

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



CEN24FA089

METEOROLOGY

Specialist's Factual Report

March 18, 2024

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A. ACCIDENT

Location: Poolville, Texas
Date: January 14, 2024
Time: 1215 central standard time
1815 coordinated universal time (UTC)
Airplane: Cessna 310R; Registration: N252DL

B. METEOROLOGY SPECIALIST

Paul Suffern
Senior Meteorologist
National Transportation Safety Board
Washington, DC

C. DETAILS OF THE INVESTIGATION

The NTSB's Senior Meteorologist did not travel for this investigation but gathered all data remotely. Data for this investigation were collected from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the Weather Prediction Center (WPC) and the National Center for Environmental Information (NCEI). This Specialist's Factual Report contains the meteorological factors pertinent to the weather surrounding the accident time. All times are central standard time (CST) and are based upon the 24-hour clock, where local time is -6 hours from UTC. Directions are referenced to true north and distances are in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles. NWS station identifiers use the standard International Civil Aviation Organization 4-letter station identifiers versus the International Air Transport Association 3-letter identifiers, which deletes the initial country code designator "K" for U.S. airports.

The accident site was located at approximate latitude 32.9863° N, longitude 97.8972° W, and elevation of 1,160 feet (ft).

D. FACTUAL INFORMATION

1.0 Synoptic Situation

The synoptic or large-scale migratory weather systems influencing the area were documented using standard NWS charts issued by the National Center for Environmental Prediction and the WPC, located in College Park, Maryland. These are the base products used in describing synoptic weather features and in the creation of forecasts and warnings for the NWS. Reference to these charts can be found in the Federal Aviation Administration (FAA) "Aviation Weather Handbook", FAA-H-8083-28.¹

1.1 Surface Analysis Chart

The NWS Surface Analysis Chart centered over the south-central United States for 1200 CST is provided as figure 1 with the location of the accident site within the black circle. The chart depicted a low-pressure system at 1019-hectopascals (hPa) located along the northwestern Gulf of Mexico near the Louisiana and Texas borders. Another low-pressure system was located in far southwestern Texas at 1014-hPa with two additional low-pressure systems in New Mexico and central Colorado, respectively. Frontal boundaries connected each of these low-pressure systems. A high-pressure system at 1034-hPa was located in northern Kansas. There were no surface frontal boundaries near the accident site at 1200 CST.

The station models closest to the accident site depicted air temperatures of 12 to 13 degrees Fahrenheit (°F), dew point temperatures of -4 to -6°F, cloudy skies, and a north wind at 10 knots.

¹ [FAA-H-8083-28](#)

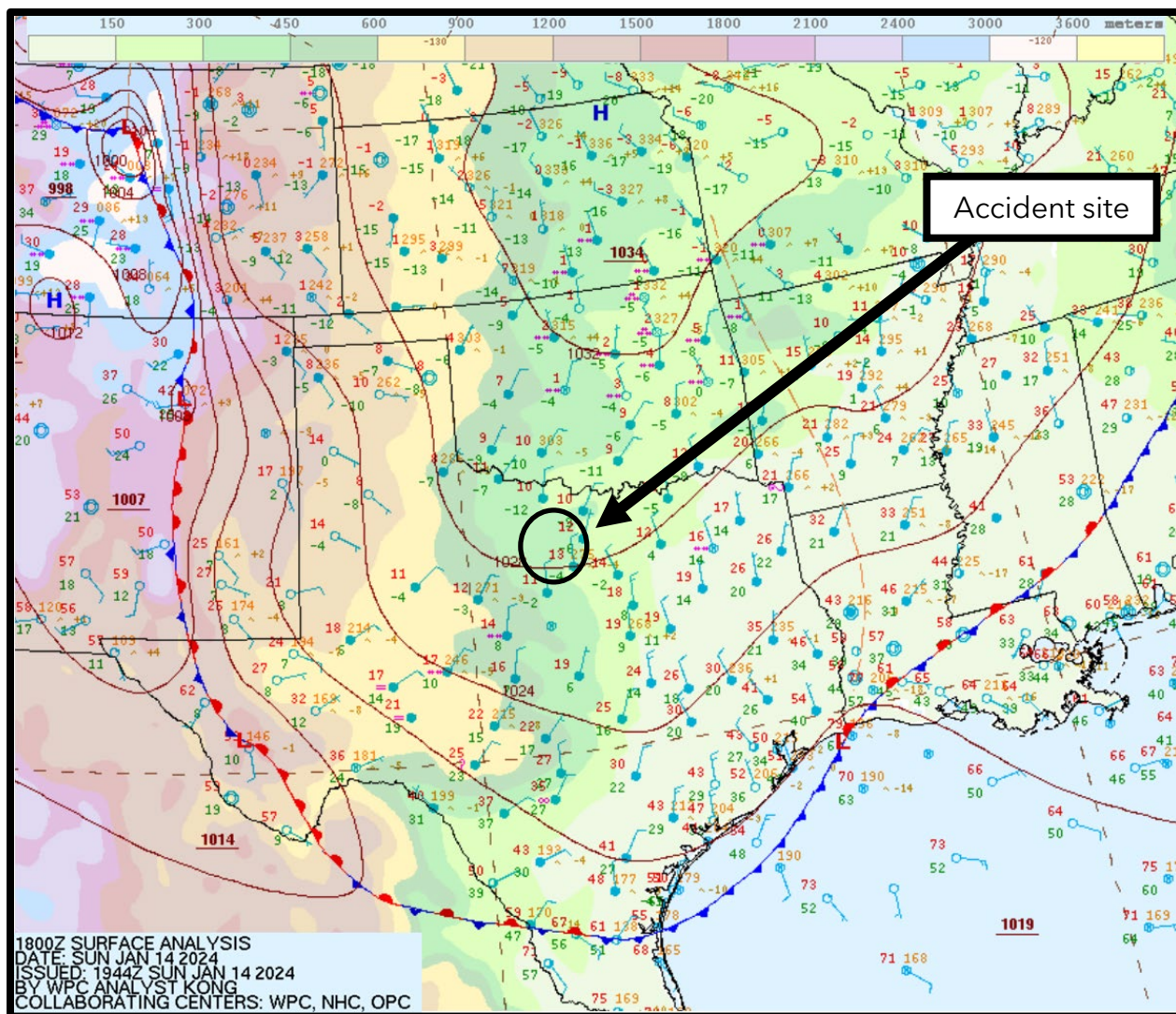


Figure 1. NWS Surface Analysis Chart for 1200 CST.

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 1800 CST at 925-, 850-, and 700-hPa are presented in figures 2 through 4. The charts indicated a mid-level trough² at 850-hPa (figure 3) in central Texas. An additional trough was located at 700-hPa from New Mexico into Colorado. Troughs and fronts can act as lifting mechanisms to help produce clouds and precipitation if sufficient moisture is present. The 925-hPa constant pressure chart depicted a northeast wind around 15 knots (figure 2) becoming a southwest 35 knot wind by 850-hPa (figure 3). By 700-hPa, the wind became westerly at 45 knots (figure 4).

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

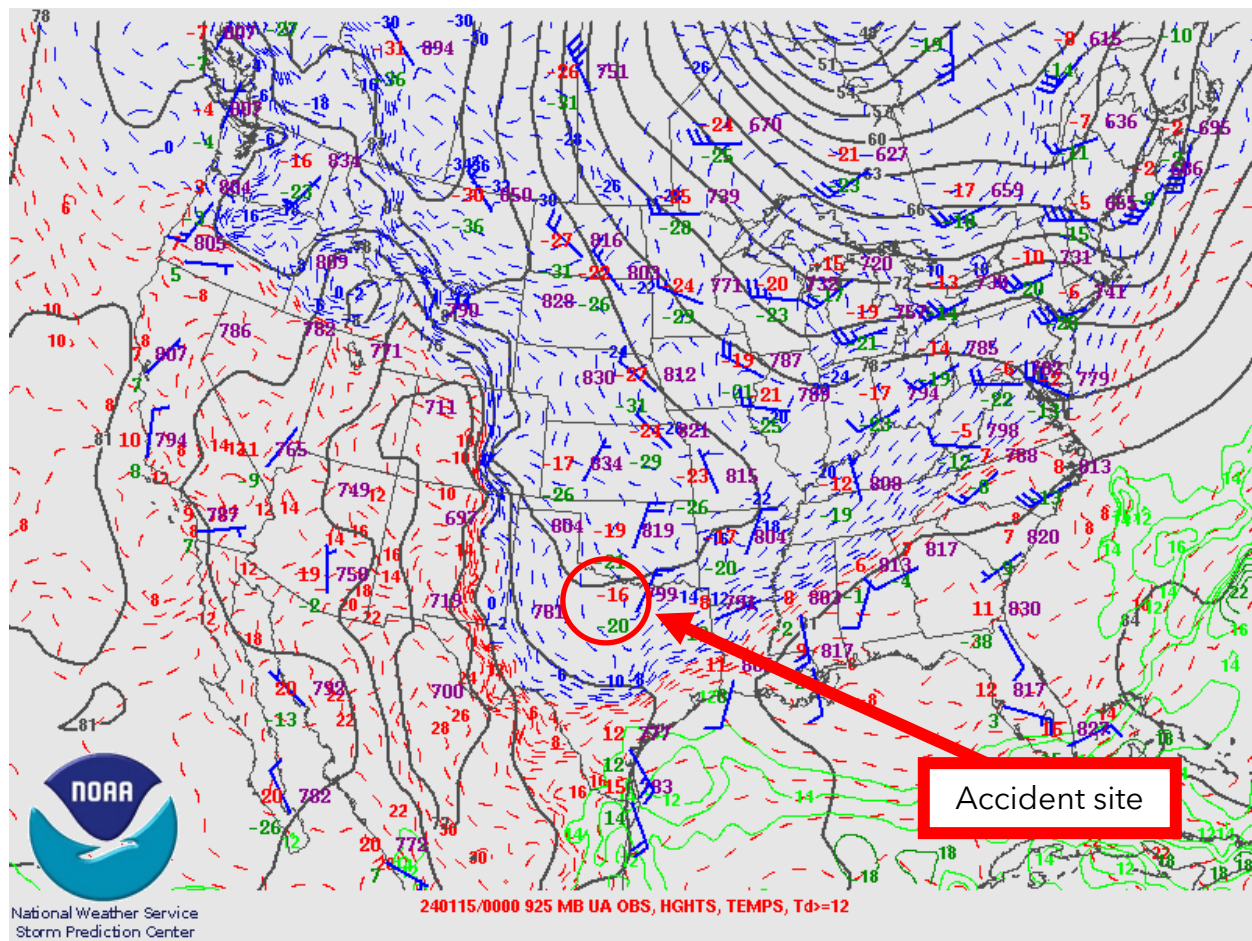


Figure 2. 925-hPa Constant Pressure Chart for 1800 CST.

