NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

March 19, 2013

Group Chairman's Factual Report

METEOROLOGY

CEN13FA122

Table Of Contents

A. ACCIDENT

Location:	Clear Lake, Iowa
Date:	January 2, 2013
Time:	About 2057 central standard time (0257 UTC[1] on January 3, 2013)
Airplane:	Bell 407; registration N445MT

B. METEOROLOGY GROUP

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C. SUMMARY

On January 2, 2013, about 2057 central standard time, a Bell Helicopter model 407, N445MT, impacted terrain near Clear Lake, Iowa. The pilot and two medical crew members sustained fatal injuries. The helicopter was destroyed. The helicopter was registered to Suntrust Equipment Leasing & Finance Corporation and operated by Med-Trans Corporation under the provisions of 14 Code of Federal Regulations Part 135 as a positioning flight. Night visual meteorological conditions prevailed for the flight, which was operated on a company flight plan. A flight plan was not filed with the Federal Aviation Administration. The flight originated from the Mercy Medical Center, Mason City, Iowa, about 2049, with an intended destination of the Palo Alto County Hospital, (IA76), Emmetsburg, Iowa.

D. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) 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 National Climatic Data Center (NCDC). All times are central standard time (CST) based upon the 24 hour clock, local time is +6 hours to UTC, and UTC=Z. Directions are referenced to true north and distances in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles. NWS airport and station identifiers use standard International Civil Aviation Organization (ICAO) 4 letter station identifiers versus International Air Transport Association (IATA) 3-letter identifiers, both codes are intermittently used in this report.

The accident site was located at latitude 43.1426° N and longitude 93.4827° W.

[1] UTC – is an abbreviation for Coordinated Universal Time.

E. FACTUAL INFORMATION

1.0 Synoptic Situation

The synoptic or large scale migratory weather systems influencing the area were documented using standard NWS charts issued by the National Center for Environmental Prediction (NCEP) located in Camp Springs, 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 00-45.

1.1 NWS Surface Analysis Chart

The NWS Surface Analysis Chart for 2100 CST on January 2, 2013 is included as figure 1 with the approximate accident site marked by a red cross. The chart depicted a low pressure at 1016-hPa over Ontario with a cold front extending southward from the low across Minnesota and into northwestern Iowa. Ahead of the cold front stretched a trough of low pressure that extended southward across Wisconsin, into eastern Iowa, and then curving southwestward into Missouri. The accident site was located ahead of the cold front and behind or west of the trough of low pressure.

The station model in the immediate vicinity of the accident site ahead of the cold front indicated westerly wind at approximately 5 knots, visibility restricted in mist, overcast clouds, a temperature of 27° Fahrenheit (F), and a dew point of 23° F. Numerous other station models northeast through southeast of the site over central and eastern Iowa, eastern Minnesota reported visibility restriction in mist with several stations reporting light snow.

