



## **NATIONAL TRANSPORTATION SAFETY BOARD**

Office of Aviation Safety  
Washington, D.C. 20594

April 23, 2021

### **Specialist's Factual Report**

# **METEOROLOGY**

CEN21LA112

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## **A. ACCIDENT**

Location: Sparta, Michigan  
Date: January 12, 2021  
Time: 1658 eastern standard time  
2158 Coordinated Universal Time (UTC)  
Airplane: Piper PA-32R-301; Registration: N35718

## **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 official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources and also from the National Centers for Environmental Information (NCEI). This specialist factual contains the meteorological factors pertinent to the weather surrounding the accident time. All times are eastern standard time (EST) on January 12, 2021, and are based upon the 24-hour clock, where local time is -5 hours from UTC. 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. NWS station identifiers use the standard International Civil Aviation Organization 4-letter station identifiers versus the International Air Transport Association 3-letter identifiers, which deletes the initial country code designator "K" for U.S. airports.

The accident site was located at latitude 43.1300° N, Longitude 85.6724° W, with an approximate elevation of 740 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 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.<sup>1</sup>

### **1.1 Surface Analysis Chart**

The NWS Surface Analysis Chart centered over the Great Lakes for 1600 EST is provided as figure 1 with the approximate location of the accident site within the red circle. The chart identified no frontal boundaries or low or high pressure systems in the vicinity of the accident site at the accident time.

The station models around the accident site depicted air temperatures in the low 30’s degrees Fahrenheit (°F), dew point temperatures in the upper 20’s °F with temperature-dew point spreads of 3°F or less, a south wind at 10 knots, overcast sky cover, mist, and haze.

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<sup>1</sup>

[https://www.faa.gov/regulations\\_policies/advisory\\_circulars/index.cfm/go/document.information/documentID/1030235](https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1030235)

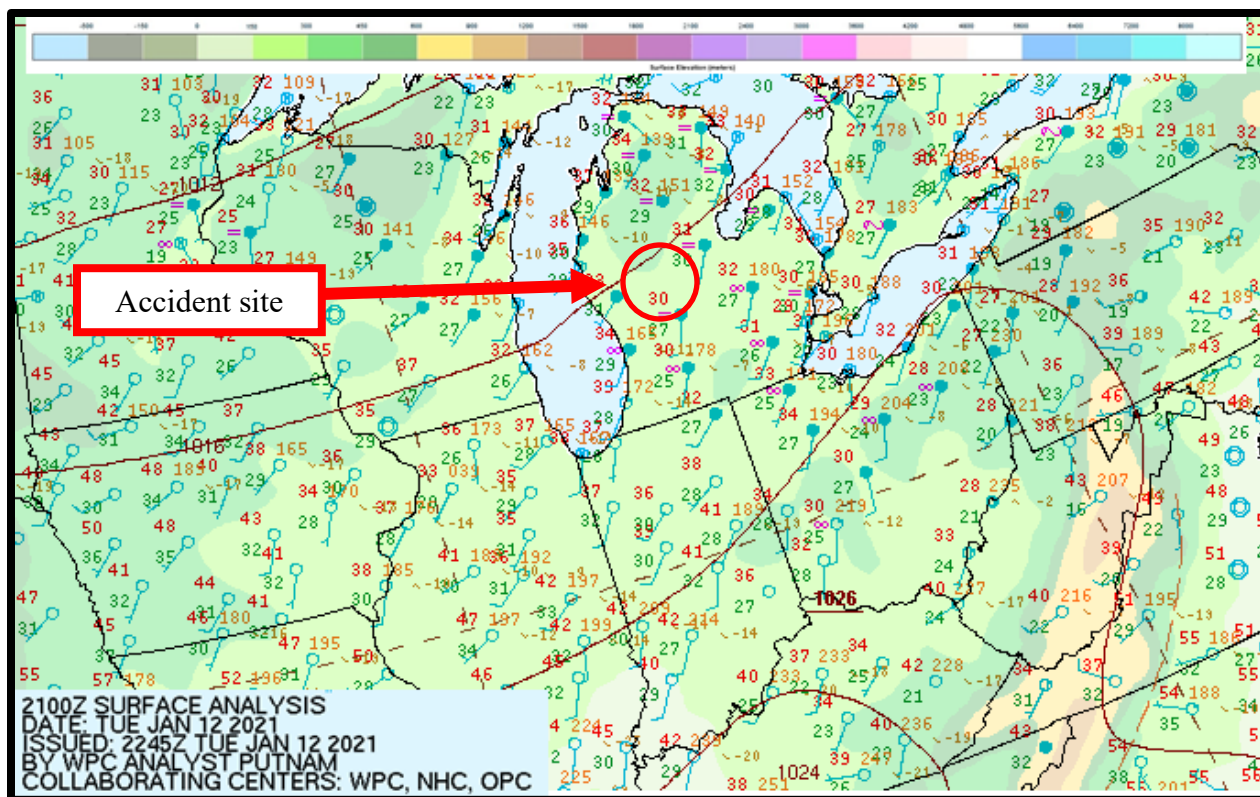


Figure 1 – NWS Surface Analysis Chart for 1600 EST.

## 1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 1900 EST at 925-, 850- and 700-hectopascals (hPa) are presented in figures 2 through 4. A low-level trough<sup>2</sup> was located west of the accident site stretching from southern Canada southward into the northern United States. Troughs can act as lifting mechanisms to help produce clouds and precipitation if sufficient moisture is present. There was a southwest wind at 15 knots at 925-hPa with the wind becoming westerly at 30 knots by 700-hPa.

<sup>2</sup> Trough – An elongated area of relatively low atmospheric pressure or heights.

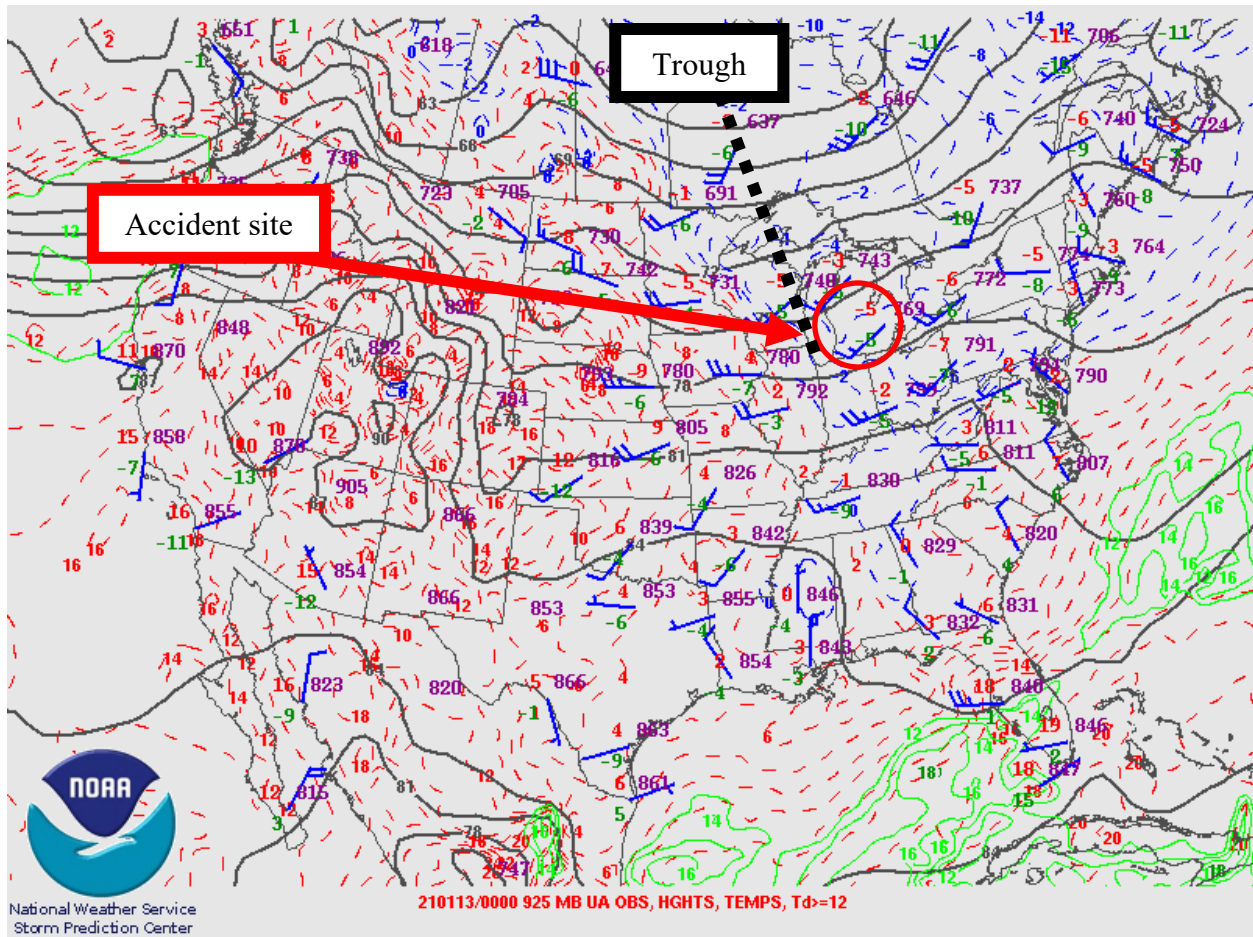


Figure 2 – 925-hPa Constant Pressure Chart for 1900 EST.