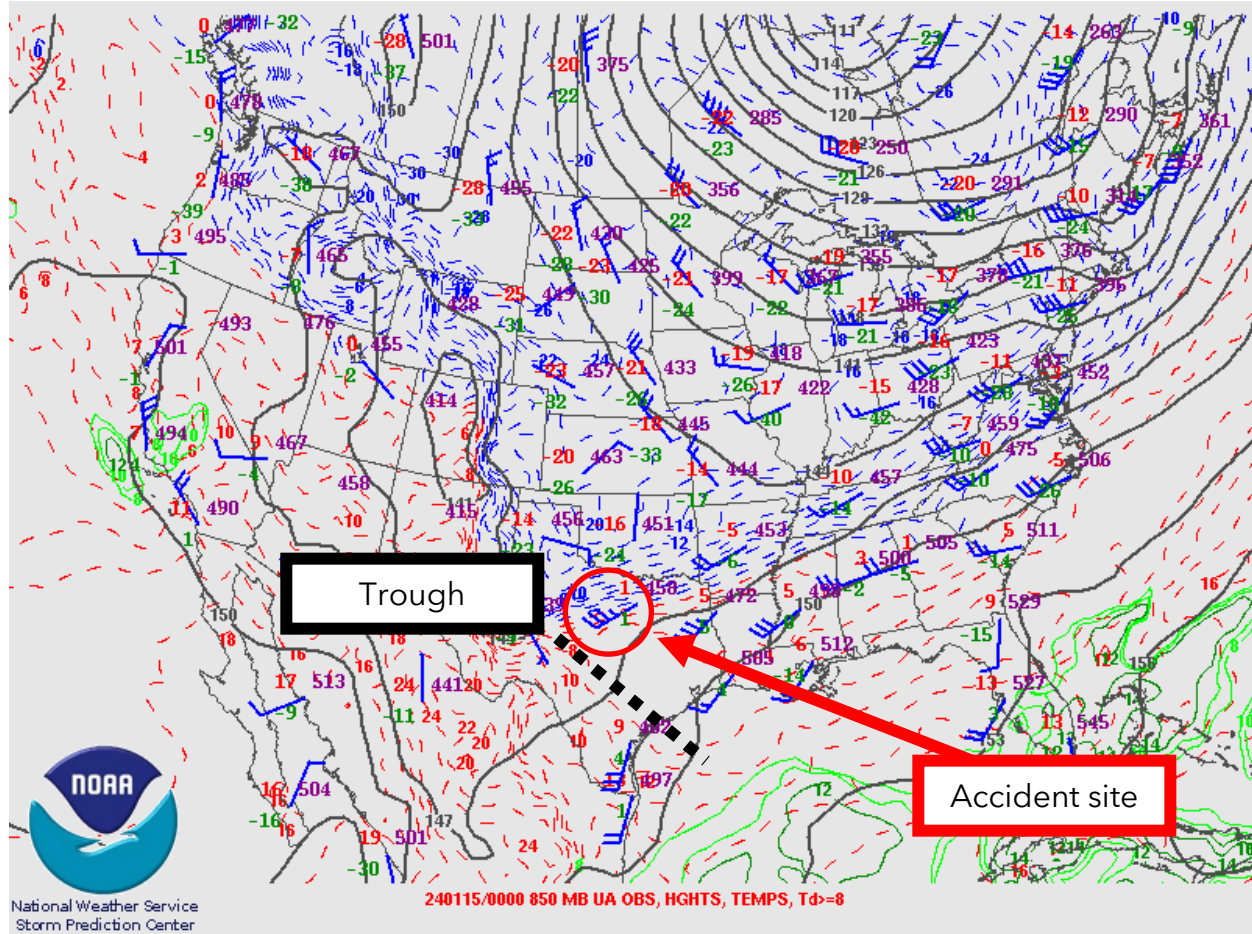


Figure 3. 850-hPa Constant Pressure Chart for 1800 CST.

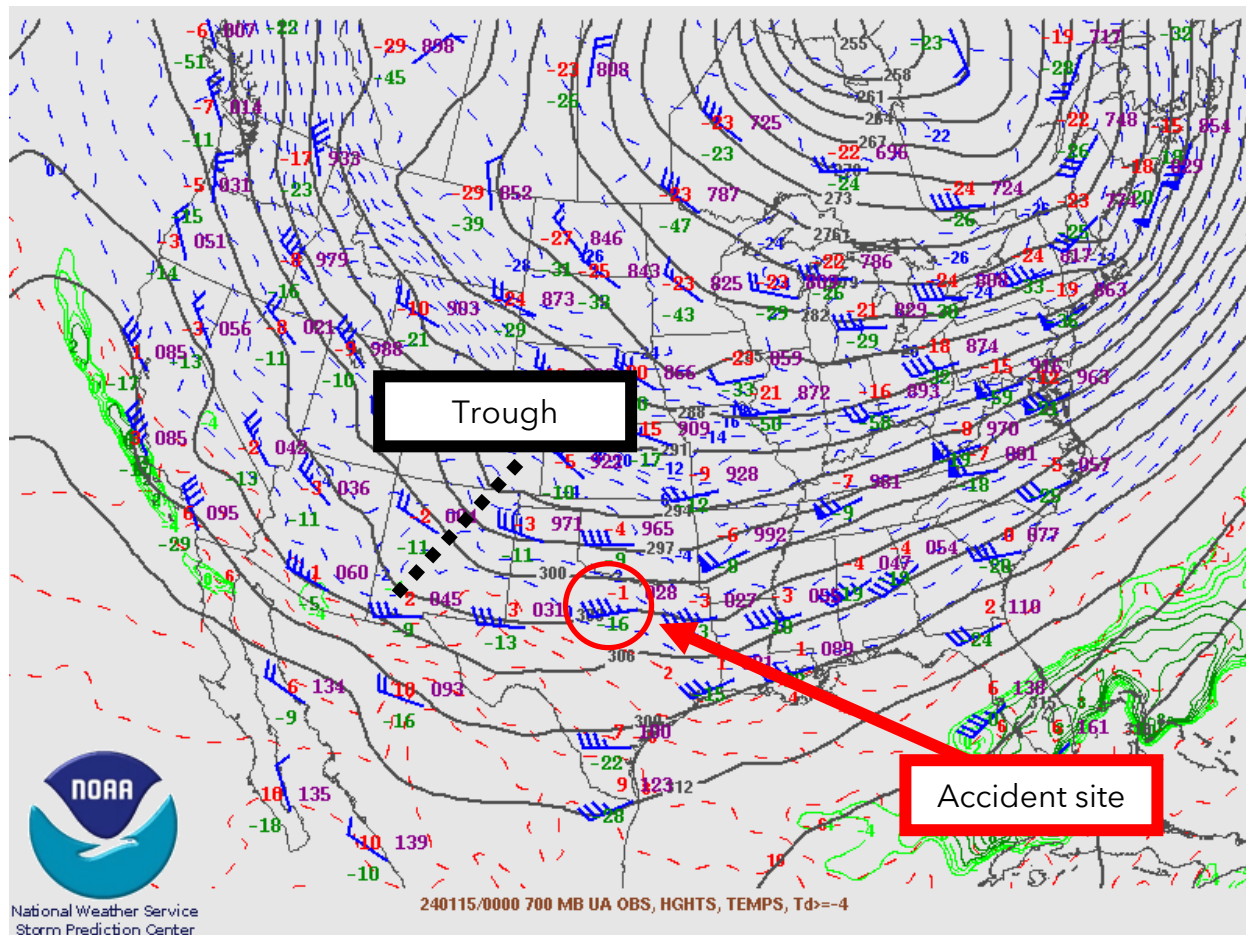


Figure 4. 700-hPa Constant Pressure Chart for 1800 CST.

2.0 Surface Observations

The area surrounding the accident site was documented using official Aviation Routine Weather Reports (METARs) and Special Reports (SPECIs)³. The following observations were taken from standard code and are provided in plain language. Figure 5 is a local sectional chart with the accident site and the closest weather reporting locations marked. A magnetic variation⁴ of 4° east was indicated over the area.

