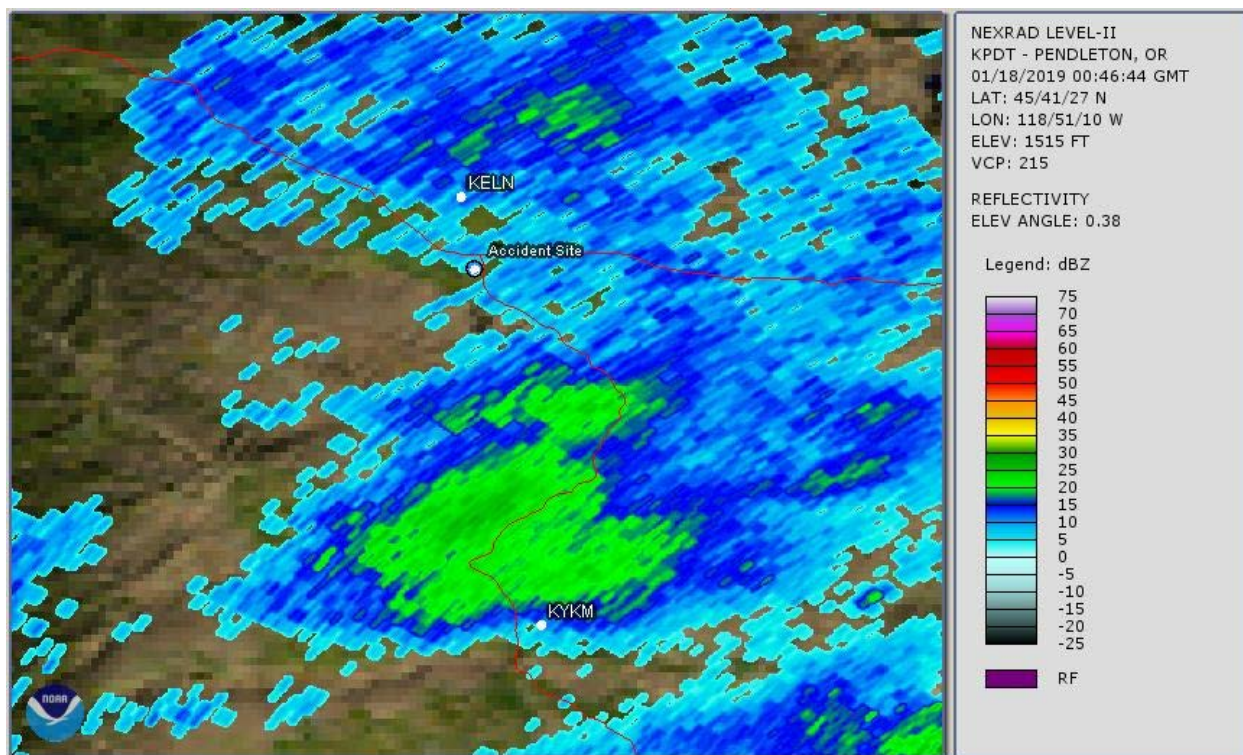


Figure 9 - KPDT WSR-88D 0.5° base reflectivity image at 1646 PST

⁹ Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

6.0 Pilot Reports

A search of pilot reports or PIREPs in the immediate vicinity and within 4 hours either side of the accident provided two reports below 18,000 ft. The reports were as follows in standard code and abbreviations, and immediately below decoded in plain language with time converted to local. The reports were as follows:

YKM UA /OV YKM/TM 2001/FL026/TP C750/SK OVC031/WX FV07SM/TA 03/WV CALM/TB N/R/IC N/R

Yakima (YKM) routine pilot report (UA); Over – the YKM VORTAC (approximately 52 miles south of the accident site); Time – 1201 PST; Altitude – 2,600 ft msl; Type aircraft – Cessna Citation X business jet; Sky cover – overcast at 3,100 ft msl; Weather – flight visibility 7 miles; Temperature – +3° C; Wind – calm; Turbulence – none reported in-clouds.

EAT UA /OV EAT100010/TM 0036/FL034/TP C208/TA M02/IC TRACE CLR/RM 034 BASE/044 TOPS -ZSE

Pangborn Memorial Airport (KEAT), Wenatchee, WA routine pilot report (UA); Over – EAT VORTAC 100° radial at 10 miles (approximately 26 miles northeast of the accident site); Time – 1636 PST; Altitude – 3,400 ft msl; Type aircraft – Cessna 208 Caravan single engine turboprop; Temperature – minus 2° C, Icing – a trace of clear type ice; Remarks – base of icing at 3,400 ft with tops at 4,400 ft msl entered by Settle Center.