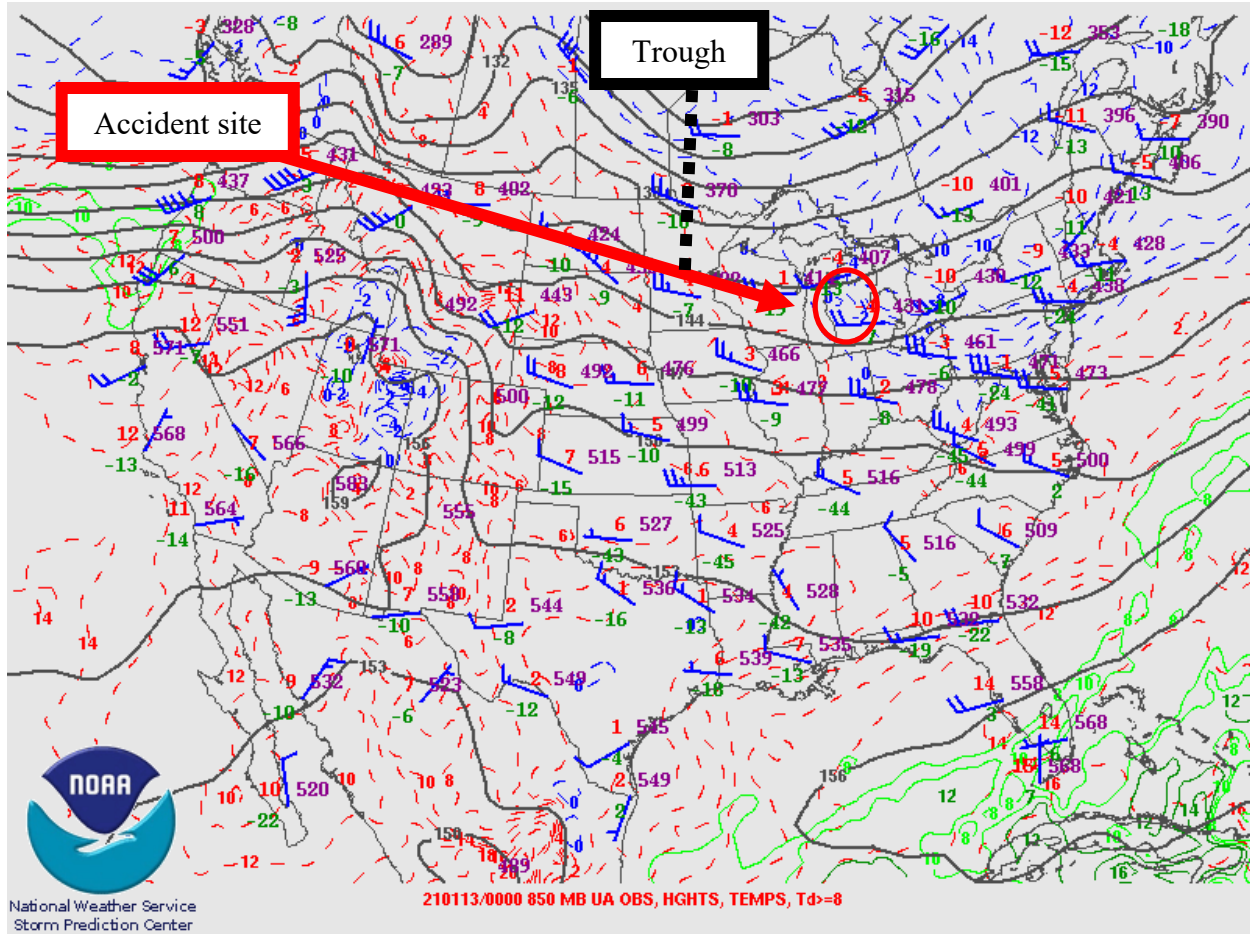
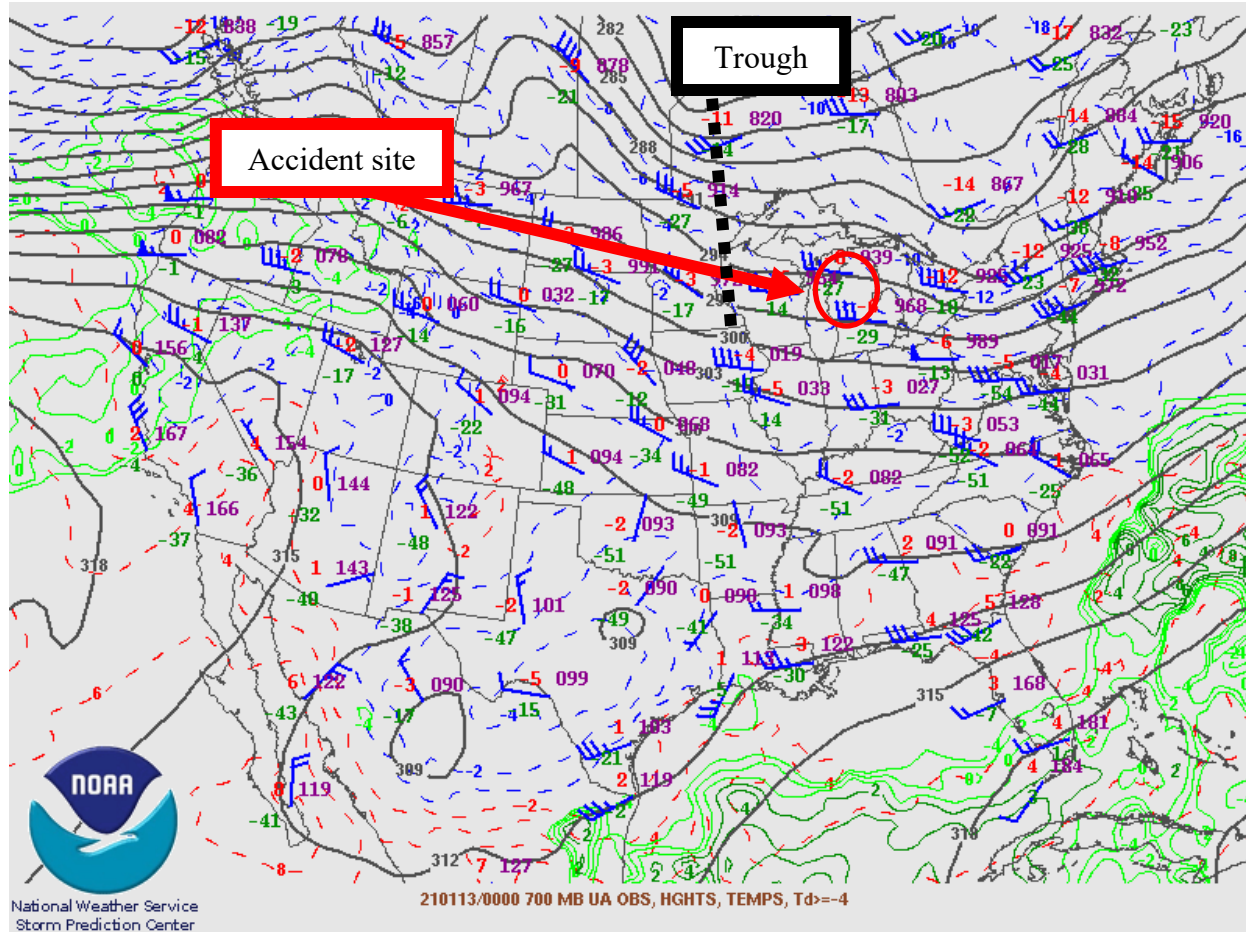


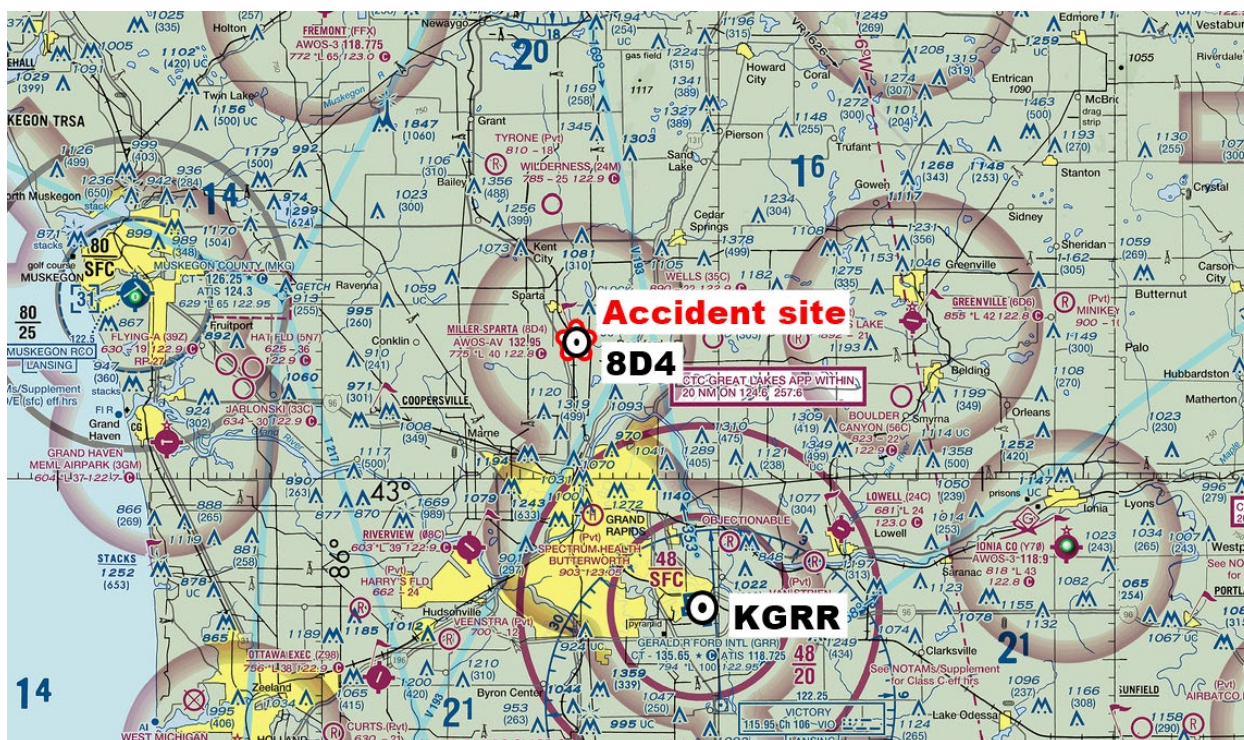
Figure 3 – 850-hPa Constant Pressure Chart for 1900 EST.



**Figure 4 – 700-hPa Constant Pressure Chart for 1900 EST.**

## 2.0 Surface Observations

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



**Figure 5 – Sectional map of the accident area with the location of the accident site and surface observation sites.**

The accident occurred at the Paul C. Miller-Sparta Airport (8D4), Sparta, Michigan. The airport had an Automated Weather Observing System (AWOS<sup>3</sup>) whose reports were not augmented. 8D4 AWOS was located within a mile of the accident site, at an elevation of 775 ft, and a 6° westerly magnetic variation<sup>4</sup>. 8D4 weather observations were not distributed longline<sup>5</sup>, however, the investigation was able to obtain the 8D4 observations around the accident time and they are contained in attachment 1. The 8D4 observation at the time of the accident indicated a wind from 210° at 6 knots, with a visibility of 3 miles, and altimeter of 30.01 inches of mercury (inHg).

<sup>3</sup> 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 12,000 feet, and altimeter setting. AWOS are maintained by the FAA.

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

<sup>5</sup> “Longline” refers to the dissemination of weather observations with the intent that they are available in near-real time to national databases (effectively, the whole world) 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 general global public has access to surface weather observations, particularly outside of the aviation community.

Gerald R. Ford International Airport (KGRR) had the next closest official weather station to the accident site. KGRR had an Automated Surface Observing System (ASOS<sup>6</sup>) whose longline reports were supplemented by air traffic control (ATC) when the tower was in operation<sup>7</sup>. KGRR ASOS was located 16 miles southeast of the accident site, at an elevation of 794 ft, and had a 6° westerly magnetic variation. The following automated longline observations were disseminated during the times surrounding the accident:<sup>8</sup>

[1253 EST] METAR KGRR 121753Z 20012KT 4SM BR OVC009 M02/M03 A3003 RMK  
AO2 SLP178 4/001 60000 I6000 T10171033 11011 21017 58010=

[1353 EST] METAR KGRR 121853Z 21009KT 4SM BR OVC009 M01/M03 A3002 RMK  
AO2 SLP175 T10111028=

[1453 EST] METAR KGRR 121953Z 21009KT 3SM BR OVC009 M01/M03 A3001 RMK  
AO2 SLP173 T10111028=

[1553 EST] METAR KGRR 122053Z 19010KT 4SM BR OVC009 M01/M03 A3000 RMK  
AO2 SLP170 T10111028 56008=

***[1653 EST] METAR KGRR 122153Z 19007KT 4SM BR OVC009 M01/M03 A3001 RMK  
AO2 SLP172 T10061028=***

#### **ACCIDENT TIME 1658 EST**

***[1742 EST] SPECI KGRR 122242Z 19009KT 6SM BR OVC011 M01/M03 A3001 RMK  
AO2 T10061028=***

[1753 EST] METAR KGRR 122253Z 19007KT 6SM BR OVC011 M01/M03 A3002 RMK  
AO2 SLP174 T10061028=

KGRR weather at 1653 EST, wind from 190° at 7 knots, visibility 4 miles, mist, overcast ceiling at 900 ft above ground level (agl), temperature of -1°Celsius (C), dew point temperature of -3°C, and an altimeter setting of 30.01 inHg. Remarks: automated station with a precipitation discriminator, sea level pressure 1017.2 hPa, temperature -0.6°C, dew point temperature -2.8°C.

KGRR weather at 1742 EST, wind from 190° at 9 knots, visibility 6 miles, mist, overcast ceiling at 1,100 ft agl, temperature of -1°C, dew point temperature of -3°C, and an altimeter setting of 30.01 inHg. Remarks: automated station with a precipitation discriminator, temperature -0.6°C, dew point temperature -2.8°C.

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<sup>6</sup> 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.

<sup>7</sup> ATC hours of operation between 0530 and midnight local.

<sup>8</sup> The bold sections in this NWS product and the rest of the products in this report are intended to highlight the sections that directly reference the weather conditions that affected the accident location around the accident time. The local times in this section next to the METARs are provided for quick reference between UTC and local times around the accident time.

The observations from 8D4 and KGRR surrounding the accident time indicated IFR<sup>9</sup> to MVFR conditions prevailing with mist and temperature below freezing.

### 3.0 Upper Air Sounding

A High-Resolution Rapid Refresh (HRRR)<sup>10</sup> model sounding was created for the accident site for 1700 EST using a surface elevation of 778 ft.<sup>11</sup> The 1700 EST HRRR sounding was plotted on a standard Skew-T Log P diagram<sup>12</sup> with the derived stability parameters included in figure 6 with data from the surface to 700-hPa (or approximately 10,000 ft msl). These data were analyzed using the RAOB<sup>13</sup> software package. The sounding depicted the lifted condensation level (LCL)<sup>14</sup> and the level of free convection (LFC)<sup>15</sup> at 246 ft agl (1,024 ft msl) and the convective condensation level (CCL)<sup>16</sup> at 1,422 ft agl (2,200 ft msl). It was below freezing at the surface. The precipitable water value was 0.31 inches.