³ Latest criteria for SPECIs can be found in the Federal Meteorological Handbook: [Federal Meteorological Handbook Number 1, Surface Weather Observations and Reports \(icams-portal.gov\)](https://www.federalregister.gov/documents/2018/01/16/2018-01-16-federal-meteorological-handbook-number-1-surface-weather-observations-and-reports)

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

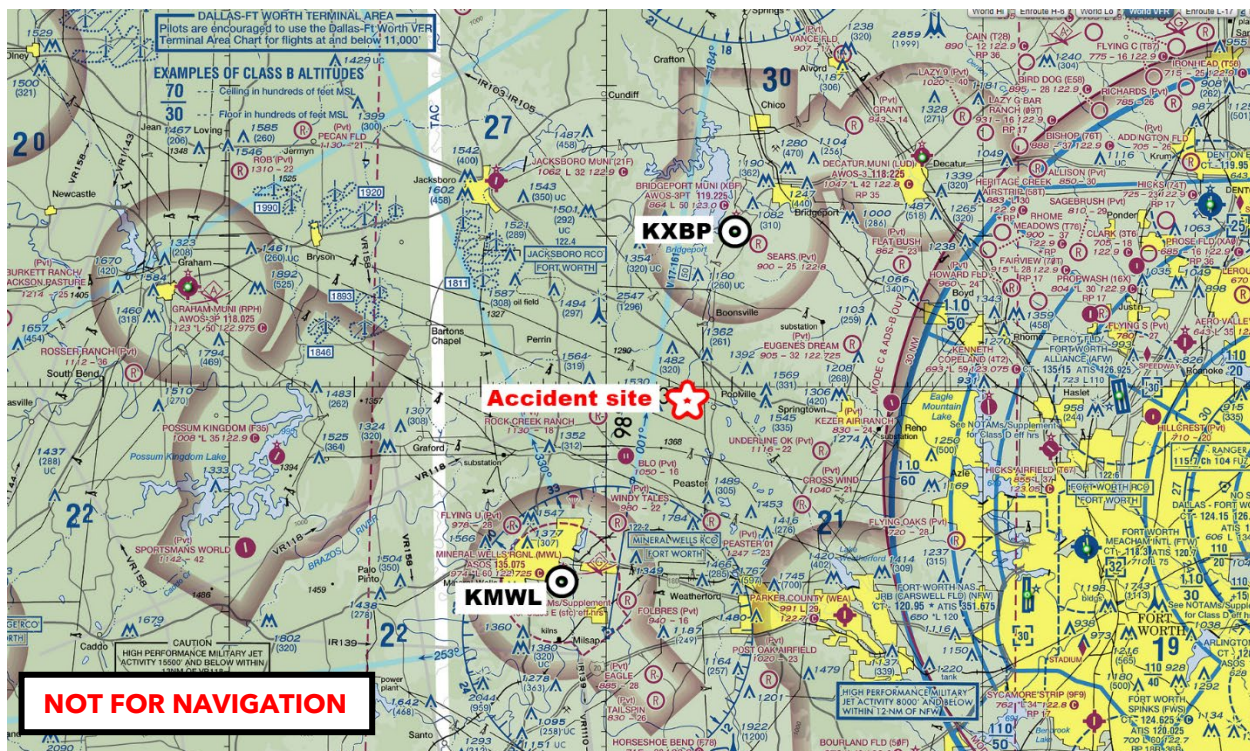


Figure 5. FAA sectional aeronautical chart of the accident area with the location of the accident site and surface observation sites noted.

Bridgeport Municipal Airport (KXBP) had the closest official weather station to the accident site and was the intended destination airport. KXBP had an Automated Weather Observing System (AWOS⁵) and its longline⁶ reports were not augmented. The KXBP AWOS was located 12 miles north-northeast of the accident site (figure 5) at an elevation of 864 ft, and issued the following observations surrounding the accident time:⁷

[1055 CST] METAR KXBP 141655Z AUTO 01011KT 10SM OVC036
M11/M21 A3039 RMK AO2 T11121208

⁵ AWOS - Automated Weather Observing System is equipped with meteorological instruments to typically observe and report temperature, dewpoint, wind speed and direction, visibility, cloud coverage and ceiling up to 12,000 feet, and altimeter setting. AWOS are maintained by the FAA. Certain AWOS may have different reporting or observational equipment.

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

⁷ The bold sections of products in this report are intended to highlight the text that directly reference the weather conditions that affected the accident region around the accident time. The local times in this section next to the METARs are provided for quick reference between UTC and local times.

[1115 CST] METAR KXBP 141715Z AUTO 01008KT 10SM OVC036
M11/M21 A3038 RMK AO2 T11101212

[1135 CST] METAR KXBP 141735Z AUTO 02008KT 10SM OVC032
M11/M21 A3038 RMK AO2 T11101209

[1155 CST] METAR KXBP 141755Z AUTO 02007KT 350V050 10SM
OVC032 M11/M21 A3035 RMK AO2 T11101211 11108 21117

**[1215 CST] METAR KXBP 141815Z AUTO 02006KT 10SM OVC030
M11/M21 A3034 RMK AO2 T11101215**

ACCIDENT TIME 1215 CST

**[1235 CST] METAR KXBP 141835Z AUTO 36007KT 10SM OVC030
M11/M21 A3033 RMK AO2 T11091209**

[1255 CST] METAR KXBP 141855Z AUTO 04008KT 10SM OVC030
M11/M21 A3032 RMK AO2 T11081212

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

KXBP weather at 1215 CST, automated, wind from 020° at 6 knots, visibility 10 miles or greater, overcast ceiling at 3,000 ft above ground level (agl), temperature of -11° Celsius (C), dew point temperature of -21°C, and an altimeter setting of 30.34 inches of mercury (inHg). Remarks, automated station with a precipitation discriminator, temperature -11.0°C, dew point temperature -21.5°C.

KXBP weather at 1235 CST, automated, wind from 360° at 7 knots, visibility 10 miles or greater, overcast ceiling at 3,000 ft agl, temperature of -11°C, dew point temperature of -21°C, and an altimeter setting of 30.33 inHg. Remarks, automated station with a precipitation discriminator, temperature -10.9°C, dew point temperature -20.9°C.

Mineral Wells Regional Airport (KMWL) was the next closest official weather station to the accident site. KMWL had an Automated Surface Observing System (ASOS⁸) and its longline reports were not augmented. The KMWL ASOS was located 15 miles southwest of the accident site (figure 5), at an elevation of 974 ft, and issued the following observations surrounding the accident time:

[1053 CST] METAR KMWL 141653Z AUTO 01008KT 10SM OVC032
M11/M20 A3033 RMK AO2 SLP284 T11061200

[1142 CST] SPECI KMWL 141742Z AUTO 36008KT 10SM OVC029
M11/M20 A3032 RMK AO2 T11111200

[1153 CST] METAR KMWL 141753Z AUTO 36009KT 10SM OVC031
M11/M20 A3031 RMK AO2 SLP275 T11061200 11106 21111 58004

**[1206 CST] SPECI KMWL 141806Z AUTO 36010KT 10SM BKN029
OVC034 M11/M20 A3030 RMK AO2 T11061200**

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**[1224 CST] SPECI KMWL 141824Z AUTO 35009G17KT 10SM
OVC031 M11/M19 A3028 RMK AO2 T11061194**

[1253 CST] METAR KMWL 141853Z AUTO 35011KT 10SM OVC032
M11/M19 A3027 RMK AO2 SLP263 T11061189

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

KMWL weather at 1206 CST, automated, wind from 360° at 10 knots, visibility 10 miles or greater, broken ceiling at 2,900 ft agl, overcast skies at 3,400 ft agl, temperature of -11°C, dew point temperature of -20°C, and an altimeter setting of 30.30 inHg. Remarks, automated station with a precipitation discriminator, temperature -10.6°C, dew point temperature -20.0°C.

⁸ ASOS - Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, weather phenomena, ceiling, temperature, dewpoint, altimeter, and barometric pressure. ASOS are maintained by the NWS.

KMWL weather at 1224 CST, automated, wind from 350° at 9 knots with gusts to 17 knots, visibility 10 miles or greater, overcast ceiling at 3,100 ft agl, temperature of -11°C, dew point temperature of -19°C, and an altimeter setting of 30.28 inHg. Remarks, automated station with a precipitation discriminator, temperature -10.6°C, dew point temperature -19.4°C.

The observations from the KXBP and KMWL both reported MVFR⁹ conditions at the time of the accident due to cloud ceilings with a north wind around 5 to 10 knots and gusts to 17 knots.

3.0 Upper Air Sounding

A High-Resolution Rapid Refresh (HRRR)¹⁰ model sounding was created¹¹ for the approximate accident site coordinates for 1200 CST. The HRRR sounding was plotted on a standard Skew-T Log P diagram¹² from the surface to 600-hPa (or approximately 14,000 ft) using the RAOB¹³ software package and is included as figure 6. The sounding depicted an elevation of 1,214 ft over the grid point with a near surface temperature of -11.0°C, a dew point temperature of -20.1°C, and a relative humidity of 47%. The sounding depicted the lifted condensation level (LCL)¹⁴ at 4,897 ft and the convective condensation level (CCL)¹⁵ at 25,140 ft. It was only above freezing between 5,750 and 9,750 ft. The precipitable water value was 0.50 inches.

⁹ 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.

¹⁰ 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.

¹¹ HRRR sounding was created using NOAA Air Resource Laboratory: [READY Archived Meteorology \(noaa.gov\)](https://ready.noaa.gov/).

¹² 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.

¹³ RAOB - (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Esonde Research Services, The Villages, Florida.