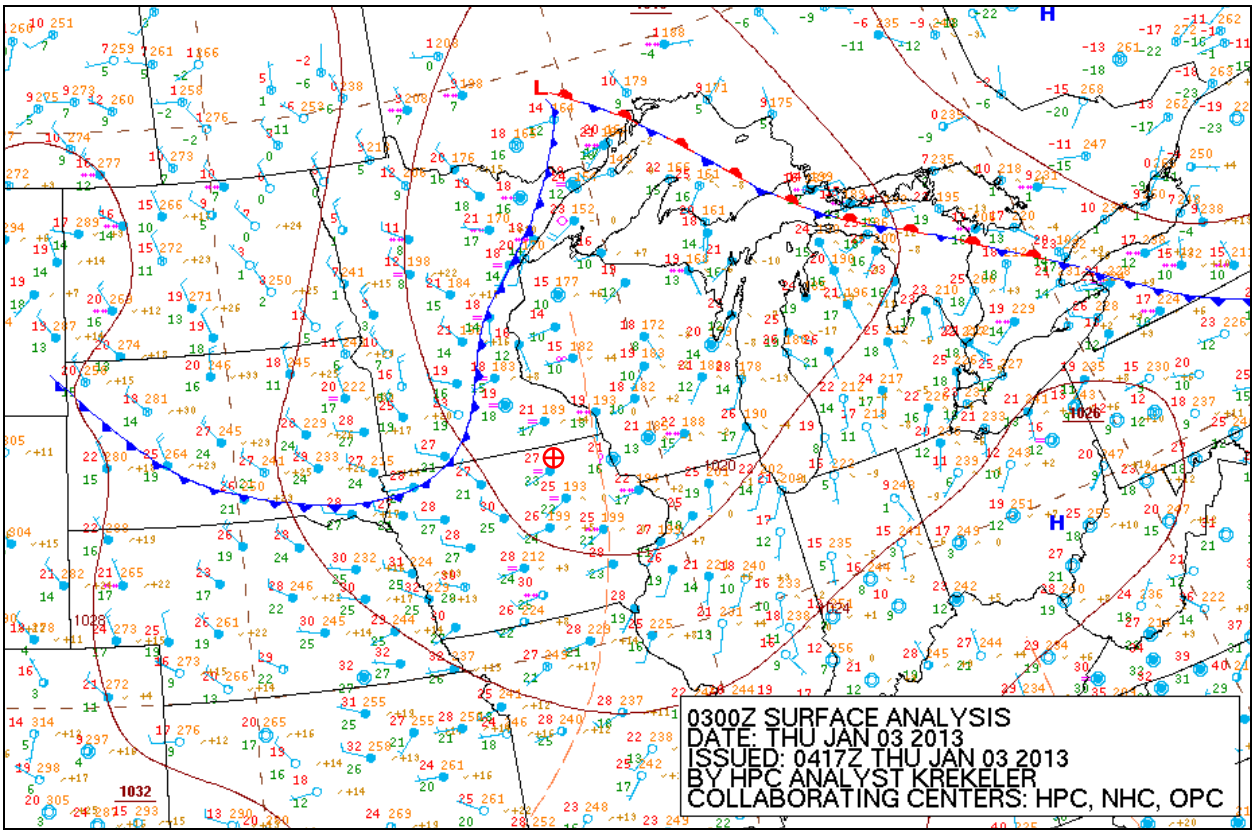

Figure 1 - NWS Surface Analysis Chart for 2100 CST

1.2 NWS Weather Radar Mosaic

The NWS regional radar mosaic for Iowa depicted no significant meteorological echoes over the accident site surrounding the period, and with only several small areas of very light intensity echoes associated with light snow showers. Figure 2 is a radar coded message (RCM) plot of the echoes at 2045 CST.

The closest WSR-88D for Des Moines (KDMX) WSR-88D was also reviewed specifically for any boundaries and the base reflectivity imagery surrounding the period also depicted no significant meteorological echoes in the vicinity of the accident site. However, it was noted the KDMX WSR-88D 0.5° base reflectivity scan assuming standard refraction of the beam sampled the volume from 6,630 to 15,100 feet over the accident site. Any echoes below this would not be detected by the weather radar.