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<sup>9</sup> 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.

<sup>10</sup> 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.

<sup>11</sup> HRRR sounding was created using NOAA Air Resource Laboratory: <https://ready.arl.noaa.gov/READYamet.php>

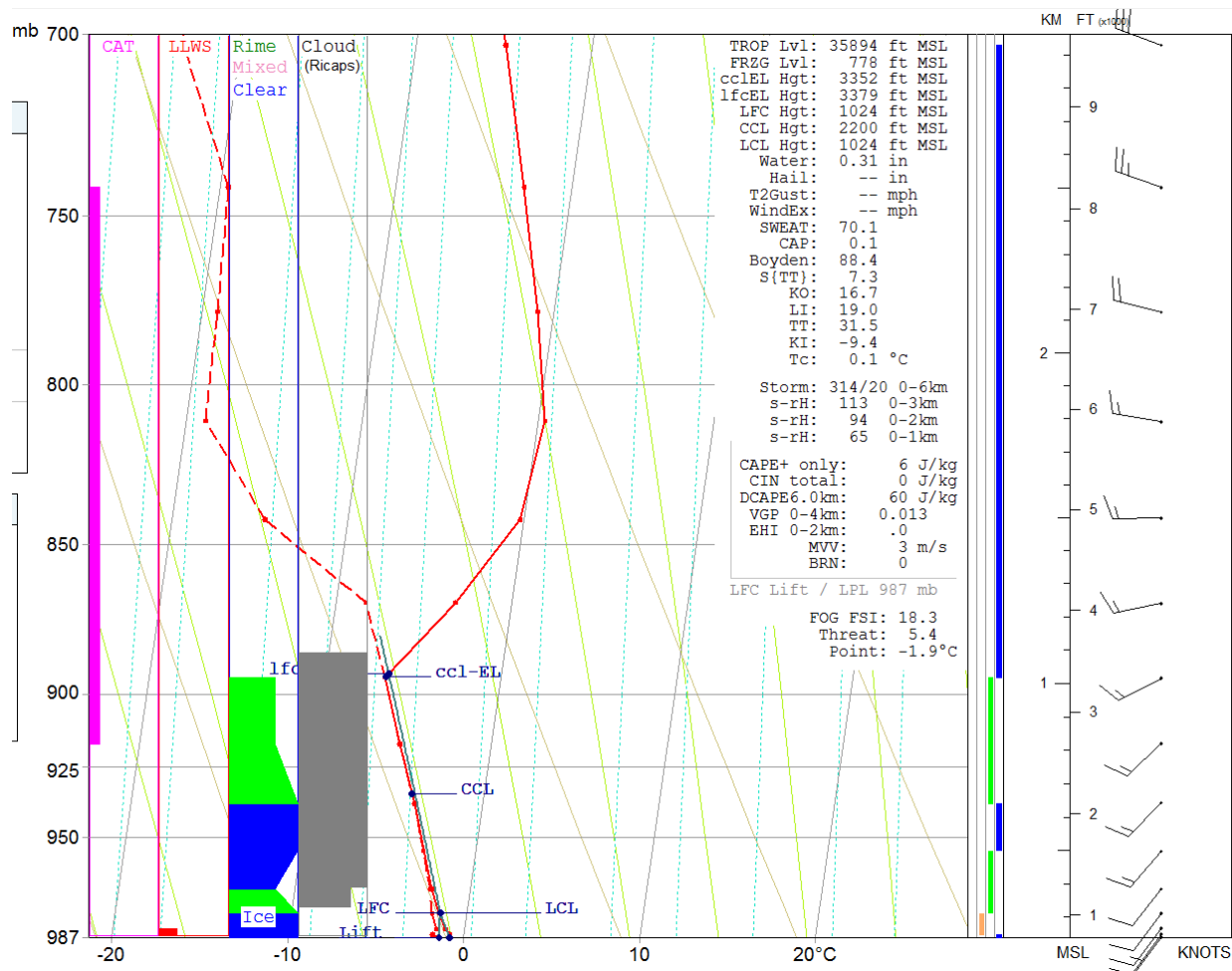
<sup>12</sup> Skew T log P diagram – is a standard meteorological plot using temperature and the logarithmic of pressure as coordinates, used to display winds, temperature, dew point, and various indices used to define the vertical structure of the atmosphere.

<sup>13</sup> RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Eosonde Research Services, The Villages, Florida.

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

<sup>15</sup> LFC – The level at which a parcel of saturated air becomes warmer than the surrounding air and begins to rise freely. This occurs most readily in a conditionally unstable atmosphere.

<sup>16</sup> CCL – The level in the atmosphere to which an air parcel, if heated from below, will rise dry adiabatically, without becoming colder than its environment just before the parcel becomes saturated.



**Figure 6 – 1700 EST HRRR sounding.**

The 1700 EST HRRR sounding indicated a conditionally unstable and stable environment from the surface through 3,250 ft msl and a stable layer above 3,250 ft msl. RAOB indicated cloud cover between 1,250 and 4,000 ft msl, with the potential for moderate clear and rime icing in that layer.

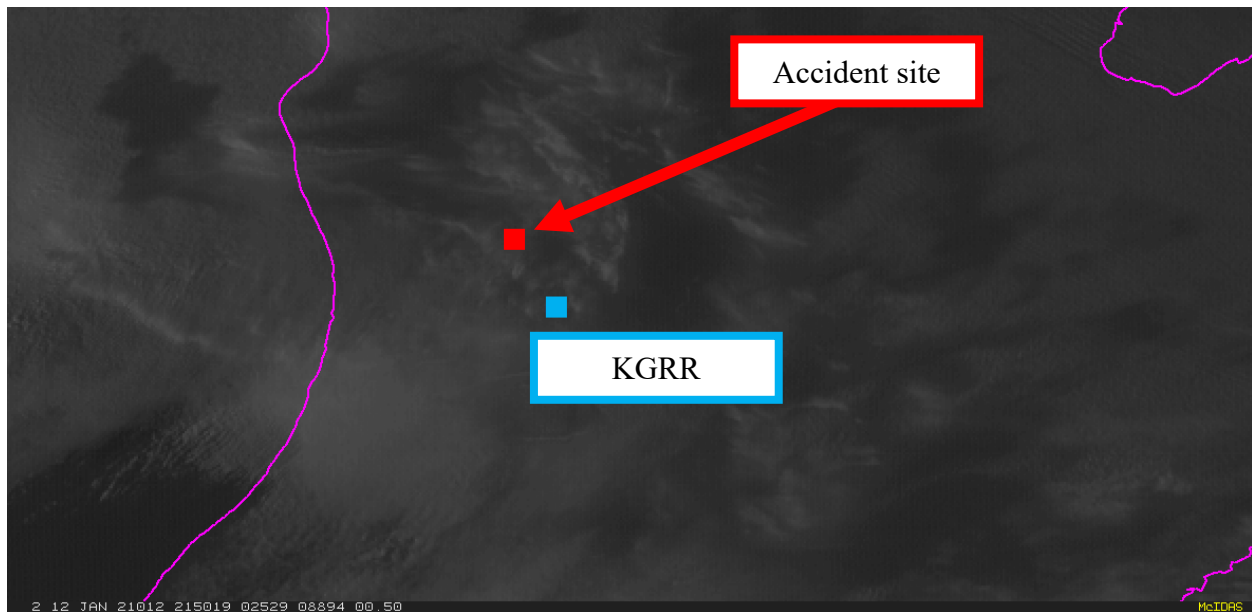
The 1700 EST HRRR sounding wind profile indicated a near surface wind from 214° at 8 knots with the wind veering<sup>17</sup> to the west through 10,000 ft. The wind speed increased to 15 knots by 1,500 ft msl and 30 knots by 10,000 ft. RAOB indicated the possibility of light low-level wind shear (LLWS) between the surface and 200 ft agl. RAOB did indicated the possibility of light clear-air turbulence between 3,000 and 8,000 ft msl.

<sup>17</sup> A clockwise turning of the wind with height in the northern hemisphere.

#### 4.0 Satellite Data

The 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) at wavelengths of 0.64 microns ( $\mu\text{m}$ ) and 10.3  $\mu\text{m}$ , respectively, were retrieved for the period from 1400 EST through 1900 EST and reviewed, and the closest images to the time of the accident were documented.

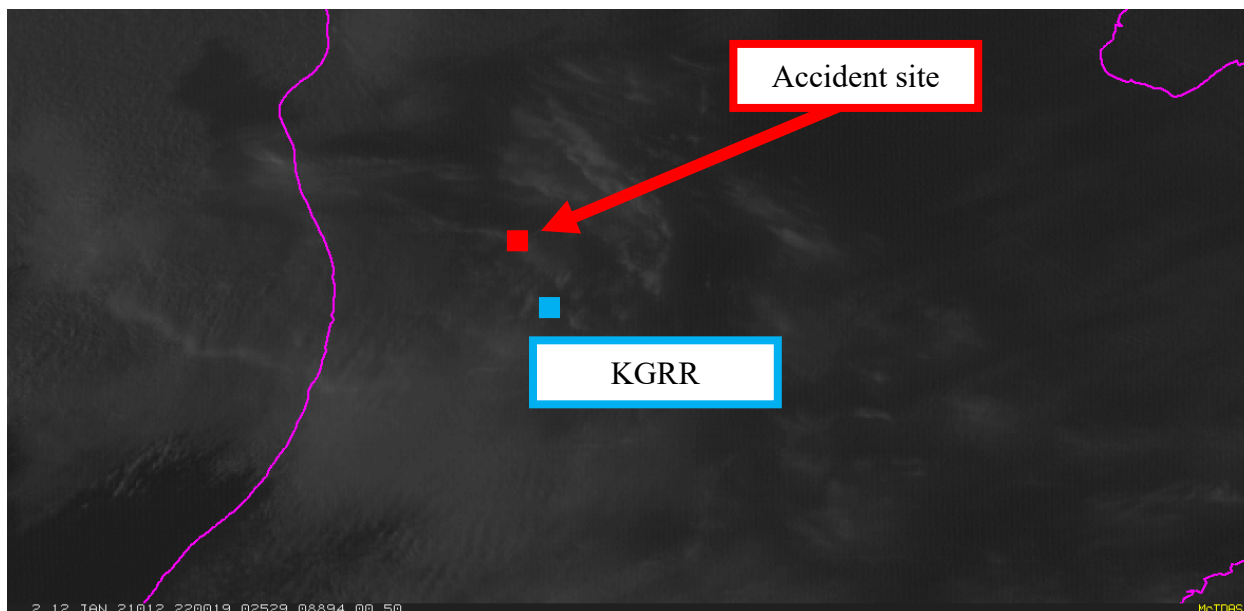
Figures 7 and 8 present the GOES-16 visible imagery from 1650 and 1700 EST at 2X magnification with the accident site highlighted with a red square. The cloud cover was moving from west to east. Figure 9 presents the GOES-16 infrared imagery from 1700 EST at 6X magnification with the accident site highlighted with a red square. The lower brightness temperatures (yellow colors; higher cloud tops) were located above and to the west of the accident site. Based on the brightness temperatures above the accident site and the vertical temperature profile provided by the 1700 EST HRRR sounding, the approximate cloud-top heights over the accident site were 17,000 ft above msl at 1700 EST (256 Kelvin). It should be noted these figures have not been corrected for any parallax error. The Nighttime Microphysics Red, Green, Blue (RGB) imagery<sup>18</sup> indicated the cloud cover above the accident site was a combination of mid- and low-level ice and water clouds (attachment 2).