¹⁴ LCL - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

¹⁵ CCL - The level in the atmosphere to which an air parcel, if heated from below, will rise dry

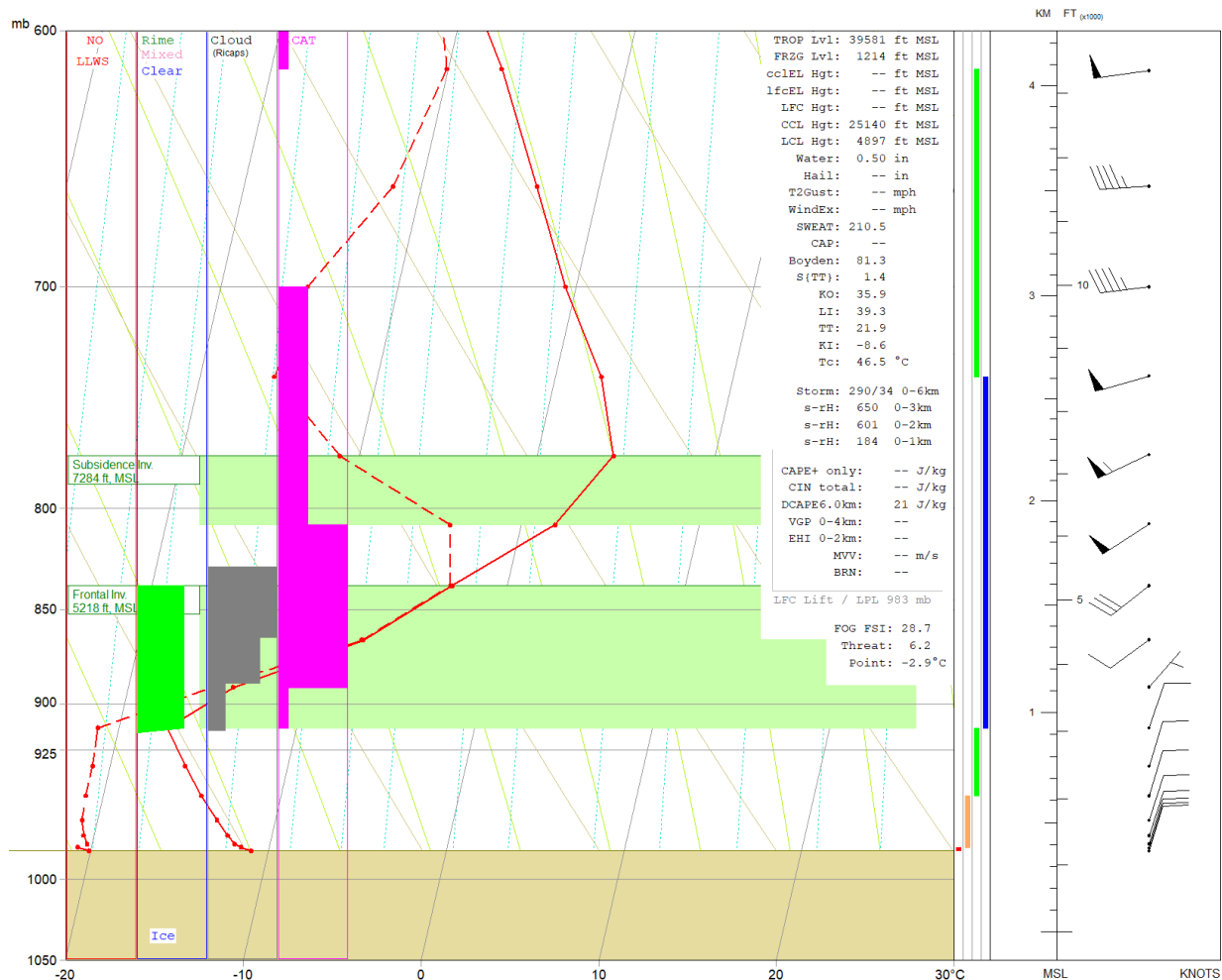


Figure 6. 1200 CST HRRR sounding.

The 1200 CST HRRR sounding identified both unstable and conditionally unstable environments from the surface through 3,000 ft, then a stable layer between 3,000 and 8,500 ft. RAOB indicated a cloud layer between 3,000 ft (~1,800 ft agl) and 5,500 ft (~4,300 ft agl). Moderate rime icing was indicated between 3,000 and 5,000 ft. The top of a frontal inversion¹⁶ was indicated at 5,218 ft and the top of a subsidence inversion was indicated at 7,284 ft.

adiabatically, without becoming colder than its environment just before the parcel becomes saturated.
¹⁶ Inversion - A departure from the usual decrease of the value of an atmospheric property with increasing altitude; also, the layer through which this departure occurs (the "inversion layer"), or the lowest altitude at which the departure is found (the "base of the inversion").

The 1200 CST HRRR sounding wind profile indicated a near-surface wind from 020° at 10 knots with the wind remaining northerly through 4,000 ft. The wind veered¹⁷ to the southwest by 4,000 ft. The wind speed increased to 30 knots by 5,000 ft and to 50 knots by 6,000 ft. No low-level wind shear (LLWS) was indicated by RAOB. RAOB indicated light to moderate clear air turbulence (CAT) between 3,000 ft and 10,000 ft.

4.0 Satellite Data

Geostationary Operational Environmental Satellite number 16 (GOES-16) visible and infrared data were obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man-computer Interactive Data Access System software. Visible and infrared imagery (GOES-16 bands 2 and 13, respectively) at wavelengths of 0.64 microns (μm) and 10.3 μm , respectively, were retrieved for the period from 1000 CST through 1600 CST and reviewed, and the closest images to the time of the accident were documented.

Figure 7 presents the GOES-16 visible image at 1216 CST at 2X magnification with the accident site highlighted with a red square. Cloud cover was indicated above the accident site with the higher cloud cover moving from west to east and the lower cloud cover nearly stationary around the accident time (attachment 1). Figure 8 presents the GOES-16 infrared image at 1216 CST at 6X magnification with the accident site highlighted with a red square. Cloud cover was indicated above the accident site with lower brightness temperatures (green and yellow colors; higher cloud tops) located above and surrounding the accident site at the accident time. The brightness temperature of 247 Kelvin¹⁸ above the accident site would have been near 24,000 ft based on the vertical temperature profile provided by the 1200 CST HRRR sounding (not shown in figure 6). It should be noted these figures have not been corrected for any parallax error.

¹⁷ Veered - Wind turning clockwise with height.

¹⁸ around -26°C

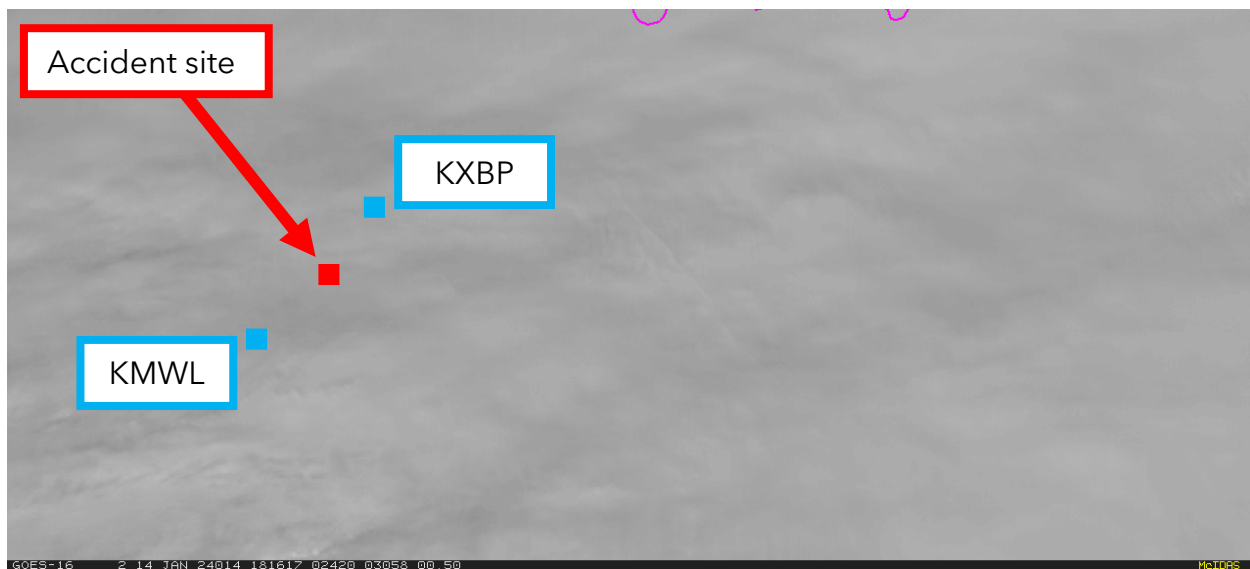


Figure 7. GOES-16 visible image at 1216 CST.

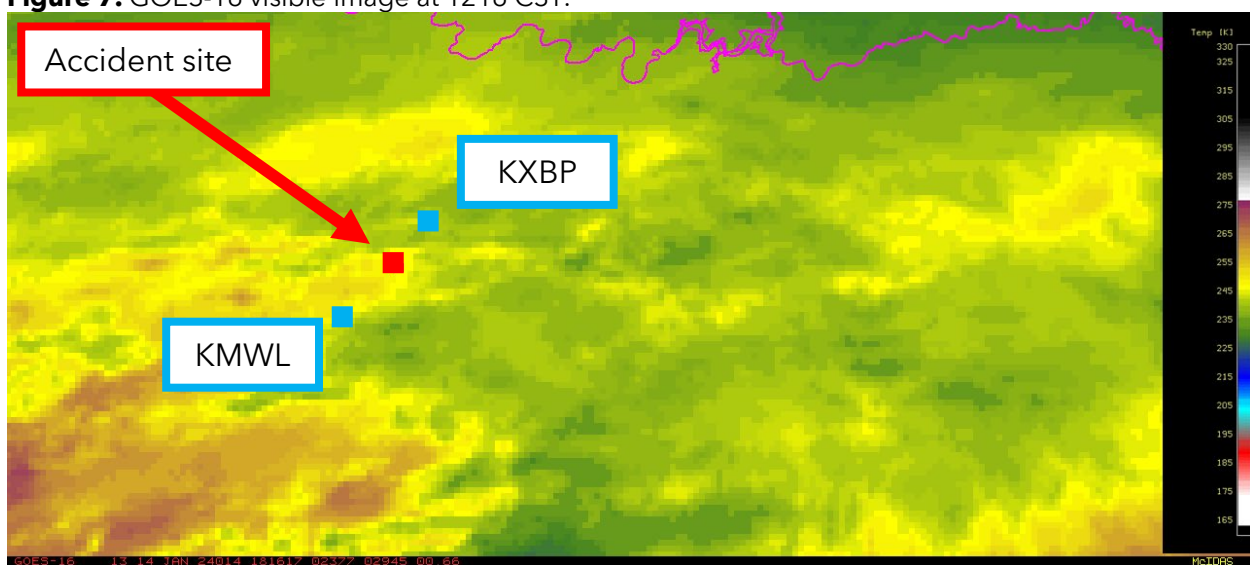


Figure 8. GOES-16 infrared image at 1216 CST.