7.0 NWS Forecasts

The following NWS forecast products issued during the period were documented.

7.1 Terminal Aerodrome Forecast

The closest Terminal Aerodrome Forecast (TAF) to KELN was from Pangborn Memorial Airport (KEAT), Wenatchee, Washington, located 26 miles northeast of KELN at an elevation of 1,246 ft. TAFs are valid for a 5 mile radius around an airport's center point. When planning a flight to an airport that does not have a TAF, pilots and other flight planning systems will typically refer to the closest available TAFs to supplement the information in weather forecast products that cover large areas, such as the Graphic Aviation Forecast (GFA), Airmen's Meteorological Information (AIRMET) bulletins, and other graphical products. The NWS Spokane (KOTX), Washington, Weather Forecast office (WFO) was responsible for the KEAT TAF and issued the following forecast:

***TAF KEAT 172336Z 1800/1824 VRB03KT 6SM BR FEW002 OVC025
FM180100 26003KT 6SM BR SCT008 OVC015
FM180200 VRB02KT 2SM -RASN BR OVC007
FM181000 31003KT 1SM BR OVC005
FM182300 12002KT 5SM BR SCT005 BKN120=***

The forecast for KEAT issued at 1536 PST expected a variable wind at 3 knots, visibility 6 miles in mist, a few clouds at 200 ft agl, ceiling overcast at 2,500 ft. The forecast from 1700 to 1800 PST expected, winds from 260 at 3 knots, visibility 6 miles in mist, scattered clouds at 800 ft, with a ceiling overcast at 1,500 ft. After 1800 PST IFR conditions were expected with visibility 2 miles in light rain, snow, and mist with a ceiling overcast at 700 ft.

The TAF for the destination of KYKM was issued by the NWS Pendleton (KPDT), Oregon, WFO and was as follows:

TAF KYKM 172321Z 1800/1824 VRB03KT P6SM OVC015
FM180400 24005KT P6SM SCT015 OVC025
FM180900 25006KT P6SM SCT025 OVC050
FM181800 VRB03KT P6SM OVC025

The forecast for the time of arrival expected a variable wind at 3 knots, visibility better than 6 miles, with a ceiling overcast at 1,500 ft agl. No precipitation was expected during the period.

7.2 Area Forecast Discussion

The NWS KOTX WFO issued the following Area Forecast Discussion (AFD) at 1548 PST discussing the synoptic conditions, the short term forecast, and an aviation discussion regarding the KEAT issuance. The bulletin is issued in plain language with minimal abbreviation. While it is not a standard aviation weather briefing product, it provides useful information on conditions impacting the forecast region. The advisory current at the time was as follows:

FXUS66 KOTX 172348
AFDOTX

Area Forecast Discussion
National Weather Service Spokane WA
348 PM PST Thu Jan 17 2019

.SYNOPSIS...

***Periods of rain and snow across the region will continue into the overnight hours.** Motorists should expect slick driving conditions especially across the passes. Another round of rain and snow is forecast Friday night into Saturday with moderate snow possible in the Cascades. Cooler and unsettled weather continues into the middle of next week.*

.DISCUSSION...

*Tonight through Friday...**Active weather will continue tonight into early Friday with a mix of fog, rain and snow in the valleys and snow in the mountains** concentrated especially across the eastern third of Washington and the Idaho Panhandle. As a Pacific low pressure trough moves through ahead of a building high pressure ridge we will see showers re-energize and push across east Washington into the Idaho Panhandle this evening and overnight.*

Snow levels will be low enough that Lookout Pass will continue to accumulate persistent light to moderate snow into Friday morning. Last check on information at Lookout chains were required so be prepared traveling the passes.

Earlier this morning there was freezing rain and that threat is gone. After showers go through tonight there will be a chance for wet roads to refreeze. Any untreated roads may become very slick with Black ICE so be on the watch Tonight and Friday morning on your commutes.

.AVIATION...