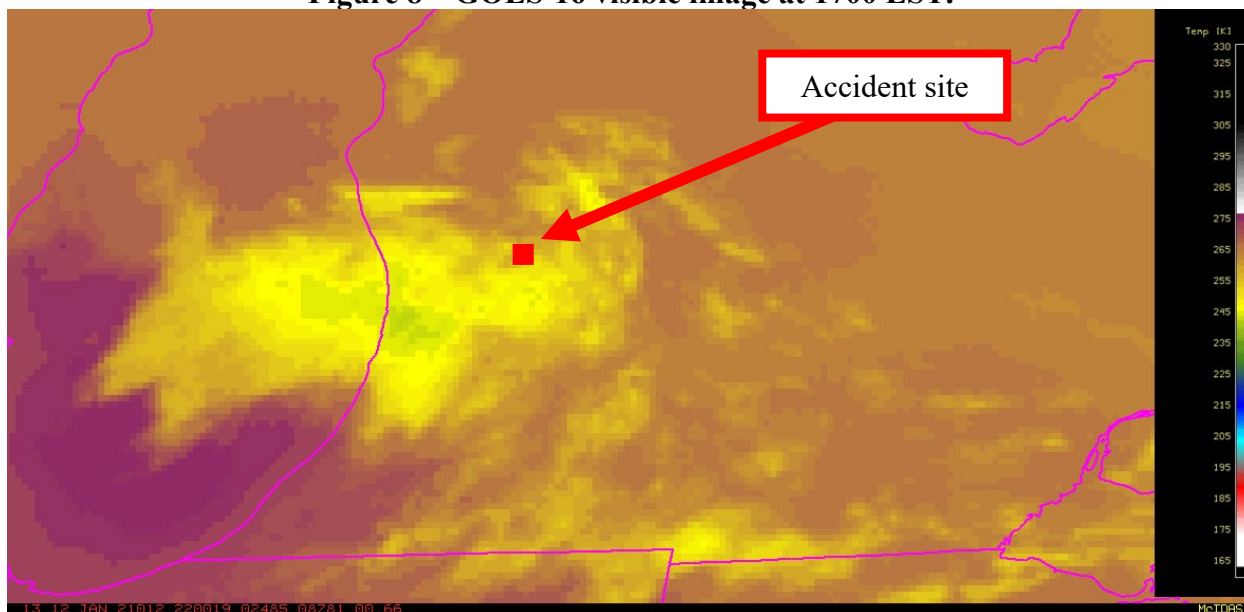
**Figure 7 – GOES-16 visible image at 1650 EST.**

<sup>18</sup>

[https://weather.msfc.nasa.gov/sport/training/quickGuides/rgb/QuickGuide\\_NtMicro\\_GOESR\\_NASA\\_SPoRT\\_2019\\_1206.pdf](https://weather.msfc.nasa.gov/sport/training/quickGuides/rgb/QuickGuide_NtMicro_GOESR_NASA_SPoRT_2019_1206.pdf)



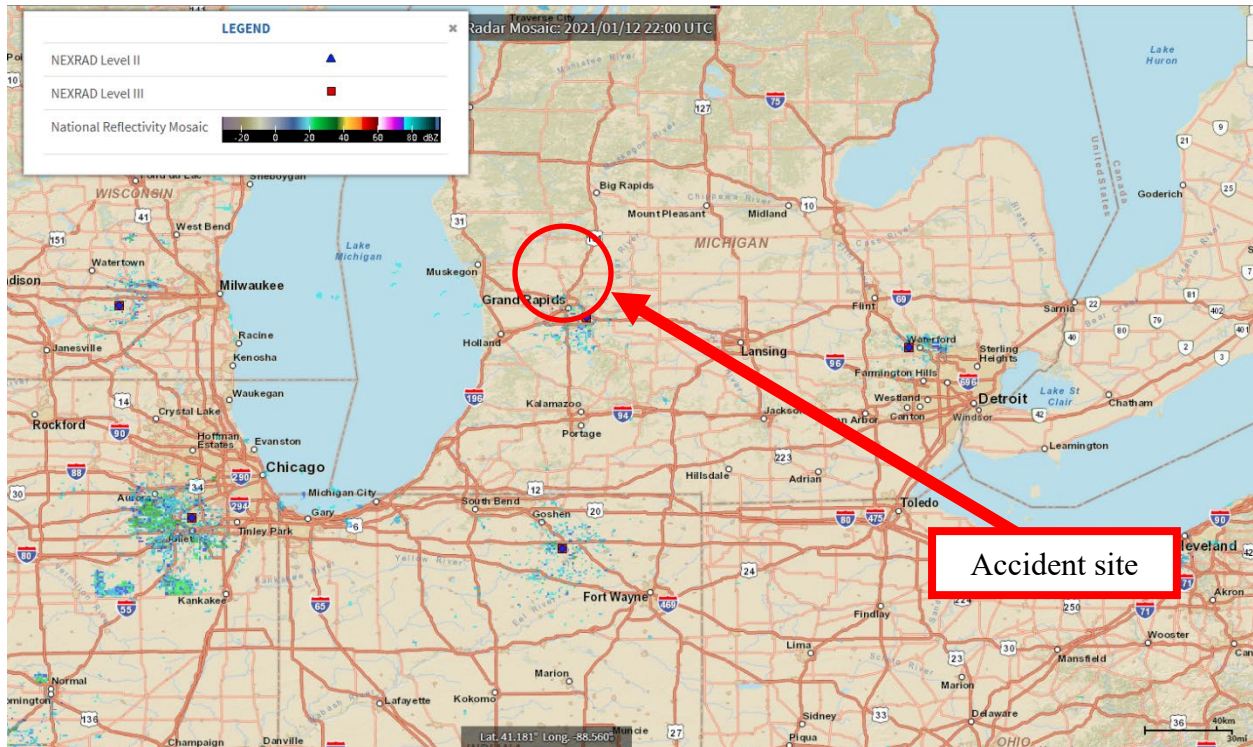
**Figure 8 – GOES-16 visible image at 1700 EST.**



**Figure 9 – GOES-16 infrared image at 1700 EST.**

## 5.0 Regional Radar Imagery Information

A regional view of the NWS national composite radar mosaic is included as figure 10 for 1700 EST with the approximate location of the accident site marked within a red circle. The image depicted no precipitation echoes above the accident site at the accident time.



**Figure 10 – Regional Composite Reflectivity image for 1700 EST.**

## 6.0 Pilot Reports<sup>19</sup>

The following are the publicly longline-disseminated pilot reports<sup>20</sup> (PIREPs) distributed into the national airspace system (NAS) within 125 miles of the accident site from about two hours prior to the accident time to one hour after the accident time for below 18,000 ft above msl.

DTW UA /OV DXO360010/TM 2035/FL040/TP CRJ2/SK T043/TA M7/IC MDT RIME =

YIP UA /OV 5MI NE/TM 2037/FL016/TP GLF4/TA UNK/IC LIGHT RIME (TEMP UNK)/RM B016=

AZO UA /OV 4D0/TM 2038/FL030/TP UH60/TA M06/IC MOD RIME =

MBS UA /OV MBS/TM 2039/FLSFC/TP PC12/SK TOP050 OVC015/IC LT MIXED/RM

TEW UA /OV TEW/TM 2041/FL030/TP SR22/TA -4/IC LT RIME =

DTW UA /OV SVM0100010/TM 2043/FLDURC/TP SR22/SK TOPS OVC 043/IC TR

LAN UA /OV 10E LAN/TM 2048/FL030/TP C310/TA -2/IC MOD RIME=

TVC UA /OV TVC/TM 2049/FL050/TP SR22/TA M04/IC LGT-MOD RIME 028-040=

DTW UA /OV DXO250012/TM 2050/FL045/TP CRJ2/SK T045/TA M8/IC MOD MIX/RM DURC=

<sup>19</sup> Only pilot reports with the World Meteorological Organization headers UBMI\*\*, UBOH\*\*, and UBIN\*\* were considered.

<sup>20</sup> These do not include pilot reports only broadcast via radio.

OZW UA /OV OZW/TM 2057/FL040/TP PAY2/TA -2/IC LT RIME =

AZO UA /OV MKG360007/TM 2101/FL035/TP CRJ2/SK OVC035/TA M04/IC LGT

LAN UA /OV 10E LAN/TM 2102/FL030/TP CRJ2/TA -4/IC LT RIME =

DTW UA /OV RWY 22R DURD/TM 2103/FL030/TP A321/IC LT RIME 30-20=

DTW UA /OV YIP055005/TM 2104/FL024/TP FA20/TA M2/IC MOD MIX=

YIP UA /OV YIP/TM 2108/FL016/TP FL20/SK OVC/WX 6/TA 0/IC - RIME =

DTW UA /OV DXO240012/TM 2121/FL037/TP A321/SK T40 B05 /TA M7/IC MOD MIX/RM DURC=

PTK UA /OV 6E/TM 2126/FLDURD/TP C68A/SK OVC 015/UKN/TA M01/IC-RIME=

LAN UA /OV LAN230005/TM 2137/FL030/TP C310/SK OVC-TOP038/IC LGT-MOD RIME=

TVC UA /OV TVC/TM 2147/FL047/TP C414/SK BASE030-TOP047/TA UNKN/IC LGT RIME 047-030/RM DURD=

DTW UA /OV 30 N DXO/TM 2148/FLDURD/TP BE9L/TA M04/IC MOD RIME/RM STARTING AT 040=

GRR UA /OV GRR130015/TM 2150/FL038/TP CRJ9/IC LGT MIXED=

DTW UA /OV 15 S DXO/TM 2155/FLDURC/TP A321/SK TOPS040/TA M03/IC LGHT RIME/RM 1020AGL THROUGH 040=

DTW UA /OV DXO360010/TM 2201/FL040/TP B737/SK TOPS 044 BASES UKN/TA M06/IC LGHT RIME@030=

DTW UA /OV 10 S DXO/TM 2208/FLDURC/TP A321/IC MOD MIXED SFC-040=

TVC UA /OV TVC/TM 2209/FL042/TP C414/SK UNKN-TOP042/TA M01/IC TRACE RIME=

DTW UA /OV DXO220008/TM 2223/FL020/TP B739/TA M02/IC MOD MIXED 020-040/RM DURGC=

DTW UA /OV DXO360015/TM 2250/FL030/TP A321/TA M07/IC LGT RIME =

MBL UA /OV MBL/TM 2254/FL047/TP C402/SK BASE022-TOP047/TA 00/IC TRACE RIME 047-022/RM DURD=

## **7.0 SIGMET**

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

## **8.0 CWSU Advisories**

The Chicago (ZAU) Air Route Traffic Control Center (ARTCC) Center Weather Service Unit (CWSU) was responsible for the accident region. The ZAU CWSU did not issue a Meteorological Impact Statement (MIS) or a Center Weather Advisory (CWA) for the accident site at the accident time.

## 9.0 AIRMETs

There were Airmen's Meteorological Information (AIRMET) advisories Zulu and Sierra valid for the accident site at the accident time. The AIRMETs warned of moderate icing below 6,000 ft msl and IFR conditions due to mist and fog:

WAUS43 KPCI 122045

WA3Z

-CHIZ WA 122045

AIRMET ZULU UPDT 3 FOR ICE AND FRZLVL VALID UNTIL 130300

AIRMET ICE...ND SD

FROM 50N MOT TO 30N ABR TO 30WSW BIS TO 50NW DPR TO 60WSW DIK TO

50NNW ISN TO 50N MOT

MOD ICE BTN 070 AND FL180. CONDS DVLPG AFT 21Z. CONDS CONTG BYD

03Z THRU 09Z.

AIRMET ICE...LM LS MI LH

FROM SSM TO YVV TO 30SE ECK TO 40SE DXO TO 20WSW DXO TO 20ENE TVC  
TO SSM

MOD ICE BLW 060. CONDS ENDG 00-03Z.

OTLK VALID 0300-0900Z...ICE ND SD MN

BOUNDED BY 60SSE YWG-MSP-20SSE RWF-20E PIR-20SE RAP-60WNW RAP-30N

DPR-60WSW DIK-50NNW ISN-40N MOT-60SSE YWG

MOD ICE BTN 070 AND FL200. CONDS CONTG THRU 09Z.