5.0 National Radar Imagery

A regional view of the NWS National Reflectivity Mosaic is included as figure 9 for 1215 CST with the approximate location of the accident site marked by a red circle. The image depicted no echoes above the accident site.

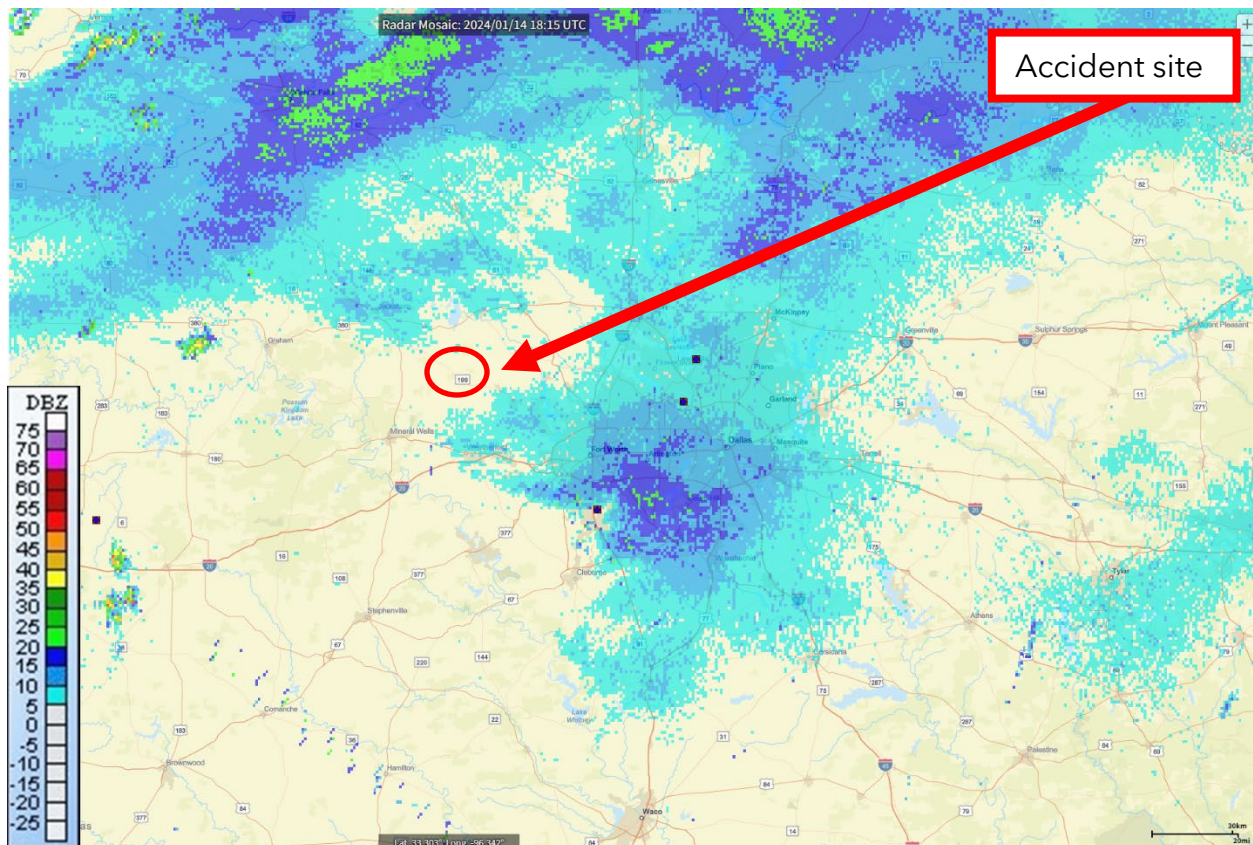


Figure 9. National Reflectivity Mosaic for 1215 CST.

6.0 Pilot Reports

The longline-disseminated pilot reports¹⁹ (PIREPs) distributed into the national airspace system (NAS) within 2 hours either side of the accident time and within 100 miles of the accident site at altitudes below 18,000 ft are shown here:

DFW UA /OV 20 W/TM 1623/FLDURC/TP CRJ7/TB CONT LT TURB 135
 DFW UA /OV DFW360010/TM 1700/FLB035/TP E175/SK B035 T070
 DFW UA /OV 170006/TM 1704/FL033/TP A321
 DFW UA /OV DAL135010/TM 1705/FL030/TP B737/IC MOD/RM M14C
 DFW UA /OV 25 NE DFW/TM 1710/FL140/TP A320/TB MOD 140-120/RM DURD
 FTW UA /OV FTW180010/TM 1715/FLDURGD/TP BE9L/SK OVC038
 DFW UA /OV FTW360001/TM 1715/FL040/TP PAY2/IC LGT RIME
 DFW UA /OV DFW045020/TM 1740/FL130/TP F2TH/TB LIGHT CHOP/RM SMOOTH

¹⁹ Only PIREPs with the World Meteorological Organization headers UBTX** and UBOK** were considered. These do not include pilot reports only broadcast via radio.

BELOW 130

CRS UA /OV CQY360025/TM 1741/FL150/TP B737/TB LGT/RM 130-170

DFW UA /OV DFW045012/TM 1744/FL100/TP B738/SK OVC032-TOP066

DFW UA /OV DAL135008/TM 1746/FL030/TP GLF5/TA -8C/TB LT MIXED

ADS UA /OV ADS160008/TM 1808/FL030/TP SR22/SK OVC030

DFW UA /OV TKI315010/TM 1823/FL070/TP C56X/SK TOP070

DFW UA /OV 130005/TM 1837/FL033/TP CRJ9

DAL UA /OV DAL310004/TM 1841/FL034/TP B738/SK OVC034

DFW UA /OV DFW360010/TM 1911/FL045/TP E170/TA 03/IC LGT RIME

DFW UA /OV 6 N ADS/TM 1918/FL040/TP PC12/TA M06/IC LGT CLR

DUA UA /OV UKW200015/TM 1928/FL080/TP BE20/TA M10/IC LGT RIME 230-150/RM

ZFW

DFW UA /OV DFW310015/TM 1935/FL130/TP A321/SK BASE 031 TOPS 075/TB -

TURB MOD CHOP

DFW UA /OV 130004/TM 1935/FL035/TP A321/IC TRACE ICING

HQZ UA /OV HQZ360002/TM 1938/FL018/TP C25C/SK OVC/RM DUR C

DFW UA /OV DFW360007/TM 1941/FL040/TP E170/TA M10/IC RIME

SPS UA /OV SPS/TM 1956/FL130/TP PC12/TA M05/IC LGT RIME/RM ZFW

DAL UA /OV DAL310005/TM 2014/FL030/TP C750/SK OVC030

DFW UA /OV DFW180015/TM 2015/FL050/TP A321/TA M03/IC RIME

7.0 Significant Meteorological Information

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

8.0 Center Weather Service Advisories

The Fort Worth (ZFW) Air Route Traffic Control Center (ARTCC) Center Weather Service Unit (CWSU) was responsible for the accident region. There was no Center Weather Advisory (CWA) valid for the accident site at the accident time. The Pre-Duty Weather Briefing (PDWB) valid at the accident time is contained in attachment 2.

9.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) products issued by the AWC before the accident flight and valid at 1200 CST and issued around 0700 CST are shown in figures 10 and 11 (additional GFA forecast products produced after 0700 CST were not available due to AWC archiving constraints). The GFA surface forecasts applicable at 1200 CST for the accident site indicated VFR conditions with light freezing rain and a northeast wind of 10 knots. The GFA cloud forecast applicable to the accident site for 1200 CST indicated overcast cloud cover at the accident site with cloud bases around 4,000 ft and cloud tops to FL270²⁰ with cirrus clouds above. Graphical AIRMET²¹ (G-AIRMET) Zulu was valid for 1200 CST for the accident site (figure 11). The only human-generated information reflected in the two GFA products were the G-AIRMETs. Similar weather forecast conditions were noted for the 0900 and 1800 CST GFA surface and cloud forecasts (not shown). G-AIRMET Zulu issued at 0845 CST and valid for 1200 CST (figure 12) forecast moderate icing between the surface and FL220 for the accident site.

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 standard 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.

²¹ Graphical AIRMETs (G-AIRMETs), found on the Aviation Weather Center webpage at <http://aviationweather.gov>, are graphical forecasts of en-route weather hazards valid at discrete times no more than 3 hours apart for a period of up to 12 hours into the future (for example, 00, 03, 06, 09, and 12 hours). G-AIRMETs are snap shots at discrete time intervals as defined above. The text AIRMET is the result of the production of the G-AIRMET but provided in a time smear for a 6hr valid period.