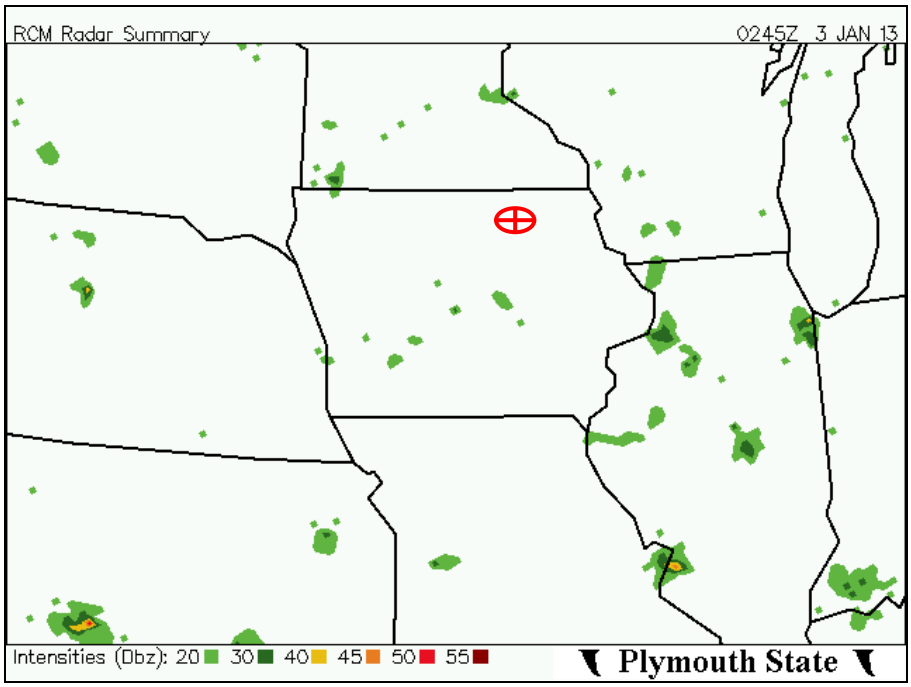

Figure 2- Radar Coded Message plot of echoes at 2045 CST

1.3 NWS Weather Depiction Chart

The NWS Weather Depiction Charts for 1900 and 2200 CST (0100Z and 0400Z on January 3, 2013) centered over the region were document in figures 3 and 4 respectively to document the general flight conditions being depicted over the region. The chart at 1900 CST depicted an area of instrument flight rule (IFR) conditions[2] due to low ceilings along the cold and ahead of the cold front and the trough Minnesota, western Wisconsin, into northern Iowa in the vicinity of the accident site, depicted by a shaded contour line. That area was enclosed by a large area of marginal visual flight rule (MVFR) conditions[3] which stretched over eastern Minnesota and Iowa with several stations reporting light snow. General visual flight rule (VFR) conditions[4] were depicted over western Iowa depicted without a contour line.

The chart for 2200 CST depicted a smaller area of IFR conditions over Minnesota, with a MVFR conditions continuing over eastern Minnesota and Iowa, and most of Wisconsin. MVFR conditions were depicted surrounding the accident site with overcast ceilings.

[2] IFR conditions – are defined as a ceiling or lowest height of a broken or overcast layer of clouds, or the vertical visibility into a surface based obscuration of 1,000 feet above the ground (agl) and/or visibility less than 3 statute miles.

[3] MVFR conditions – are defined as a ceiling between 1,000 and 3,000 feet agl inclusive and/or visibility from 3 to 5 miles inclusive.

[4] VFR conditions – are defined as no ceiling or a ceiling higher than 3,000 feet agl and visibility greater than 5 statute miles.