FRZLVL...RANGING FROM SFC-100 ACRS AREA

MULT FRZLVL BLW 100 BOUNDED BY 20SSE DXO-FWA-CVG-HNN-HMV-

40SSW VXV-50ESE BNA-30WSW BWG-60NE DYR-20SE ORD-20SSE DXO

MULT FRZLVL BLW 090 BOUNDED BY 30N INL-40ESE YQT-50SW YVV-30E

ECK-30SW FNT-20S DXO-20SE ORD-50WSW BVT-20SSW PWE-20ENE

ONL-50SSW FSD-30SSE MOT-20SSW ISN-50NNW ISN-30N INL

SFC ALG 20W ISN-30WNW BIS-70W ABR-20SSW PIR-70WNW ANW-60SSE

RAP-50WNW RAP

SFC ALG OSW-60ESE MCI-30SW UIN-40SE UIN-40NE FAM-20N DYR

SFC ALG 60ESE BWG-40W BKW

SFC BOUNDED BY 50E LBF-30SSW OBH-70SSE OBH-60W PWE-20NNE SLN-

20SSW SLN-30NW ICT-60W ICT-70E GCK-50S HLC-30SSW HLC-30WNW

HLC-40SSW MCK-20SW MCK-20NW MCK-40ESE LBF-50E LBF

040 ALG 40NNW ISN-60SE BIS-50WSW ABR-20WNW ANW-60W PWE-40SSW

ICT

040 ALG 20SE OSW-60ESE MCI-30NNW COU-30WNW STL-40SSE STL-30NW

DYR

040 ALG 30SSW BWG-40N HMV

....

WAUS43 KPCI 121445

WA3Z

-CHIZ WA 121445

AIRMET ZULU UPDT 2 FOR ICE AND FRZLVL VALID UNTIL 122100

AIRMET ICE...WI LM LS MI LH IL IN

**FROM 90ESE YQT TO SSM TO 60NW YVV TO 30SE ECK TO FWA TO CVG TO  
20E IND TO 30SE ORD TO 40SSW GRB TO 20SSE RHI TO 60WNW SAW TO  
90ESE YQT  
MOD ICE BLW 060. CONDS CONTG BYD 21Z ENDG 21-00Z.**

.  
OTLK VALID 2100-0300Z...ICE ND SD  
BOUNDED BY 80SW YWG-40E BIS-60NW RAP-50NNW ISN-80SW YWG  
MOD ICE BTN FRZLVL AND FL200. FRZLVL SFC-100. CONDS DVLPG AFT  
00Z. CONDS CONTG THRU 03Z.

.  
FRZLVL...RANGING FROM SFC-110 ACRS AREA  
MULT FRZLVL BLW 080 BOUNDED BY 50N ISN-60SSE YWG-30E YQT-  
20SSE MKG-50NNE FWA-FWA-CVG-HNN-HMV-70SSW PXV-20NW LIT-  
50SSW MLC-20NW SLN-20WSW ONL-70SW DIK-50N ISN  
MULT FRZLVL BLW 110 BOUNDED BY 70SW DIK-20WSW ONL-30S SLN-  
50SSW MLC-70WSW LBB-30ESE TBE-50W LBL-GLD-BFF-70SW RAP-  
70SW DIK  
SFC ALG 20NW RZC-40S SGF-60SSE SGF-70SE SGF-70W ARG

....

WAUS43 KPCI 122045  
WA3S  
-CHIS WA 122045  
AIRMET SIERRA UPDT 6 FOR IFR AND MTN OBSCN VALID UNTIL 130300

.  
**AIRMET IFR...MN WI LM LS MI LH IL IN  
FROM YQT TO SSM TO 70NW YVV TO 30SE ECK TO FWA TO 40SSE FWA TO  
30NNE BVT TO 50E DBQ TO 20W DLL TO 50S BRD TO 30NE BRD TO 60SSE  
INL TO 70ESE INL TO YQT  
CIG BLW 010/VIS BLW 3SM BR/FG. CONDS CONTG BYD 03Z THRU 09Z.**

.  
AIRMET MTN OBSCN...KY TN  
FROM 50WSW BKW TO HMV TO GQO TO 50W VXV TO 50WSW BKW  
MTNS OBSC BY CLDS. CONDS ENDG 21-00Z.

.  
OTLK VALID 0300-0900Z  
AREA 1...IFR MN IA WI LM LS MI LH IL IN  
BOUNDED BY 40WNW INL-50E INL-20NW YQT-SSM-YVV-30SE ECK-FWA-50SW  
ROD-20ENE BVT-30WSW BDF-30NNW IOW-30SW ODI-20W MSP-40SSW BRD-  
40WNW INL  
CIG BLW 010/VIS BLW 3SM BR/FG. CONDS CONTG THRU 09Z.

.  
AREA 2...MTN OBSCN KY TN  
BOUNDED BY HNN-HMV-20S VXV-50WSW LOZ-HNN  
MTNS OBSC BY CLDS/BR. CONDS DVLPG 03-06Z. CONDS CONTG THRU 09Z.

....

WAUS43 KPCI 121809 AAA  
WA3S  
-CHIS WA 121809 AMD  
AIRMET SIERRA UPDT 5 FOR IFR AND MTN OBSCN VALID UNTIL 122100

.  
AIRMET IFR...MN WI LM LS MI IL...UPDT  
FROM 20WNW INL TO 30SSW YQT TO 30ESE YQT TO 80NE SAW TO 40NE BAE  
TO 20NE ORD TO 40N BDF TO ODI TO 60SSW BRD TO 50SSE BJI TO 20WNW  
INL

CIG BLW 010/VIS BLW 3SM BR/FG. CONDS ENDG BY 21Z.

.  
**AIRMET IFR...LM LS MI LH IN KY...UPDT**  
**FROM 30NW SSM TO 60NW YVV TO 50SW YVV TO 40ESE ECK TO FWA TO HNN**  
**TO CVG TO 30SE GIJ TO 30ENE ORD TO 70SE SAW TO 30NW SSM**  
**CIG BLW 010/VIS BLW 3SM BR/FG. CONDS CONTG BYD 21Z THRU 03Z.**

.  
AIRMET MTN OBSCN...KY TN...UPDT  
FROM 60NE LOZ TO 20SSW BKW TO HNV TO GQO TO 50WSW LOZ TO 60NE LOZ  
MTNS OBSC BY CLDS. CONDS DVLPG BY 18Z. CONDS ENDG 18-21Z.

.  
OTLK VALID 2100-0300Z...IFR WI LM LS MI LH IN  
BOUNDED BY 70NNE SAW-SSM-60NW YVV-60SSW YVV-40ESE ECK-60SW DXO-  
30NE BVT-30ENE ORD-40ESE GRB-70NNE SAW  
CIG BLW 010/VIS BLW 3SM BR/FG. CONDS CONTG THRU 03Z.

....

## 10.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) products made available before the accident flight and valid at 1600 EST are shown in attachment 3. The GFA surface forecast products indicated VFR surface visibilities with patches of LIFR conditions and a surface wind from the southwest at 5 knots. The GFA cloud forecast valid before departure for around the accident time indicated overcast ceilings at 1,000 to 1,500 ft msl with cloud top altitudes of FL310<sup>21</sup> and cirrus clouds above. The Graphical AIRMET<sup>22</sup> (G-AIRMET) Sierra valid for the accident site was overlaid on the GFA surface forecast graphics. For more information please see attachment 3.

The reason for the differences between the GFA surface forecast and the GFA cloud forecast is the two are computed automatically by two different weather models. The Rapid Refresh (RAP) weather model is used for the cloud forecast and the Localized Aviation MOS<sup>23</sup> Program (LAMP) weather model is used for the surface forecast charts, and both forecasts are issued with no human intervention. The only human-generated information reflected in GFA<sup>24</sup> products are the G-AIRMETs.

## 11.0 Terminal Aerodrome Forecast

KGRR was the closest airport to the accident site with an NWS<sup>25</sup> Terminal Aerodrome Forecast (TAF). The KGRR TAF valid at the time of the accident was issued at 1220 EST and was valid for a 24-hour period beginning at 1300 EST. The 1220 EST TAF for KGRR was as follows:

---

<sup>21</sup> 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.

<sup>22</sup> <https://aviationweather.gov/gairmet>

<sup>23</sup> Model Output Statistics: [https://www.weather.gov/mdl/mos\\_home](https://www.weather.gov/mdl/mos_home)

<sup>24</sup> GFA is a “human-over-the-loop” product outside of the G-AIRMETs.

<sup>25</sup> According to NWS Instruction 10-813: “A 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](http://www.nws.noaa.gov/directives/sym/pd01008013curr.pdf)

TAF KGRR 121720Z 1218/1318 **22010KT 5SM BR OVC009**  
FM130200 22007KT 3SM BR OVC006=

After 1300 EST, the forecast expected a wind from 220° at 10 knots, 5 miles visibility in mist, and an overcast ceiling at 900 ft agl.

## 12.0 NWS Area Forecast Discussion

The NWS office in Grand Rapids, Michigan, (WFO GRR) issued the following Area Forecast Discussion (AFD) at 1500 EST (closest AFD to the accident time with an aviation section). The aviation section of the AFD discussed MVFR to IFR ceilings with light freezing drizzle and rime icing conditions:

FXUS63 KGRR 122000  
AFDGRR

Area Forecast Discussion  
National Weather Service Grand Rapids MI  
300 PM EST Tue Jan 12 2021

LATEST UPDATE...  
Synopsis/Discussion/Marine

.SYNOPSIS...  
Issued at 300 PM EST Tue Jan 12 2021

- Small chances for light precipitation through Thursday
- Transition from rain to snow late Thursday into early Friday
- Cooler Friday through next week with occasional lake effect chances

&&

.DISCUSSION...(This evening through next Tuesday)  
Issued at 300 PM EST Tue Jan 12 2021

-- Small chances for light precipitation through Thursday --

We will be allowing the remaining Winter Weather Advisory to expire on time this afternoon. The latest radar trends indicate the area of likely freezing drizzle has been generally shrinking in nature as expected this afternoon. Sfc temperatures have been slow to come up with dense cloud cover, but road temps have come up to around freezing, along with being treated. MI Drive highway speeds indicate little to no impact at this time. This should cause little to no issues for this evening's commute.

We can not rule out some patchy light fog/mist/drizzle that could freeze for tonight, but do not expect it to be as widespread as this morning across the north. We will have a couple of weak short waves move through tonight. The DGZ will remain unsaturated in the lower levels. The difference for tonight is that the models do not indicate as much lift in the cloud layer, and the cloud layer is not

as deep.

We will see additional weak short waves move through Wednesday night that could touch off some light precipitation. The encouraging thing with anything Wednesday and Wednesday night is that surface temperatures will be warmer, with only a low chance of some precipitation freezing across the far north. Moisture depth will remain quite low. We could see some moisture around 5-6k ft come through Wednesday night that would help to saturate the DGZ for some light precipitation.

-- Transition from rain to snow late Thursday into early Friday --

The models look like they have to come into a good consensus that precipitation with the Thu/Fri system will start to develop over the area later Thursday afternoon. This precipitation should start out as mainly rain for most of the area as the lower levels will start out above freezing up through 850 mb. This will not last long however as evaporative cooling will occur, and turn any rain to snow up north, with the south holding on to rain a little bit longer.

It does look like we will not see significant precipitation ahead of this system, keeping snow accumulations in check. The limited precipitation will be a result of limited Gulf moisture being drawn into the system before the front moves east of the area. There could be a couple of inches of snow across Central Lower, but it could be much worse if better and deeper moisture was in place. All locations will gradually see any rain change over to snow as the cooler air moves in.

-- Cooler Friday through next week with occasional lake effect chances --

There has been a decent amount of consistency in showing we will not see significant amounts of precipitation, lake effect or synoptic, after the front moves through. We will miss out on the deformation snow on the NW side of this system. The air coming in is not all that cold, only around -6 to -8C. This is not really sufficient instability for lake effect. We will see a few snow showers, with maybe some lake help, but nothing significant, especially by mid-January standards. The snow showers will be more associated with the filling upper low overhead.

Once the upper low gets kicked out, we will see the NW flow somewhat similar to the current pattern gain control of the region. The difference between the current pattern, and the one that will take place on Sunday, is that colder air will be available. We will continue to see short waves move through, but they will have more of a potential to bring some lake effect snow showers along with light synoptic amounts.

Overall, we continue to not expect a significant amount of snow in any one location in a short period of time over the next week. We will see the snow pack build up, especially near the lakeshore, as we see a couple inches fall at times from Friday through next Tuesday.

&&

**.AVIATION...(For the 18Z TAFS through 18Z Wednesday afternoon)  
Issued at 1227 PM EST Tue Jan 12 2021**

**Light freezing drizzle and rime icing conditions will continue this afternoon NE of GRR, N of LAN, affecting areas toward AMN and MOP. The threat of freezing drizzle should decrease with time. A mix of MVFR and IFR ceilings and visibility will be present through the forecast period, trending deeper into IFR tonight.**

&&

**.MARINE...  
Issued at 300 PM EST Tue Jan 12 2021**

We will be cancelling the Small Craft Advisory this afternoon, with another being needed for Wednesday and Thursday. Winds have come down, and waves are in the process of dropping below 4 ft. This will allow for a short and only relative break on the waters.