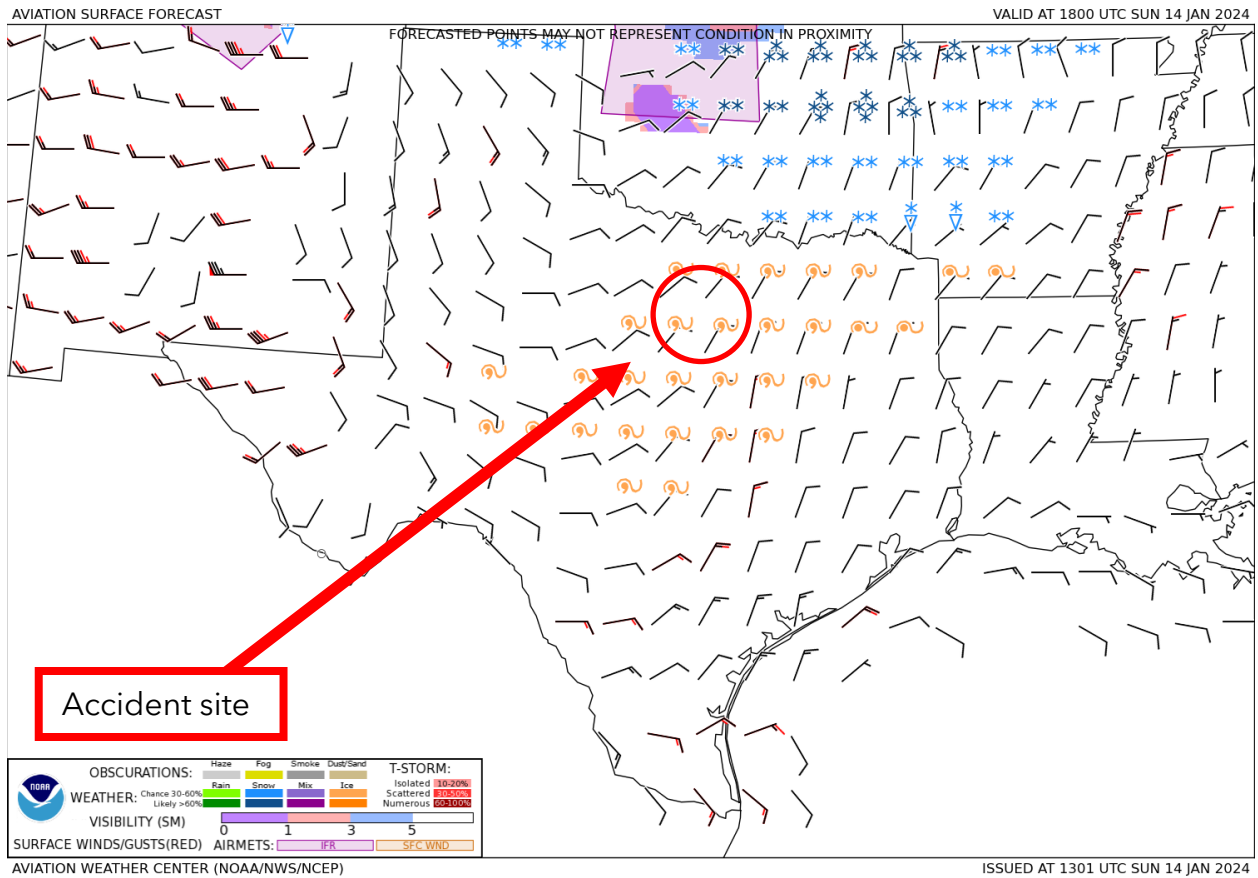


Figure 10. GFA Surface Forecast valid at 1200 CST with forecast issued at 0701 CST.

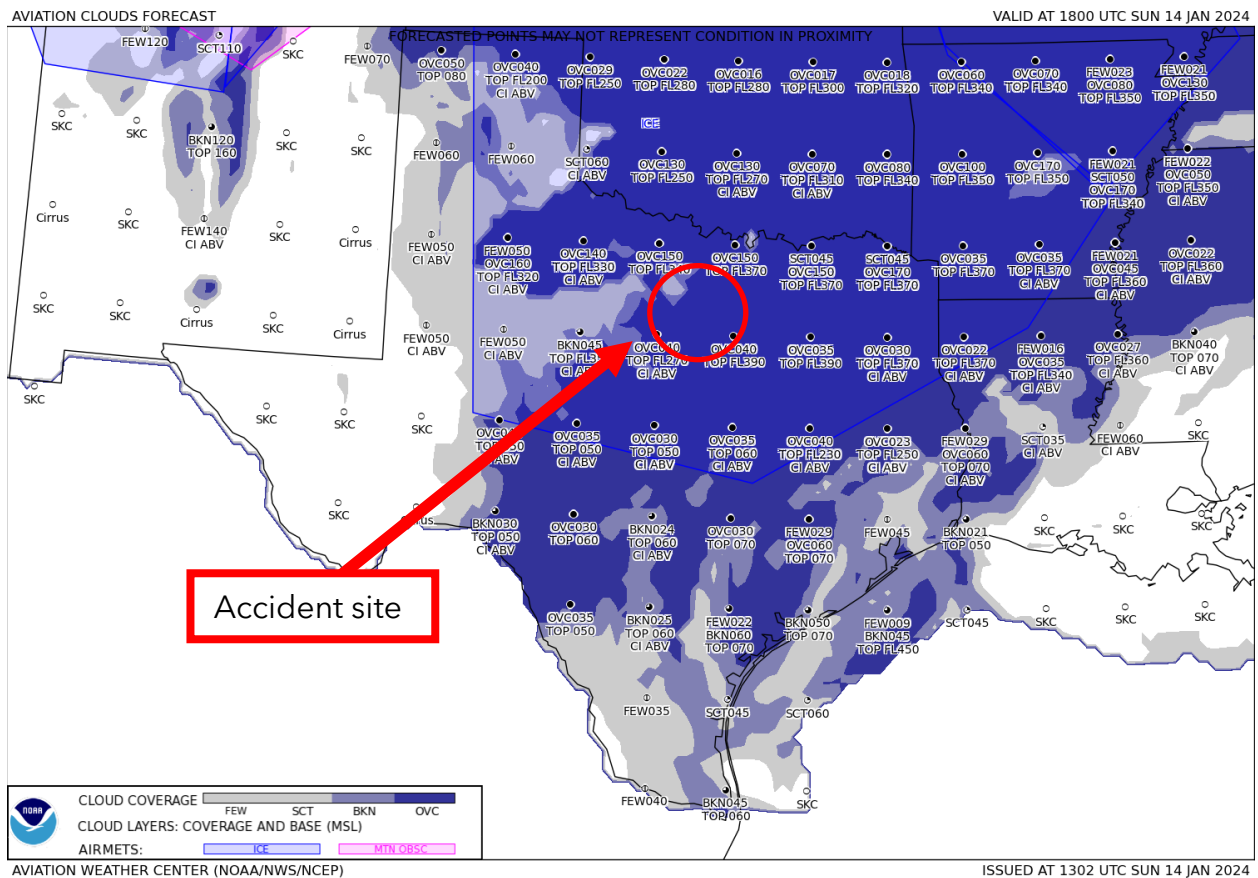


Figure 11. GFA Aviation Clouds Forecast valid at 1200 CST with forecast issued at 0702 CST.

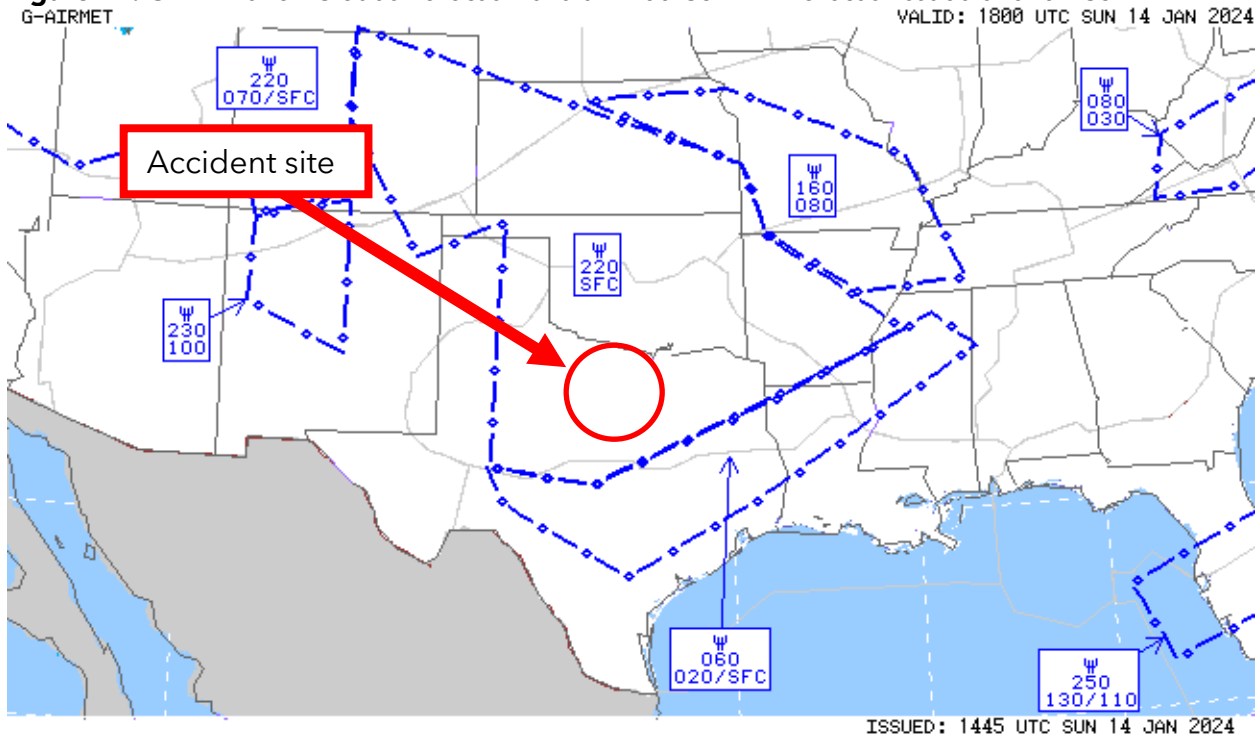


Figure 12. G-AIRMET Zulu valid at 1200 CST with forecast issued at 0845 CST.