*00Z TAFs: Cold and conditionally unstable airmass with minor disturbances swirling about it is expected to pass over the aviation area tonight thus **some minor mention of showers in the form of rain or snow remains while the threat of freezing rain ending** (with the exception of some locations to the north and east of KEGG holding onto perhaps some lingering freezing rain into the*

evening). In addition the low levels of the **atmosphere remain very saturated thus some IFR/MVFR ceilings and visibility due to stratus and/or fog remain in place for a number of TAF sites overnight and into tomorrow**. Models do show some drier air approaching from the south/southeast late tomorrow afternoon which may help erode any stubborn stratus/fog thus some TAF sites show improvement near 2330Z Friday. /Pelatti

7.3 Graphic Forecast Aviation

The following Graphic Forecast for Aviation (GFA) were issued at about 1400 PST from the NWS AWC and valid for 1600 PST for briefing purposes and to provide enroute conditions. Figure 10 and 11 are the GFA charts depicting the expected wind, visibility, weather, with the G-AIRMET Sierra overlaid and the expected cloud cover and tops with the G-AIRMET Zulu for icing overlaid.

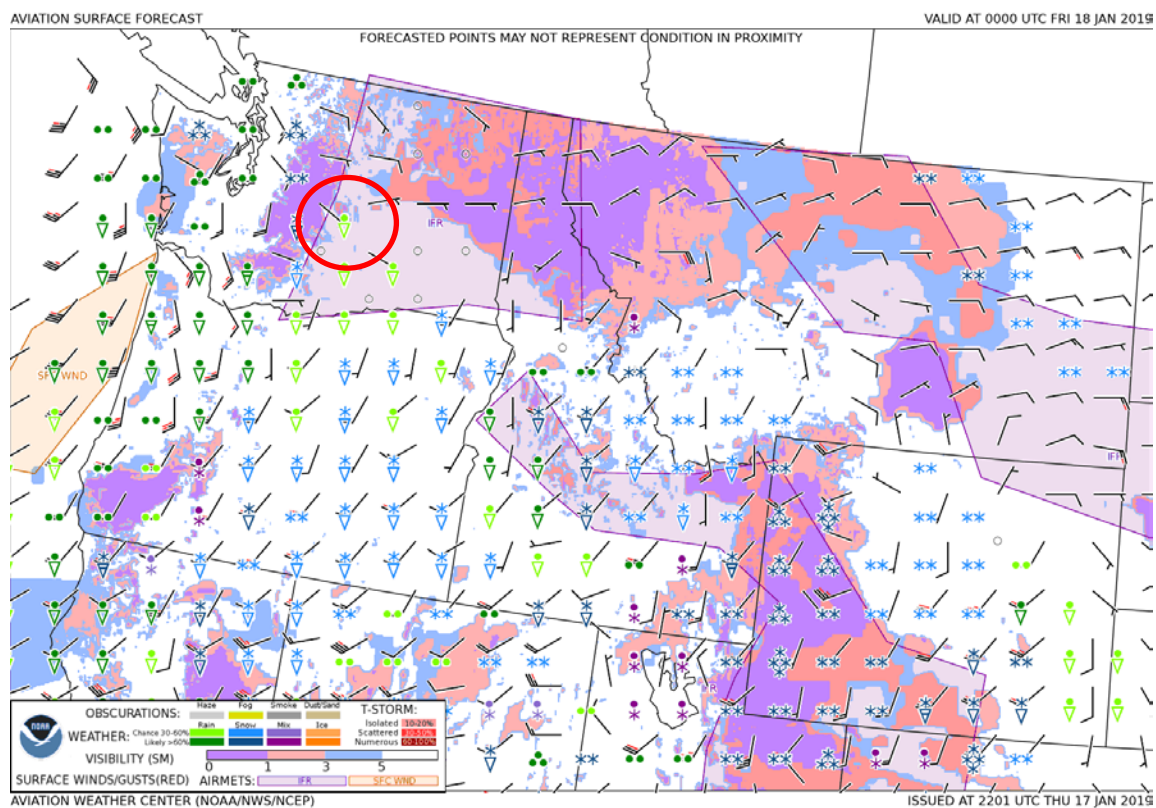


Figure 10 - GFA surface wind, visibility, and weather with AIRMET Sierra overlaid valid at 1600 PST