Winds and waves will come up a bit on Wednesday, necessitating another Advisory. These winds and waves will increase ahead of the incoming system for Thursday and Friday.

&&

**.GRR WATCHES/WARNINGS/ADVISORIES...  
MI...None.  
LM...None.**

&&

\$\$

### **13.0 Winds and Temperature Aloft Forecast**

The NWS 1455 EST Winds and Temperature Aloft forecast valid for the closest point to the accident site is included below:

```
FBUS31 KWNO 121955
FD1US1
DATA BASED ON 121800Z
VALID 130000Z    FOR USE 2000-0300Z. TEMPS NEG ABV 24000

FT    3000    6000    9000    12000    18000    24000    30000    34000    39000
MKG 2417 2821+00 2927-04 2932-09 3033-21 3245-33 324549 324157 304462
```

The closest forecast point to the accident site was Muskegon, Michigan, (MKG). The 1455 EST MKG forecast for use between 1500 EST and 2200 EST indicated a wind at 3,000 ft from 240° at 17 knots, a wind at 6,000 ft from 280° at 21 knots with a temperature of 0°C, and a wind at 9,000 ft from 290° at 27 knots with a temperature of -4°C.

## 14.0 Pilot Weather Briefing

The accident pilot did request weather information<sup>26</sup> from Leidos Flight Service. The accident pilot first requested weather information from Leidos on January 11 around 1755 EST for a flight the following day (January 12) from Grand Strand Airport (CRE) to Fayette County Airport (I23). During the January 11 weather briefing with Leidos the accident pilot also requested weather information for a flight from I23 to 8D4. The Leidos weather briefer provided all the standard weather information valid at 1755 EST on January 11 with the weather forecast going through January 12 with a “good chance of icing up there” (for the destination airport). The accident pilot requested more Leidos weather information at 1348 EST on January 12, and also received an additional full Leidos weather briefing around 1357 EST on January 12 before the accident flight from I23 to 8D4. During the January 12 Leidos weather briefing, the briefer provided all the weather forecast information valid along the route of flight including AIRMETs Sierra and Zulu, METARs along the route, potential for structural icing in the cloud cover along the route of flight, GFAs, TAFs, and PIREPs. For more information please see attachments 4 through 11.

A search of archived ForeFlight information indicated that the accident pilot did not request and receive weather information from ForeFlight.

## 15.0 Pilot Statement

The accident pilot reported flying the accident flight at 6,000 ft and before descent into destination airport and instrument meteorological conditions (IMC), the accident pilot reported hearing a PIREP that stated no icing in the climb.<sup>27</sup> After descent through IMC, the accident pilot reported breaking out of cloud cover at 1,800 ft with a clear windscreen, but a half of an inch of rime icing on the airframe. Figure 11 is a picture of the structural icing on the wing of the accident aircraft after the accident time. For more information please see the NTSB pilot accident report located in the docket of this investigation.

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<sup>26</sup> [https://www.faa.gov/documentLibrary/media/Advisory\\_Circular/AC\\_91-92.pdf](https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_91-92.pdf)

<sup>27</sup> For more information please see the ATC transcript located in the docket of this accident. It was noted there were 2 ATC communications that stated icing at 1636 and 1651 EST and 1 ATC communication with negative icing at 1645 EST.



**Figure 11 – Icing on the accident aircraft wing.**

## 16.0 Icing Potential<sup>28</sup>

Current Icing Potential (CIP) and Forecast Icing Potential (FIP) products are created by the NWS Aviation Weather Center (AWC) and are intended to supplement other icing advisories (e.g. AIRMETs and SIGMETs). Figures 12 through 14 are the FIP icing probabilities and icing severity products and 1-hour forecast valid at 1700 EST at 2,000, 3,000, and 4,000 ft above msl, and indicated a 50 to 85% probability of icing at 2,000 to 4,000 ft over the area. The FIP also indicated that the icing near the accident site would likely be in the “light” or “moderate” categories. The FIP indicated a 10 to 80% probability of Supercooled Large Droplets (SLD) over the accident site at the accident time (contained in attachment 12).<sup>29</sup>

The CIP product indicated a 30 to 85% probability of icing at 2,000 to 4,000 ft at 1708 EST above the accident site (figures 15, 16, and 17). The CIP also indicated that the icing near the accident site would be in the “light” or “moderate” categories above 2,000 ft above msl. The CIP also indicated a 50 to 70% probability of SLD at 2,000 and 3,000 ft above msl at the accident site at 1708 EST (contained in attachment 12). For more FIP and CIP data please see attachment 12.

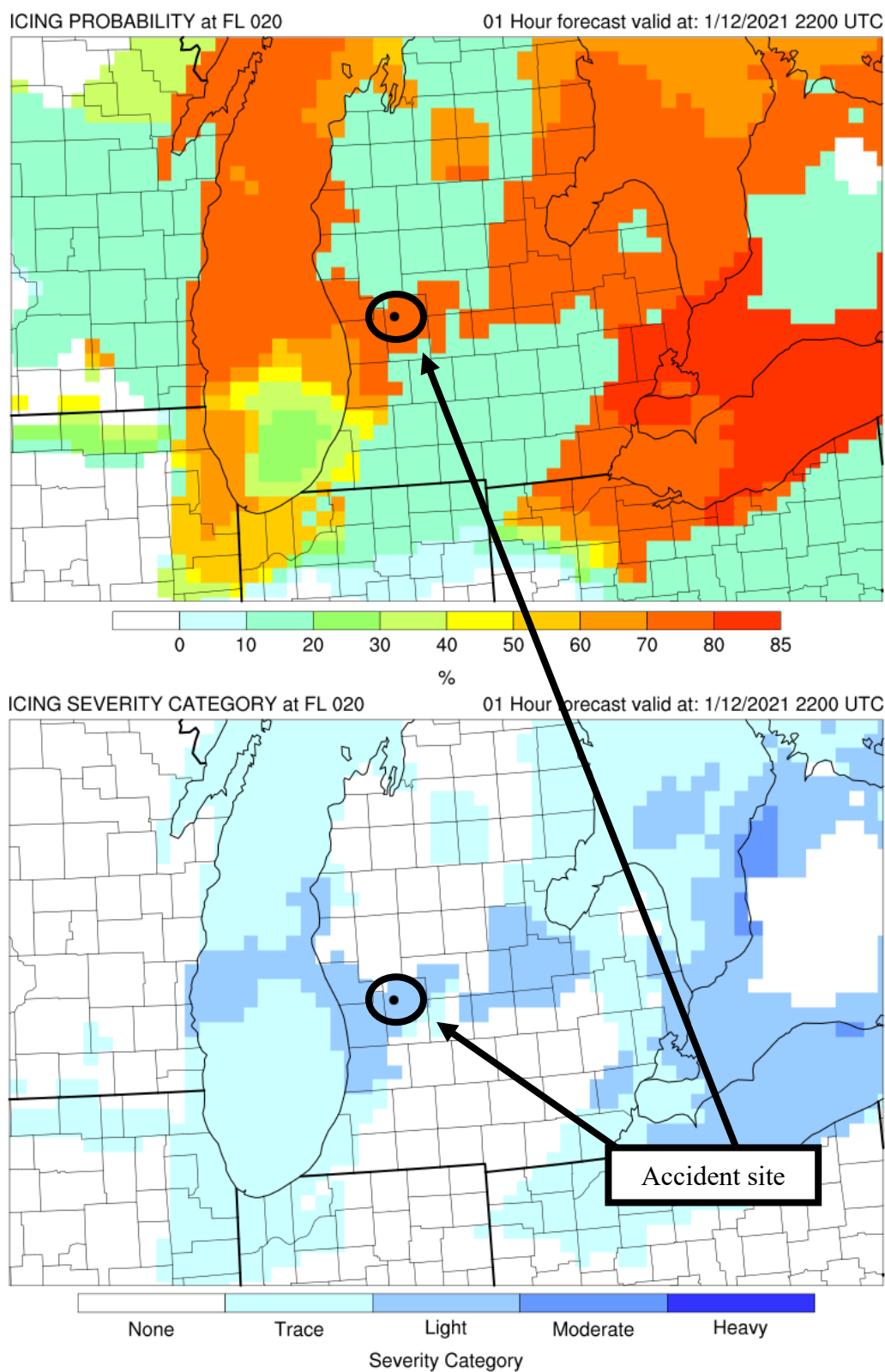
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<sup>28</sup> B.C. Bernstein, F. McDonough, M. K. Politovich, B. G. Brown, T. P. Ratvasky, D. R. Miller, C.A. Wolff, and G. Cuning, Current Icing Potential: Algorithm Description and Comparison with Aircraft Observations (Journal of Applied Meteorology, 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>

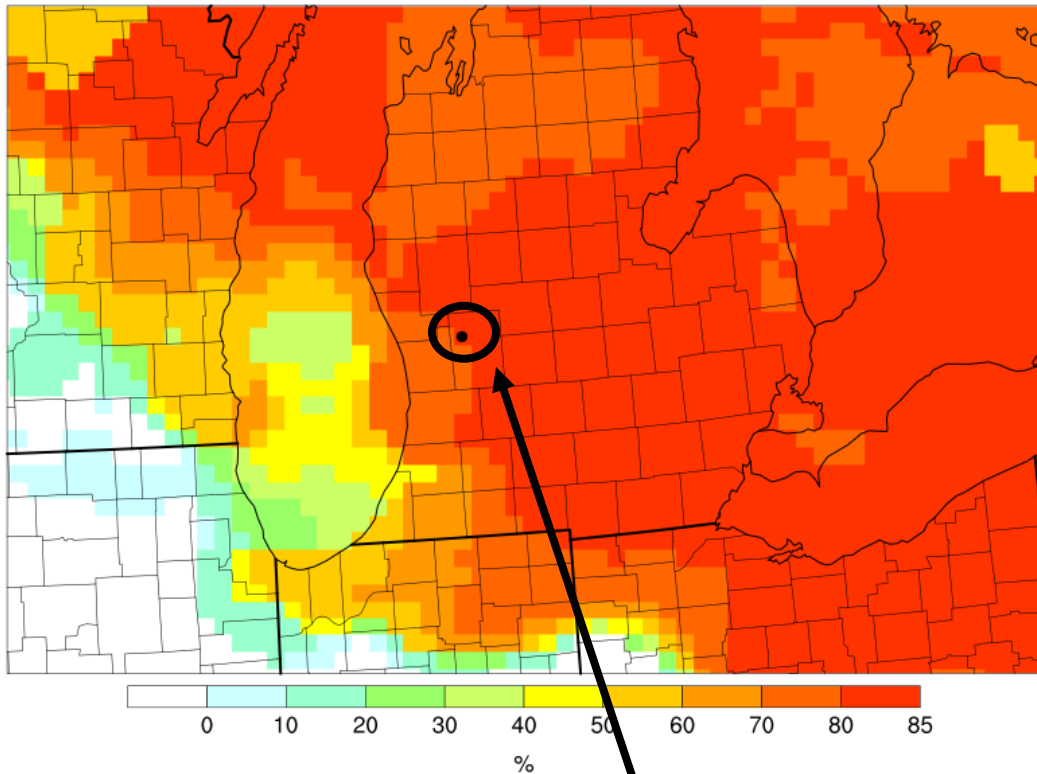
<sup>29</sup> <https://www.aviationweather.gov/icing/fip>



**Figure 12 – (top) FIP probability of icing at 2,000 ft above msl and (bottom) FIP severity of icing at 2,000 ft above msl 1-hour forecast valid for 1700 EST.**