10.0 Text Airmen's Meteorological Information

The NWS Aviation Weather Center (AWC) had text Airmen's Meteorological Information (AIRMET) advisory Zulu valid for the accident site at the accident time. The text AIRMET Zulu was issued at 0845 CST and forecast moderate icing below FL220:

WAUS44 KPCI 141445

WA4Z

-DFWZ WA 141445

AIRMET ZULU UPDT 3 FOR ICE AND FRZLVL VALID UNTIL 142100

.

AIRMET ICE...TX LA MS

FROM 40NW IGB TO 20S IGB TO 60SSE LFK TO 40NNW CRP TO 40SSW SAT
TO 50SE DLF TO DLF TO 50WSW SJT TO 40NW IAH TO 50ENE LFK TO 40NW
IGB

MOD ICE BLW 060. CONDS CONTG BYD 21Z THRU 03Z.

.

AIRMET ICE...OK AR TN NE KS MO IL IN KY

FROM 40ENE MCK TO 30ESE PWE TO 20N IJU TO 30S BWG TO 20SSE BUM TO
30NW MCI TO 20NE SLN TO 40ENE MCK

MOD ICE BTN 050 AND FL180. CONDS CONTG BYD 21Z THRU 03Z.

.

AIRMET ICE...OK TX AR TN LA MS AL NE KS MO KY

**FROM 20N SNY TO 40ENE MCK TO 20NE SLN TO 30NW MCI TO 20SSE BUM TO
30S BWG TO 40NW IGB TO 60ENE LFK TO 40NW IAH TO 60SSE MAF TO 50N
INK TO 30ESE TBE TO 50W LBL TO GLD TO 20N SNY
MOD ICE BLW FL220. CONDS CONTG BYD 21Z THRU 03Z.**

.

OTLK VALID 2100-0300Z...ICE AR TN KS MO IL IN KY

BOUNDED BY 40ESE PWE-40SE IRK-40NNW CVG-CVG-HNN-20NNE HNV-20W

GQO-30NNW MEM-20ENE SGF-40SE BUM-40SE ICT-20N SLN-40ESE PWE

MOD ICE BTN 050 AND FL200. CONDS CONTG THRU 03Z.

.

FRZLVL...RANGING FROM SFC-155 ACRS AREA

MULT FRZLVL BLW 130 BOUNDED BY 20ENE AMA-30WNW TXK-20ESE TXK-

40SSW MHZ-30SSE IAH-30NE PSX-CRP-40SSE DLF-80WSW DLF-30S

FST-60SW INK-70W INK-INK-30ENE TCC-20ENE AMA

MULT FRZLVL BLW 070 BOUNDED BY 50WSW GQO-30NNW LGC-50SE IGB-

30NNW MCB-30ESE TXK-50S MLC-50WSW GQO

SFC ALG 60E ELP-50S FST-20NNW DLF-40S CWK-60SSE EIC-20W HNV

040 ALG 30ESE FST-40SW SAT-60SE SAT-IAH-50E LFK-30WNW ATL

080 ALG 30E ELP-50N LRD-40WNW CRP-20E PSX-20N LCH-50SW MGM-

40W PZD

120 ALG 30WNW LRD-120ESE PSX

....

11.0 Terminal Aerodrome Forecast

There were no NWS Terminal Aerodrome Forecast²² (TAF)s within 25 miles of the accident site.

12.0 National Weather Service Area Forecast Discussion

The NWS weather forecast office in Fort Worth, Texas, (WFO FWD) was responsible for the public forecast in the region of the accident site. WFO FWD issued the following Area Forecast Discussion (AFD) at 0547 CST. This was the AFD issued closest to the accident time with an aviation section:

FXUS64 KFWD 141147
AFDFWD

Area Forecast Discussion
National Weather Service Fort Worth TX
547 AM CST Sun Jan 14 2024

...New Short Term, Aviation...

.SHORT TERM... /NEW/
Update:

The biggest change made with this morning's forecast update was to move up the timing of freezing drizzle across Central Texas. The stratus deck started to emerge over the Hill Country around 2AM and as of 530AM, it already covers most of North and Central Texas. We are also seeing light radar returns in close proximity to the GRK radar, indicating that drizzle is likely already falling. With that being said, the chance of any accumulation this morning is only around 10%. The other change was to trim south the freezing rain to sleet transition line late tonight and early tomorrow morning. We're gaining confidence that a full change-over to sleet (or snow) is likely across North Texas tomorrow morning, while a freezing rain/sleet mix continues across much of Central Texas.

Bonnette

Previous Discussion:
/Through Monday Night/

METEOROLOGICAL DISCUSSION...

²² According to NWS Instruction 10-813: "An NWS TAF consists of the expected meteorological conditions significant to aviation at an airport for a specified time period. For the U.S., this is the area within five (5) statute miles (SM) of the center of an airport's runway complex."
www.nws.noaa.gov/directives/sym/pd01008013curr.pdf

The arctic air has arrived as the entire forecast area is already below freezing. Cold advection will continue through the morning, resulting in many locations across western North Texas falling into the single digits. Most of our forecast area will fall into the teens, with only a few locations across the far southeast remaining in the 20s this morning. Gusty north winds will make it feel even colder with below zero wind chill values across North Texas and single digit wind chills across Central Texas.

The skies are generally clear this evening, however low-level stratus will quickly develop and overspread the entire forecast area over the course of the morning. The cloud deck will be sandwiched between very dry air both above and below it, which is an important detail regarding the precip-type forecast today and tonight. The clouds will develop due to the shallow arctic air being overrun by warm, moist air being transported north overtop of the frontal/arctic airmass. Saturation is occurring within the frontal zone, which will ultimately result in the development of light precipitation late this morning through the afternoon as supersaturation ensues. The sandwich of dry air will result in the cloud deck remaining confined to a relatively thin layer of the atmosphere. Forecast soundings favor the clouds consisting of supercooled liquid water due to the lack of ice nucleation as cloud temps remain above -10C. The initial precip will fall through very dry sub-cloud air with most of it evaporating before reaching the surface. If any precip does reach the surface this morning, it would be a very light freezing drizzle. As the afternoon progresses, precip will become more likely to reach the surface...but still likely falling as light freezing drizzle into the evening. Some sleet may mix in as well, particularly across North Texas. It's worth noting that a quick-moving snow band will move across Oklahoma today that may brush our far Northeast counties this afternoon. This forecast would result in mostly dry surface roads, with only sporadic slick spots...mainly on untreated roads and bridges/overpasses.

Precipitation will increase in coverage and intensity overnight as a quick-moving shortwave trough overspreads the forecast area. This will result in a transition from light drizzle being favored to light rain (i.e. larger drops) being favored. The dry air will still be in place, so precip-rates will continue to be light for most of the area. The only locations that may receive heavier precip will be across the southeast where deeper saturation is expected. As we move beyond midnight, the expanding cloud deck will start to tap into colder air, resulting in a transition from mostly freezing rain to mostly sleet across North Texas and our Red River counties transitioning to all sleet and snow. The shortwave will move east Monday morning, bringing an end to all precip in our forecast area by early Monday afternoon. Precip types on Monday will be similar to the overnight period. More widespread travel impacts are expected during this time, but the light precip intensity will limit the severity of the impacts to an "advisory-level" event. Most surface roads should remain dry

but bridges and overpasses are likely to become slick. The worst and most widespread travel impacts should be across the southeast part of the forecast area where ice accumulations will be highest.

WINTER ACCUMULATION FORECAST...

- * Areas northeast of the Metroplex...(Paris-Bonham-Cooper) These areas are most likely to see snow. Most can expect to receive around 1/4-1/2" of snow with some locations receiving up to 1" of snow.

- * Farther south including the Metroplex...A mix of freezing rain and sleet is expected. Sleet accumulations up to 1/10 of an inch are likely with freezing rain totaling up to a few hundredths of an inch. High-end sleet accumulation may approach 1/4". Given the very cold temperatures, icing of bridges and overpasses is expected and will make travel deceptively dangerous since most surface roads will remain dry.

- * For our southeast counties...(Athens-Corsicana-Fairfield toward the Brazos Valley) These areas will have the greatest potential for more significant icing. We currently forecast 0.10 to 0.15" of ice accumulation in this region. More widespread impacts to untreated surface roads and especially bridges and overpasses are expected. There is a 10% chance that some areas receive upwards of 1/4" of ice, which would cause significant impacts and require a Winter Storm Warning to be issued. Our confidence of ice totals this high is too low to warrant issuing a warning at this time.

TEMPERATURE FORECAST...

- * Below freezing temperatures are forecast for the entire forecast area through Wednesday. Some locations across the far southeast could have risen above freezing today, but we have lowered the high temperature forecast such that all locations should stay below freezing this afternoon.

- * Tonight's lows should fall into the low 10s for North Texas and the teens to 20s for Central Texas. Only a few locations along the Red River are expected to fall into the single digits. Due to this, we have not extended the Hard Freeze Warning into Sunday night/Monday morning.

- * Monday's highs will be a few degrees warmer than today as the airmass starts to modify. Highs will still only climb into the 20s as abundant cloud cover limits heating.

- * A reinforcing shot of cold air is slated to arrive Monday night into Tuesday. This will result in another frigidly cold night, with Tuesday morning lows falling into the single digits for most of North Texas. Lows in the teens are forecast for all of Central Texas. The cold air will come with gusty winds and below zero wind chill values across the entire forecast area.

WATCHES/WARNINGS/ADVISORIES...

- * A WINTER WEATHER ADVISORY is in effect for most of North and Central TX from noon today through noon Monday. The southeast portions of this advisory could be upgraded to a Winter Storm Warning later today.
- * A HARD FREEZE WARNING is in effect through 10 AM this morning for areas north and west of the Metroplex.
- * A WIND CHILL ADVISORY is in effect for areas generally along and north of I-20 through noon Tuesday. The advisory then expands across all of North and Central Texas Monday night and also expires at noon Tuesday.