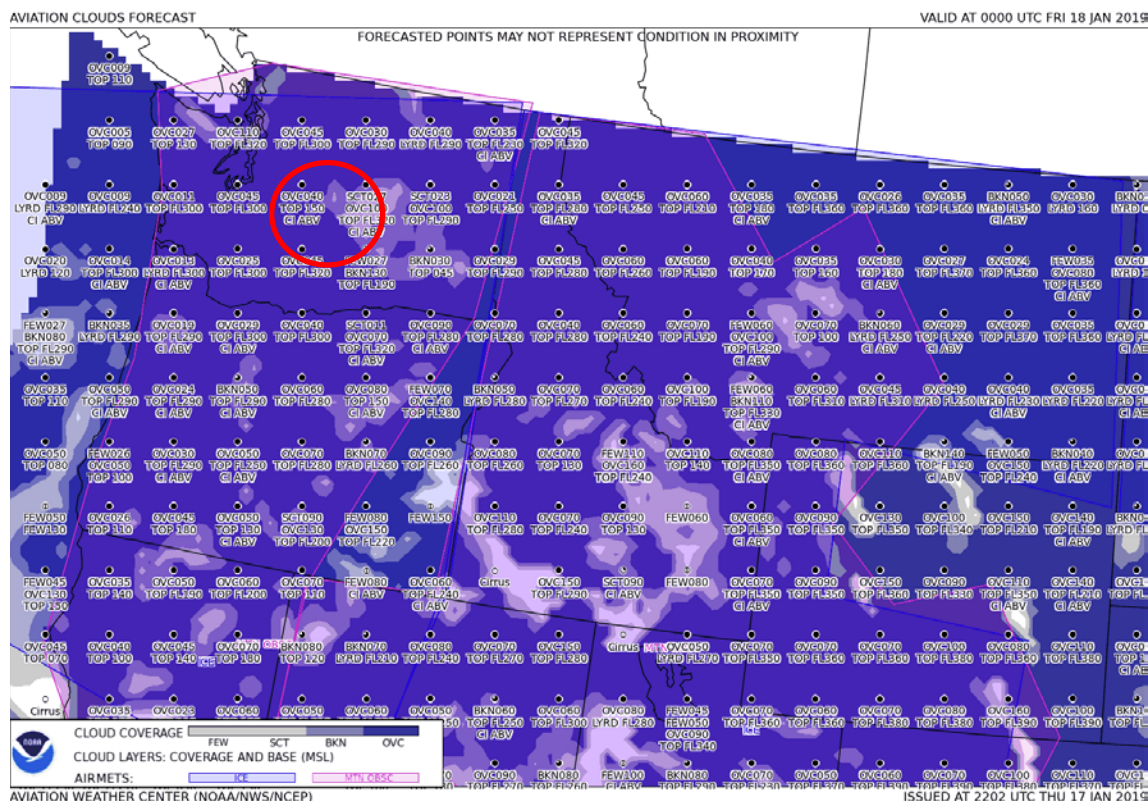


Figure 11 - GAF cloud coverage and tops with AIRMET Zulu for icing overlaid valid for 1600 PST

7.4 Inflight Weather Advisories

Inflight Aviation Weather Advisories are forecasts to advise en route aircraft of development of potentially hazardous weather. Inflight aviation weather advisories in the conterminous U.S. are issued by the NWS AWC, as well as from the Center Weather Service Units (CWSU) associated with FAA Air Route Traffic Control Center's (ARTCCs). There are four basic types of inflight aviation weather advisories: the SIGNificant METeorological Information (SIGMET), the Convective SIGMET, the AIRmen's METeorological Information (AIRMET), and the Center Weather Advisory (CWA). During the period there were no SIGMETs, or Convective SIGMETs, or CWAs were current over Washington. The NWS AWC had a full series of AIRMETs current for the region and were as follows:

IFR conditions

WAUS46 KKCI 172045

WA6S

-SFOS WA 172045

AIRMET SIERRA UPDT 4 FOR IFR AND MTN OBSCN VALID UNTIL 180300

AIRMET IFR...WA OR ID MT

FROM 50SE YXC TO 30W FCA TO 70SSE FCA TO 80SSE MLP TO 70N DNJ TO
20SSW PDT TO 50SE BTG TO 30ENE SEA TO 30SSW YDC TO 50SE YXC

CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 03Z THRU 09Z.

AIRMET MTN OBSCN...WA OR CA
FROM 60WSW YXC TO 50SE REO TO 40SSE LKV TO 30SW FMG TO EED TO
30SE HEC TO 60SSE TRM TO MZB TO LAX TO 50W RZS TO 40SSW FOT TO
50S HQM TO 20NW TOU TO 20WSW HUH TO 60WSW YXC
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 03Z THRU 09Z.