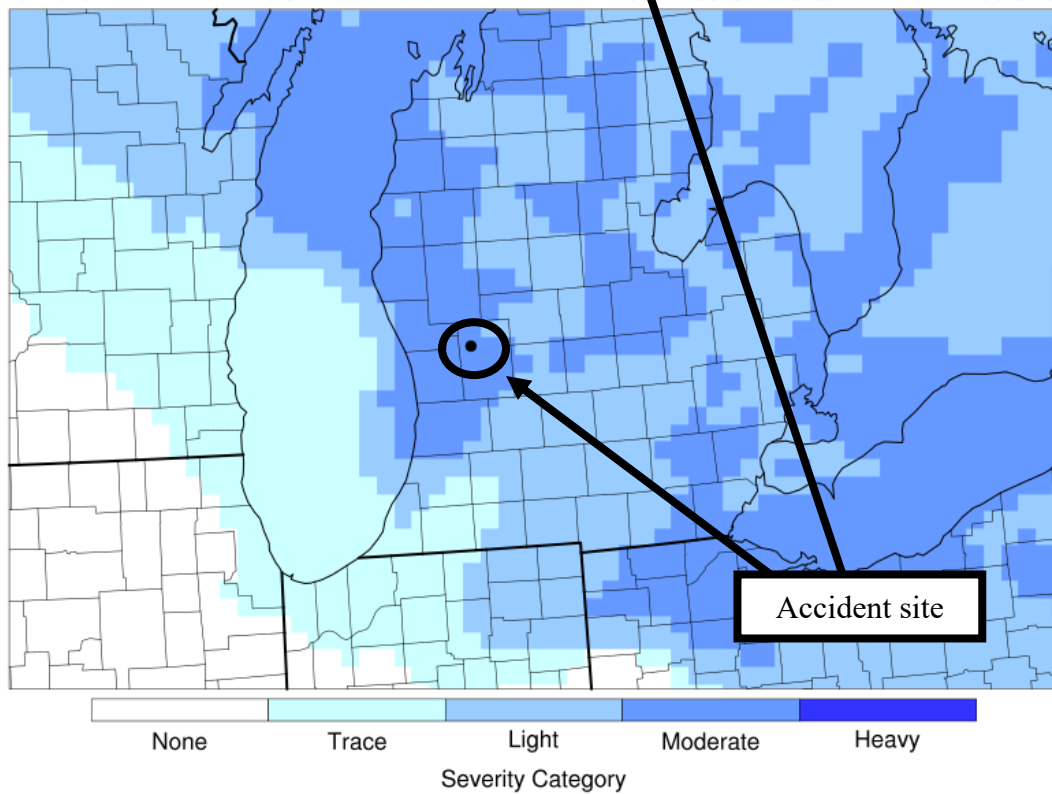
ICING PROBABILITY at FL 030

01 Hour forecast valid at: 1/12/2021 2200 UTC

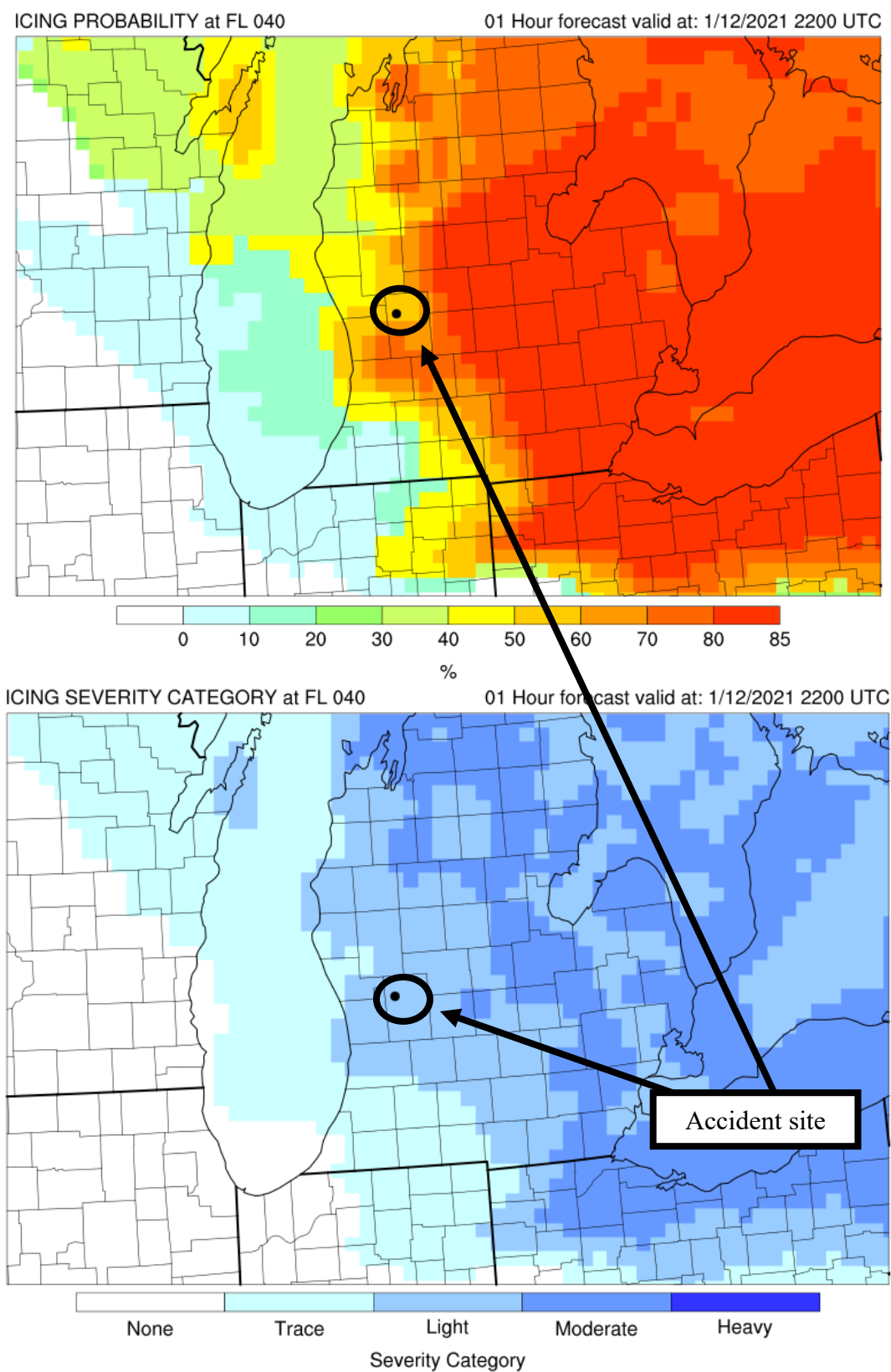


ICING SEVERITY CATEGORY at FL 030

01 Hour forecast valid at: 1/12/2021 2200 UTC



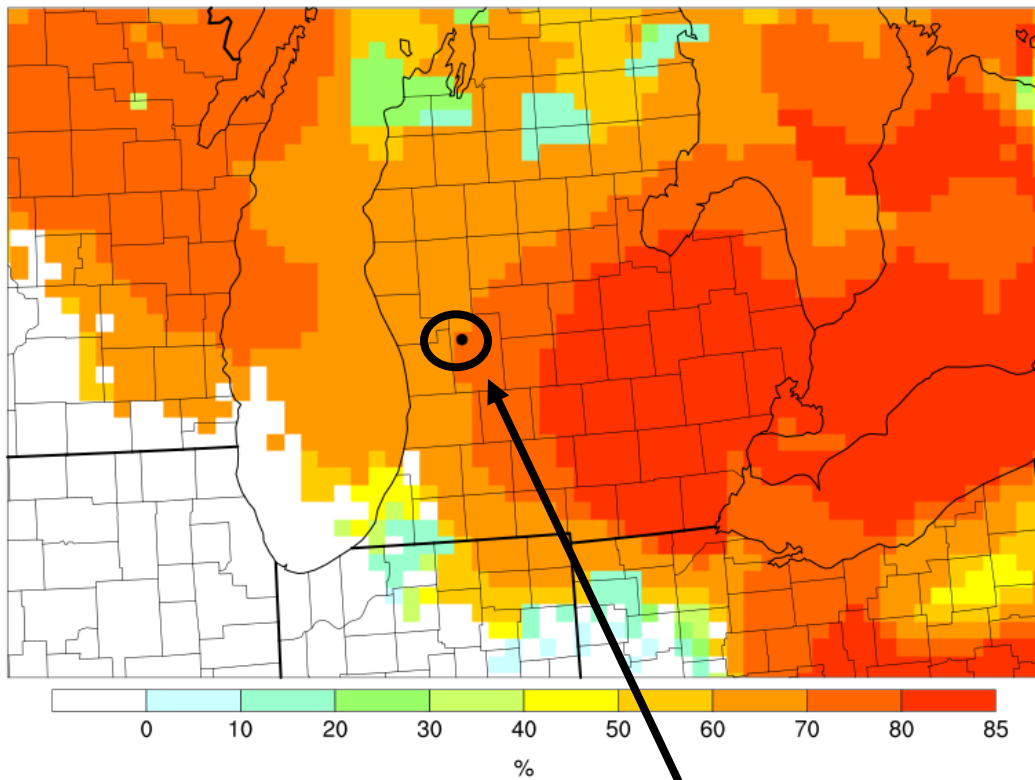
**Figure 13 – (top) FIP probability of icing at 3,000 ft above msl and (bottom) FIP severity of icing at 3,000 ft above msl 1-hour forecast valid for 1700 EST.**



**Figure 14 – (top) FIP probability of icing at 4,000 ft above msl and (bottom) FIP severity of icing at 4,000 ft above msl 1-hour forecast valid for 1700 EST.**