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.LONG TERM... /Issued 418 AM CST Sun Jan 14 2024/
/Tuesday Through Next Weekend/

Frigid, sub-freezing temperatures will continue into Tuesday. Wind chills will remain below zero degrees across the region through mid morning but will only peak in the teens during the afternoon, despite actual temperatures in the mid to upper 20s. Impacts from our wintry weather will linger throughout the day for most areas. However, the return of some sunshine could melt at least some of the ice, particularly for any unshaded/unsheltered areas. This is especially true across Central Texas where afternoon temperatures are currently forecast to climb to 30-31 degrees. Unfortunately, any sheltered areas will not experience any melting on Tuesday, and slick spots will still exist on roadways, resulting in hazardous travel conditions.

Any lingering water will refreeze Tuesday night into Wednesday morning as low temperatures bottom out in the teens, but rapid improvement/melting is expected by midday Wednesday as temperatures climb well above 32 degrees under mostly sunny skies. High temperatures Wednesday afternoon will be in the 40s to low 50s.

Southerly winds will return Wednesday, with temperatures continuing to moderate into Thursday. However, a low pressure system will send another strong cold front through North and Central Texas on Thursday. The air behind this front is not expected to be *as* cold as the weekend/early week system, but it will still be cold with high temperatures in the mid 30s to low 40s on Friday. Fortunately, both moisture and lift will be displaced from the region, which will keep FROPA dry. Chilly temperatures will continue through next weekend, with afternoon highs in the mid 30s to mid 40s and morning lows in the teens and 20s.

Barnes

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**.AVIATION... /NEW/
/12Z TAFs/**

A pretty solid sheet of stratus has engulfed the entire region over the past 3 hours. Cloud bases are VFR across North Texas and MVFR across Central Texas, but expect a very gradual lowering over the course of the afternoon and evening. Very light precip is expected to fall out of the cloud deck this morning, but most of it will evaporate before reaching the surface until later in the afternoon. The lack of ice nuclei in the clouds will keep the clouds as supercooled water, resulting in freezing drizzle being the predominate precip type this afternoon and evening. A few sleet pellets may form as the drizzle falls, but inefficient freezing should result in mainly freezing drizzle.

Precip coverage will increase tonight, coincident with the intra-cloud temperature falling as well. This will increase the threat of freezing rain initially, then favor a transition to all sleet in the early morning hours. There is a chance of snow being mixed into the precip, but snow is more likely north of the D10 TAFs.

Any precip that reaches the surface will be light for the entirety of this event. For the D10 terminals...we're expecting a sporadic light glaze of ice on untreated surfaces. Sleet is more likely to accumulate and even then, <1/4" of sleet is expected.

ACT is more likely to have ice accumulation...between 0.05-0.10" of ice is the most likely icing amount, but totals could reach as high as 0.15" on untreated surfaces. Up to 0.1" of sleet accumulation is possible.

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.PRELIMINARY POINT TEMPS/POPS...

Dallas-Ft. Worth	22	15	24	13	27	/	20	50	20	0	0
Waco	25	19	27	14	30	/	20	50	40	0	0
Paris	22	15	23	10	26	/	20	40	30	0	0
Denton	21	11	24	6	28	/	20	40	20	0	0
McKinney	21	12	23	9	27	/	20	50	30	0	0
Dallas	22	16	25	13	28	/	20	50	30	0	0
Terrell	23	16	25	10	28	/	20	70	50	0	0
Corsicana	25	20	26	15	29	/	20	70	60	0	0
Temple	26	18	27	12	30	/	20	50	40	0	0
Mineral Wells	21	12	24	10	28	/	20	20	10	0	0

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.FWD WATCHES/WARNINGS/ADVISORIES...

Hard Freeze Warning until 10 AM CST this morning for TXZ091>093-100>103-115>117.

Wind Chill Advisory until noon CST Tuesday for TXZ091>095-100>107-115>120-123-129.

Winter Weather Advisory from noon today to noon CST Monday for TXZ092>095-103>107-117>123-130>135-141>148-156>162-174-175.

Wind Chill Advisory from midnight Monday night to noon CST Tuesday for TXZ121-122-130>135-141>148-156>162-174-175.

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13.0 Winds and Temperature Aloft Forecast

The NWS 0756 CST Winds and Temperature Aloft forecast, which was intended for use between 0800 and 1500 CST and was valid for the closest points to the accident site, are included below:

FBUS31 KWN0 141356

FD1US1

DATA BASED ON 141200Z

VALID 141800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
ABI		2446+08	2750+03	2751-04	2768-14	2779-26	288541	278850	780161
DAL	0909	2353+04	2546+00	2651-05	2673-15	2781-26	279242	780051	780862
SPS	0311	2530-02	2639+00	2655-06	2771-16	2782-27	279842	771251	781361

14.0 Icing Potential

The Current Icing Product (CIP) and Forecast Icing Product (FIP²³) imagery provided information on expected icing severity as five categories: none, trace, light,

²³ B.C. Bernstein, F. McDonough, M. K. Politovich, B. G. Brown, T. P. Ratvasky, D. R. Miller, C.A. Wolff, and G. Cuning, Current Icing Potential: Algorithm Description and Comparison with Aircraft Observations (Journal of Applied Meteorology, 2005), pp. 969-986.

C.A. Wolff, F. McDonough, M. K. Politovich, B.C. Bernstein, and G. Cuning, FIP Severity Technical Document (Prepared for the Aviation Weather Technology Transfer Technical Review Board), pp. 1-44.

<https://arc.aiaa.org/doi/abs/10.2514/6.2009-3531>

Wolff, C. A., D. R. Adriaansen, and M. K. Politovich, 2014: Diagnosing and Forecasting In-Flight Icing Conditions in Alaska. Preprints, 6th AIAA Atmospheric and Space Environments Conference, Atlanta,

moderate, and heavy. The severity estimates are roughly based on the accretion rate of ice on an airplane, and the levels are determined by the time it would take for an airfoil to accrete 1/4 of an inch of ice: trace = 1 hour; light = 15 minutes to 1 hour; moderate = 5 to 15 minutes; severe = less than 5 minutes. Note that these are general values. Users should always consider the icing susceptibility of their airframe and availability of icing protection provided by their aircraft. Different aircraft and different flight configurations (airspeed, angle of attack, etc.) will experience variations in accretion rate.

The images presented in this report show data from National Center for Atmospheric Research (NCAR)'s prototype CIP and FIP algorithms, generated using NCAR's visualization software. These algorithms differ in various ways from the operational CIP and FIP²⁴ that provided data used to generate the publicly available images accessible through the AWC on the accident day. NCAR's prototype CIP and FIP represent the latest research and development conducted by their team of in-flight icing scientists, and have passed internal validation exercises using voice pilot reports (PIREPs) of icing conditions and scientific airborne research observations of in-flight icing (when available). Through coordination with the FAA and NOAA, NCAR provides the prototype CIP and FIP for an independent validation exercise to determine their suitability for operational use. Pending the outcome of that validation, the operational versions are replaced with the prototype versions. The frequency with which the operational versions are updated is dependent upon the research and development advancements in the prototype versions and available resources to support the operational upgrade.

The FIP icing probabilities and icing severity products for the 1-hour forecast valid at 1200 and 1300 CST at 3,000 through 6,000 ft indicated a 30 to 85% probability of trace to moderate icing above the accident site (attachment 3). The highest probabilities and intensity rates were from 4,000 to 5,000 ft. The CIP products indicated a 10 to 80% probability of trace to moderate icing from 3,000 ft through 6,000 ft at 1200 and 1300 CST above the accident site (attachment 3). The CIP indicated a 40 to 50% probability of Supercooled Large Droplets (SLD)²⁵ above the accident site at 4,000 and 5,000 ft at 1200 and 1300 CST. For more FIP and CIP data and imagery please see attachment 3.

GA, Amer. Inst. Aero. Astro., 2014-2070, available at: <http://arc.aiaa.org/doi/abs/10.2514/6.2014-2070>.

[Icing Product Alaska \(IPA\) - Experimental | NCAR Research Applications Laboratory | RAL \(ucar.edu\)](#)

²⁴ <https://www.aviationweather.gov/icing/fip>

²⁵ [AWC - Icing \(aviationweather.gov\)](#)

15.0 Pilot Weather Information

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

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

A search of archived information indicated that the accident pilot did not request weather information from Leidos Flight Service. The accident pilot did file a flight plan and received a weather briefing through ForeFlight at 0934 CST (attachment 4). The weather briefing information can be found in attachment 5 with all the standard weather forecast and current weather information valid at 0934 CST for the accident flight.

16.0 Astronomical Data

The astronomical data obtained²⁷ for the accident site on January 14, 2024, indicated the following:

SUN

Begin civil twilight 0708 CST

Sunrise 0735 CST

Accident time 1215 CST²⁸

Sun transit 1241 CST

Sunset 1747 CST

End civil twilight 1813 CST

At the time of the accident the Sun was 35.40° above the horizon at an azimuth of 172.69°.

E. LIST OF ATTACHMENTS

Attachment 1 - GOES-16 visible imagery animation from 1031 to 1231 CST

²⁶ https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_91-92.pdf. The AC also listed multiple online FAA resources for aviation flight planning services for adverse weather.

²⁷ <https://www.suncalc.org/> and <https://www.mooncalc.org/>

²⁸ Inserted accident time for reference and context.

Attachment 2 - ZFW PDWB valid at the accident time

Attachment 3 - FIP and CIP information valid for the accident site

Attachment 4 - ForeFlight Information

Attachment 5 - ForeFlight Briefing Information

Submitted by:

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