....

Turbulence conditions

WAUS46 KPCI 172045
WA6T
-SFOT WA 172045
AIRMET TANGO UPDT 4 FOR TURB STG WNDZ AND LLWS VALID UNTIL 180300

.
AIRMET TURB...WA OR CA AND CSTL WTRS
FROM YDC TO 30NW YKM TO 20S PDT TO 50SE REO TO 80WSW OED TO
50SSW HQM TO 60WNW TOU TO YDC
MOD TURB BLW 160. CONDS CONTG BYD 03Z THRU 09Z.

.
LLWS POTENTIAL...WA OR AND CSTL WTRS
BOUNDED BY 20N TOU-50WNW EPH-30WSW REO-30ESE OED-50S ONP-20N TOU
LLWS EXP. CONDS CONTG BYD 03Z THRU 09Z.

Icing conditions

WAUS46 KPCI 172045
WA6Z
-SFOZ WA 172045
AIRMET ZULU UPDT 3 FOR ICE AND FRZLVL VALID UNTIL 180300

.
AIRMET ICE...WA OR CA ID MT NV AND CSTL WTRS
FROM 60WSW YXC TO 60SSE YXC TO ILC TO 40W HEC TO 20N LAX TO 120SW
PYE TO 140WSW FOT TO 140W FOT TO 140W TOU TO 60WSW YXC
MOD ICE BTN FRZLVL AND FL200. FRZLVL 040-090. CONDS CONTG BYD 03Z
THRU 09Z.

.
AIRMET ICE...WA OR CA ID MT WY NV UT CO AZ NM AND CSTL WTRS
FROM 50WSW YXC TO 50NNW ISN TO 30WSW BFF TO 20NNE LAR TO 40S ALS
TO 20SE SJN TO BZA TO 50ESE TRM TO 70S RZS TO 20NNE LAX TO 40W
HEC TO ILC TO 60SSE YXC TO 50WSW YXC
MOD ICE BTN FRZLVL AND FL200. FRZLVL SFC-100. CONDS CONTG BYD 03Z THRU 09Z.

.
FRZLVL...RANGING FROM SFC-120 ACRS AREA
SFC ALG 40WSW YDC-40SSW YDC-50NW EPH-70SSE GEG-80SSE GEG
SFC ALG 40E REO-30N REO-50NW REO-20ENE LKV-40S LKV-100SSE LKV
080 ALG 140WSW SNS-20NNW EHF-70WSW BTY-40WNW BTY

....

The graphic version or G-AIRMETs current for 1600 PST are included as figures 12 through 15 below.