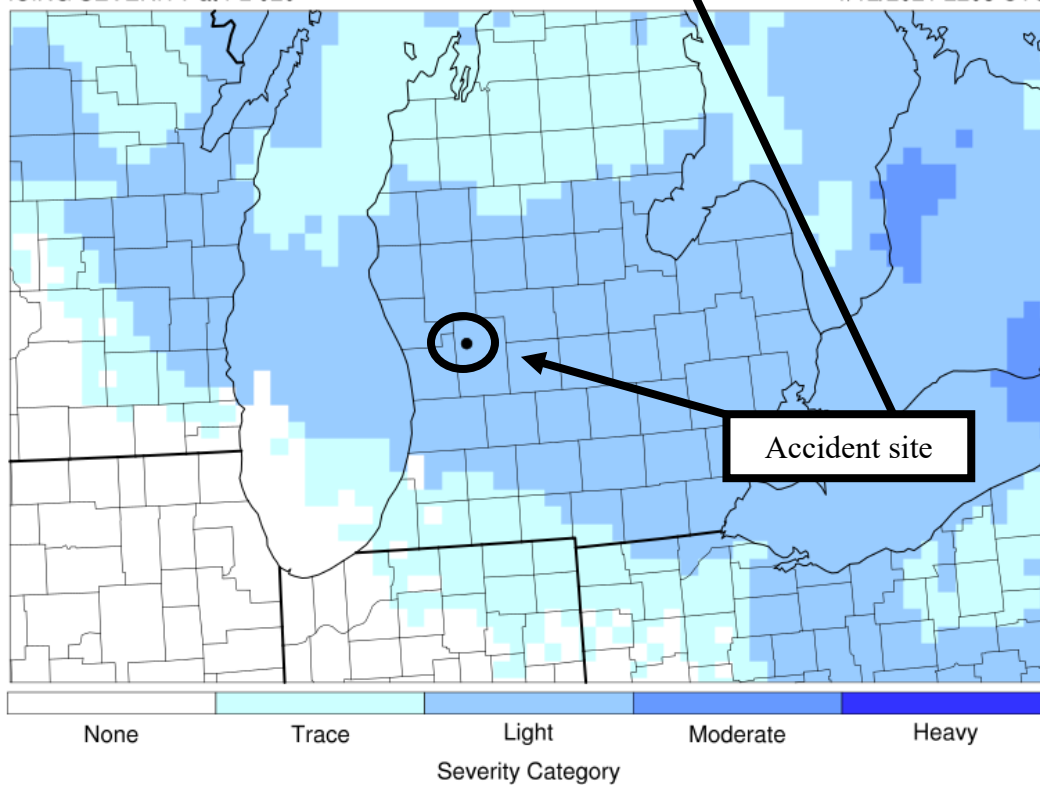
ICING PROBABILITY at FL 020

1/12/2021 2208 UTC



ICING SEVERITY at FL 020

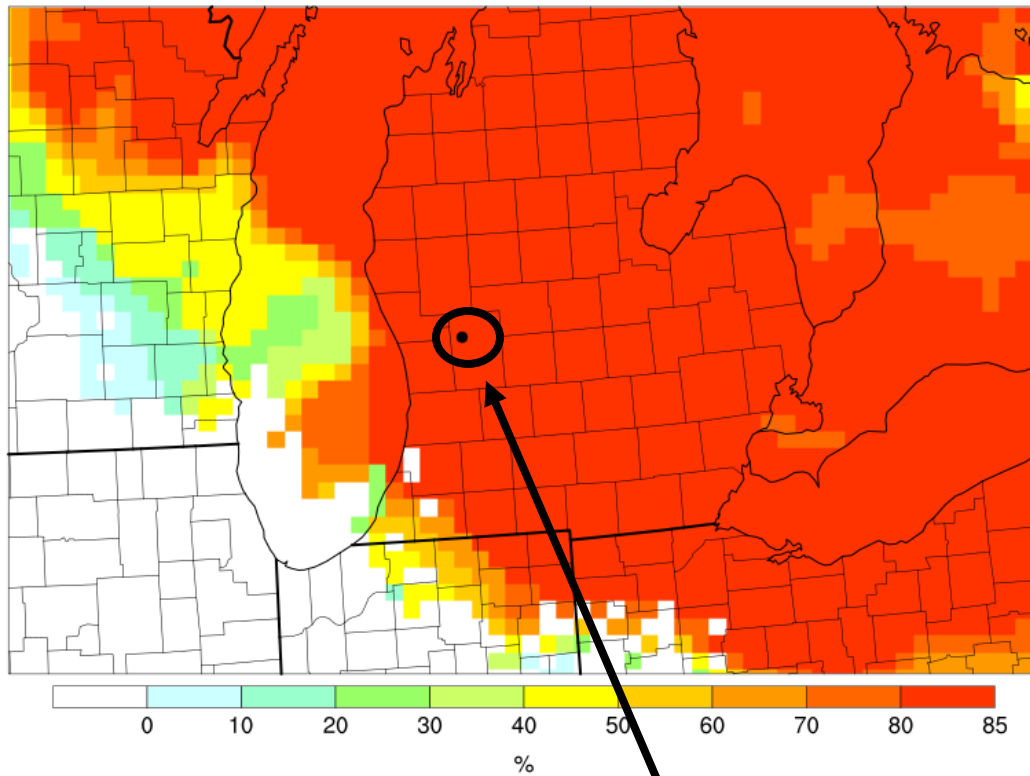
1/12/2021 2208 UTC



**Figure 15 – (top) CIP probability of icing at 2,000 ft above msl and (bottom) CIP severity of icing at 2,000 ft above msl valid for 1708 EST.**

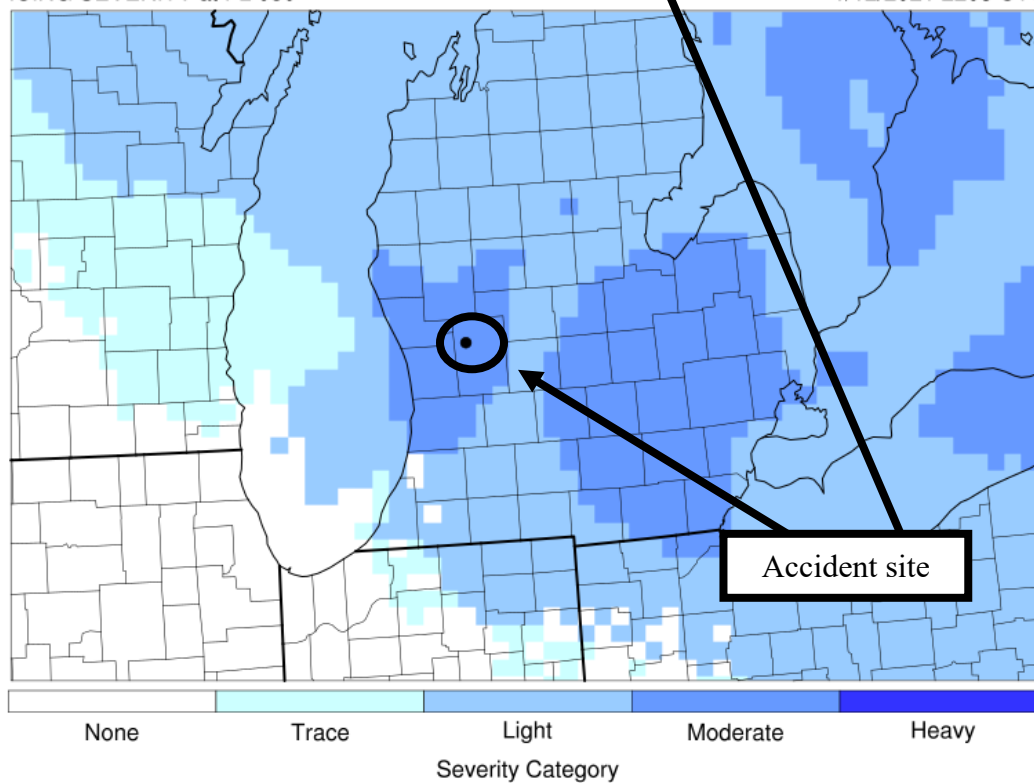
ICING PROBABILITY at FL 030

1/12/2021 2208 UTC



ICING SEVERITY at FL 030

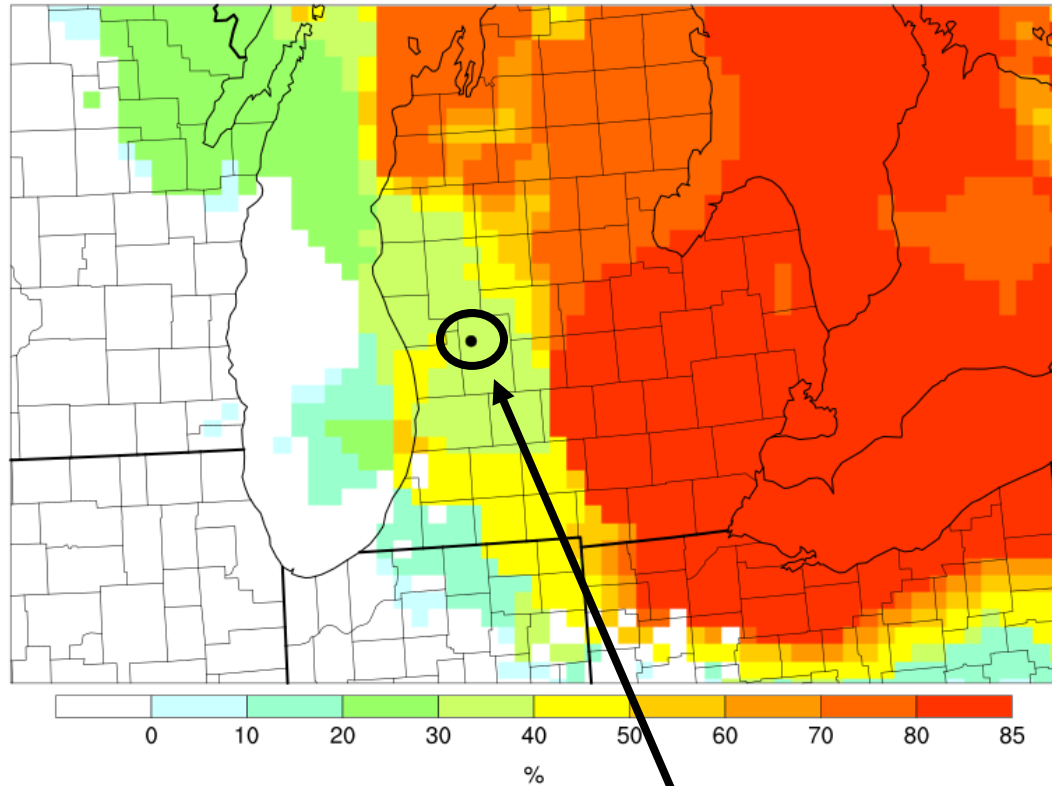
1/12/2021 2208 UTC



**Figure 16 – (top) CIP probability of icing at 3,000 ft above msl and (bottom) CIP severity of icing at 3,000 ft above msl valid for 1708 EST.**

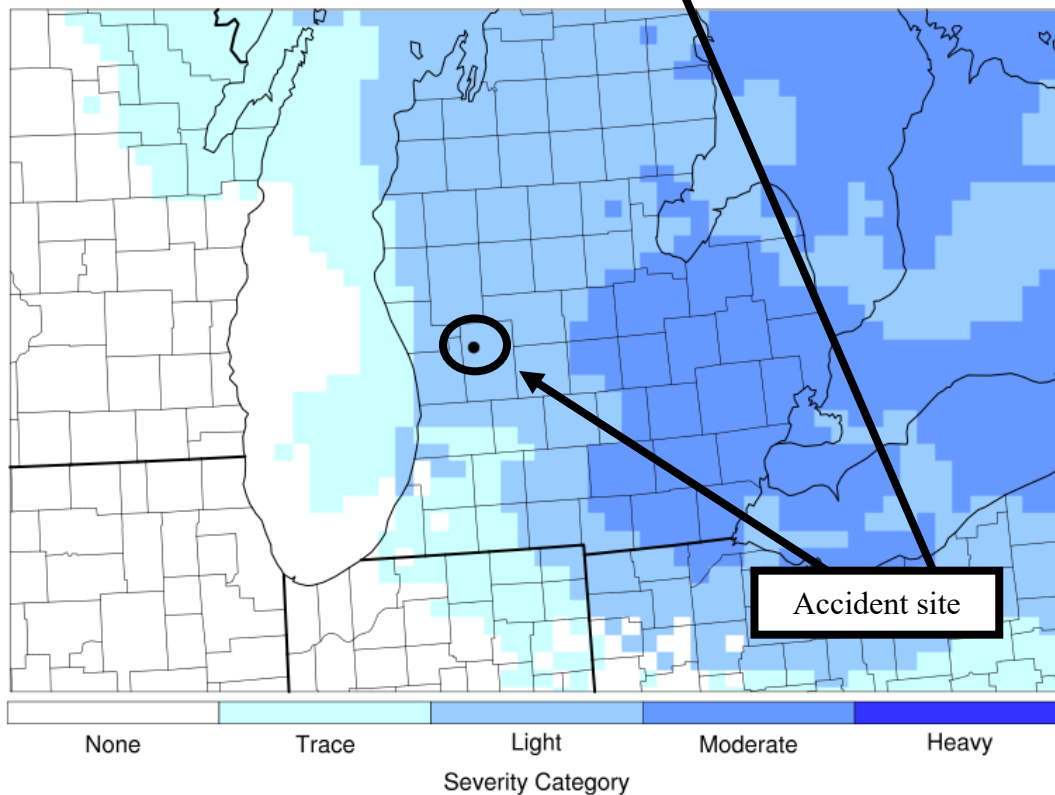
ICING PROBABILITY at FL 040

1/12/2021 2208 UTC



ICING SEVERITY at FL 040

1/12/2021 2208 UTC



**Figure 17 – (top) CIP probability of icing at 4,000 ft above msl and (bottom) CIP severity of icing at 4,000 ft above msl valid for 1708 EST.**

## 17.0 Astronomical Data

The astronomical data obtained for the accident site on January 12, 2021, indicated the following:

|                      |                              |
|----------------------|------------------------------|
| <b>SUN</b>           |                              |
| Begin civil twilight | 0741 EST                     |
| Sunrise              | 0812 EST                     |
| Sun transit          | 1251 EST                     |
| <b>Accident time</b> | <b>1658 EST<sup>30</sup></b> |
| Sunset               | 1730 EST                     |
| End civil twilight   | 1802 EST                     |

## E. LIST OF ATTACHMENTS

Attachment 1 – 8D4 AWOS observations surrounding the accident time

Attachment 2 – Nighttime Microphysics RGB animation between 1601 and 1801 EST

Attachment 3 – GFA valid for the accident site at accident time

Attachment 4 – Leidos weather briefing information text part 1

Attachment 5 – Leidos weather briefing information text part 2

Attachment 6 – Leidos weather briefing information text part 3

Attachment 7 – Leidos text flight plan log part 1

Attachment 8 – Leidos text flight plan log part 2

Attachment 9 – Leidos weather briefing information text route information

Attachment 10 – Leidos weather briefing on January 11

Attachment 11 – Leidos weather briefing on January 12

Attachment 12 – CIP and FIP imagery for the accident time

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<sup>30</sup> Inserted accident time for reference and context.

Submitted by:

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