SIERRA 2019-01-18 00:00:00

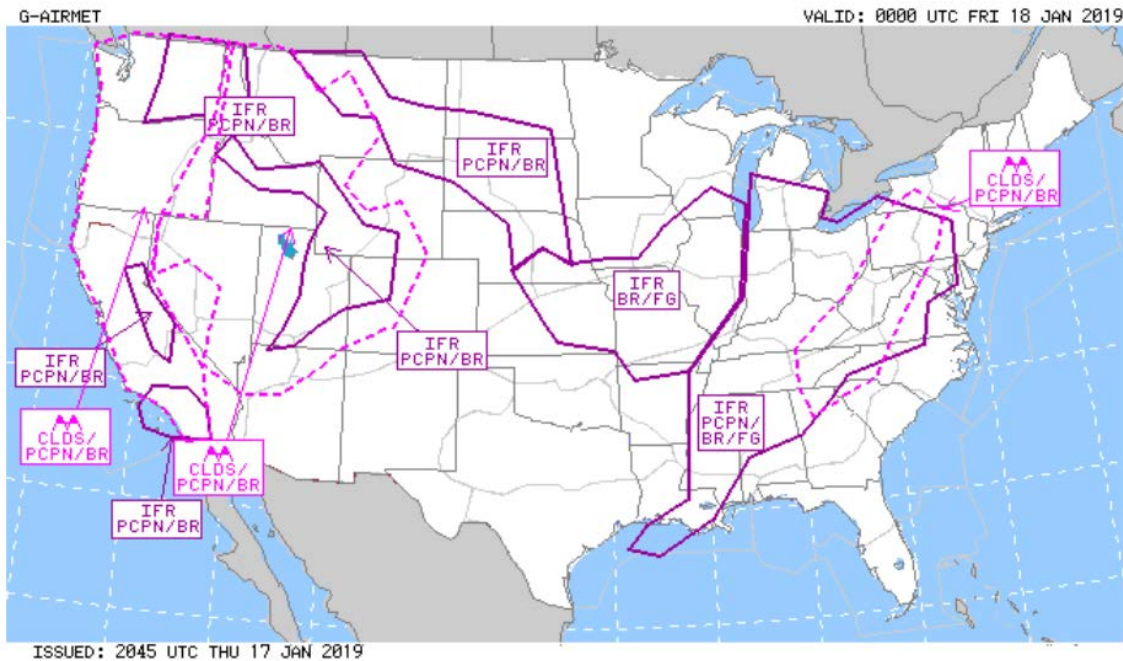


Figure 12 - G-AIRMET Sierra for IFR conditions current at 1600 PST

TANGO 2019-01-18 00:00:00

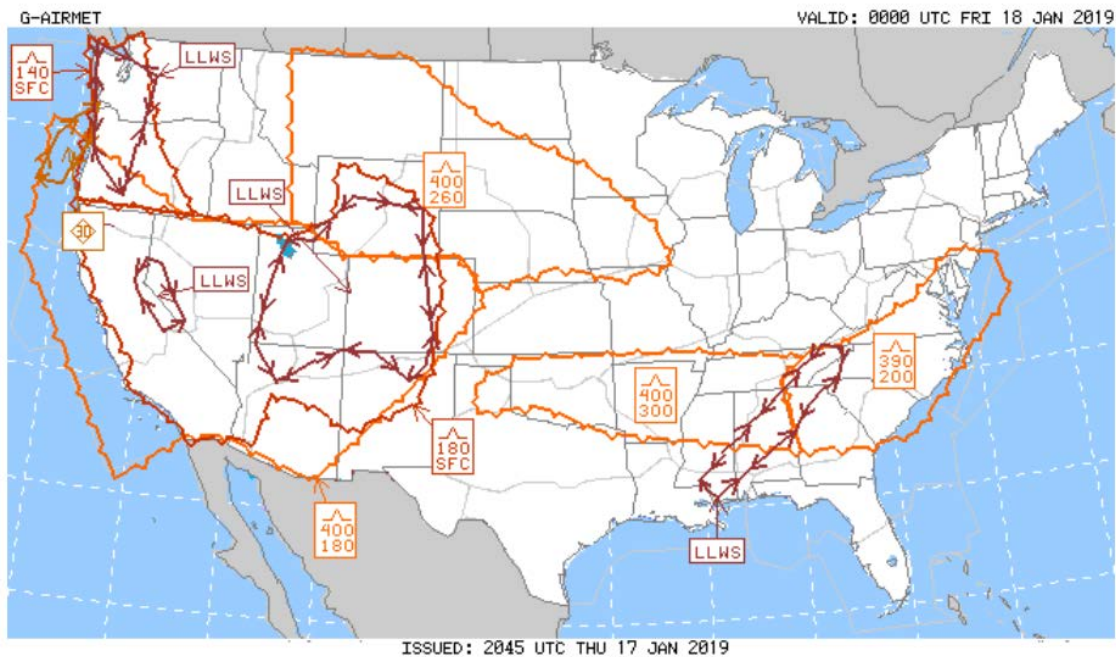


Figure 13 - G-AIRMET Tango for turbulence current at 1600 PST

ZULU 2019-01-18 00:00:00

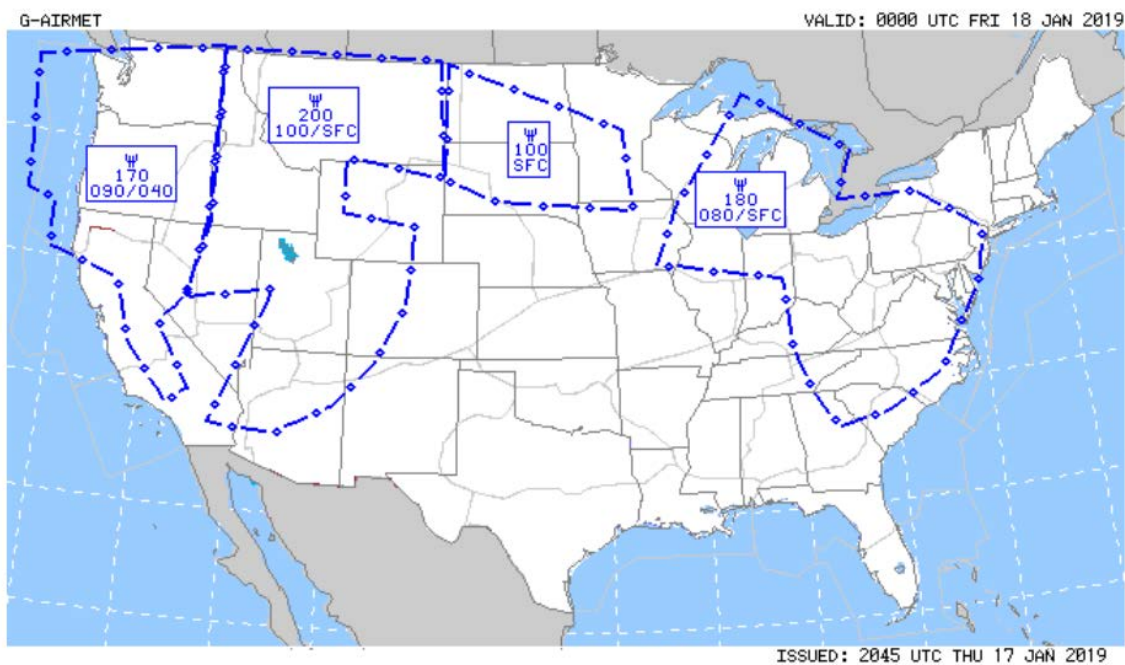


Figure 14 - G-AIRMET Zulu for icing conditions valid at 1600 PST

FREEZING LEVEL 2019-01-18 00:00:00

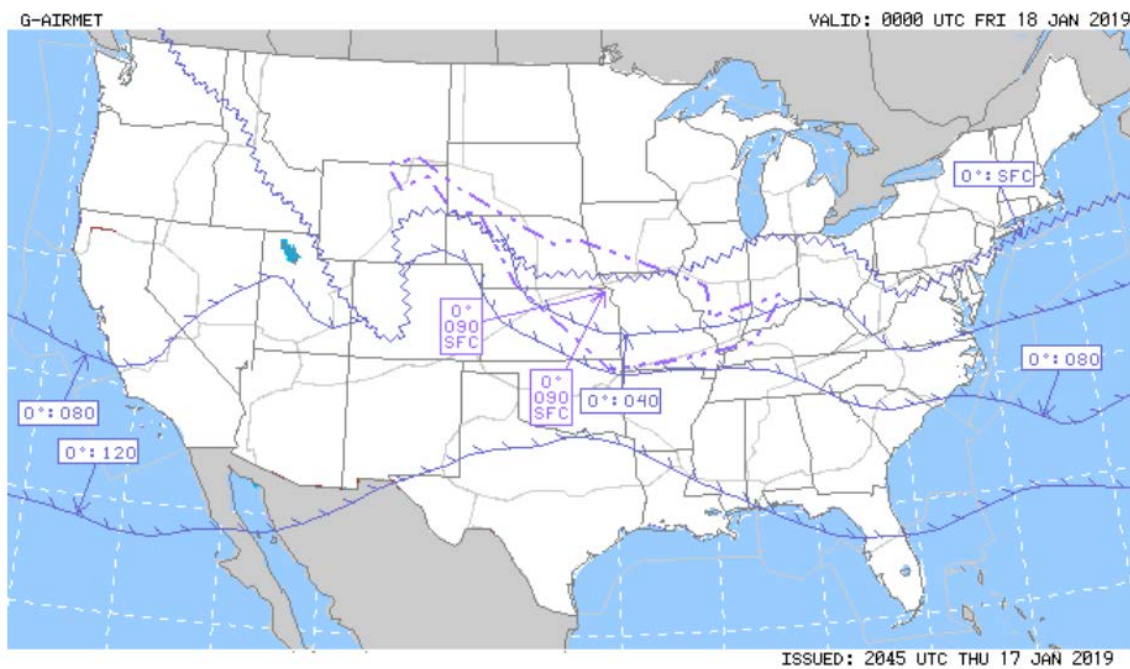


Figure 15 - G-AIRMET Zulu freezing level height valid at 1600 PST

7.5 Winds and Temperatures Aloft Forecast

The NWS Winds and Temperature Aloft Forecast that was current during the period is included below for the area. The forecast was valid for 2200 PST, and for use between 1800 PST and 0100 PST and was as follows:

*WINDS ALOFT FORECASTS
DATA BASED ON 180000Z
VALID 180600Z FOR USE 0200-0900Z. TEMPS NEG ABV 24000*

<i>FT</i>	<i>3000</i>	<i>6000</i>	<i>9000</i>	<i>12000</i>	<i>18000</i>	<i>24000</i>	<i>30000</i>	<i>34000</i>	<i>39000</i>
<i>YKM</i>	<i>2318</i>	<i>2633-01</i>	<i>2529-07</i>	<i>2425-14</i>	<i>2213-27</i>	<i>2317-41</i>	<i>273053</i>	<i>283551</i>	<i>283950</i>
<i>SEA</i>	<i>2241</i>	<i>2235-02</i>	<i>2337-08</i>	<i>2334-15</i>	<i>2018-27</i>	<i>1922-40</i>	<i>252753</i>	<i>273551</i>	<i>283850</i>

The YKM forecast wind at 3,000 ft was from 230° at 18 knots, at 6,000 ft the wind was from 260° at 33 knots with a temperature of -1° C.

8.0 Weather Briefing

The Federal Aviation Administration contract Automated Flight Service Station (AFSS) provider Leidos had no contact with the pilot on January 17, 2019 for any preflight weather briefing or for any flight plans. Foreflight also indicated that they did not have any record of any weather requests from the pilot. It is therefore unknown what weather information was used to familiarization and any preflight action for the flight.

9.0 Witness Statements

Several witness and air traffic control statements were obtained regarding the case and are summarized below. The witness statements can be found in the docket.

One witness at KELN observed the accident pilot heading out to his aircraft to remove the estimated 3 to 5 inches of snow that had accumulated overnight and into the morning hours. The witness indicated he had helped someone clear the snow from their aircraft and he indicated that the snow came off quite clean but left surface beads of water on the airframe. He then helped the accident pilot remove some snow berms around the airplane with a shovel, which were left from earlier plowing off the ramp. The accident pilot indicated to him that he had hoped to depart earlier, but he was unable due to his work and also indicated he had hoped to get back in VFR conditions. The witness looked to the south and indicated that he could see the ridge to the south in places but not in others, and indicated the whole valley was covered by clouds in one place or another. The accident pilot indicated that he would be contacting "Chinook" Pasco air traffic control TRACON for vectors around the weather. The witness then went back inside the fixed base operation, and later heard N14372 engines start but did not see it depart. A short while later a line service man answered a call from Chinook TRACON asking about the location of N14372. He located the accident pilots cell phone number, called his phone and got his voicemail.

The Chinook approach control indicated that N14372 had called and indicated he was between cloud layers at 5,000 ft and requested the ILS approach runway 27 approach into KYKM. He issued a squawk code for the transponder at 1644 PST with no response from the pilot. The controller attempted multiple time to re-establish contact with the aircraft and assumed the flight went back to KELN.

Two other witnesses observed the aircraft impact the ground and indicated that they both heard load engine sounds of the airplane and observed the aircraft in a steep dive at a low altitude. One witness indicated it was flying westward and attempted to turn to the south with one wing angled down when it hit the ground and the other indicated it looked like it was diving down sideways when it impacted the field. Both responded to the accident scene, which was on one of the witness's property.

A security camera video captured the accident airplane emerging from the clouds at a steep angle and impact the snow covered field at about 1645:34 PST. The total time from emerging from the clouds and ground impact was less than 4-seconds. In the background an extensive layer of low stratiform clouds and fog can be seen in the valley with the higher elevation ridges partly visible as described by the first witness at the FBO, with another overcast layer of clouds above.

10.0 Astronomical Conditions

The United States Naval Observatory's website¹⁰ was used to determine the astronomical conditions on January 17, 2019 for Ellensburg, Kittitas County, Washington. The accident time is added in bold italic type for reference. The conditions were as follows:

<u>Sun</u>	
Begin of civil twilight	0708 PST
Sunrise	0742 PST
Sun transit	1212 PST
Sunset	1643 PST
<i>Accident</i>	<i>1646 PST</i>
End of civil twilight	1717 PST

At the time of the accident the Sun was 1.3° below the horizon at an azimuth of 240°, official nighttime occurred 31-minutes later.

Submitted by:

¹⁰ https://aa.usno.navy.mil/data/docs/RS_OneDay.php