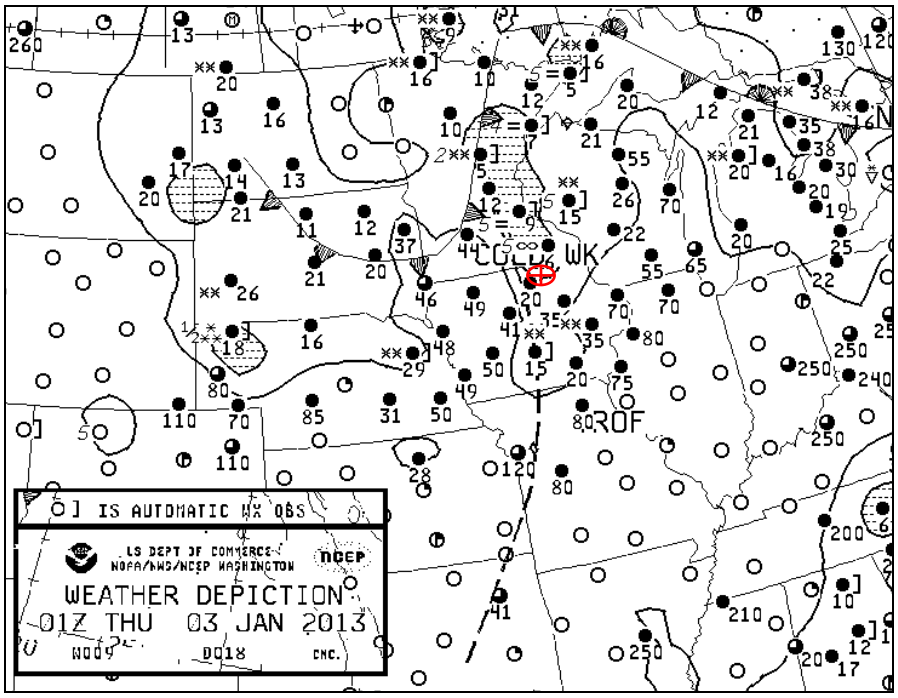

Figure 3 - NWS Weather Depiction Chart for 1900 CST

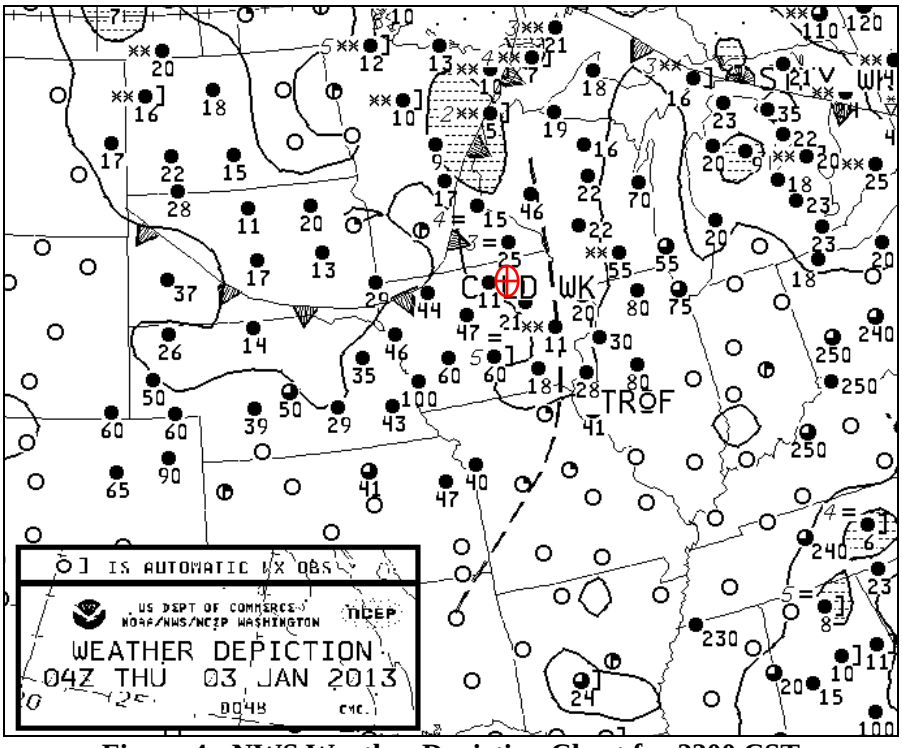

Figure 4 - NWS Weather Depiction Chart for 2200 CST

1.4 NWS Constant Pressure Charts

The NWS 850-hPa Constant Pressure Charts for January 2, 2013 at 1800 CST (0000Z on January 3, 2013) is included as figures 5, depicting the conditions at approximately 5,000 feet

over the area. The chart depicted a short wave trough extending southward across Minnesota, Iowa, into Missouri with a cyclonic shift in winds. The closest station model for Davenport, Iowa immediately southwest of the accident site indicated a westerly wind at 20 knots, a temperature of -6° Celsius (C), a temperature-dew point spread of 4° C, implying near saturated conditions at that level with a 70 meter height drop in the last 12-hours.

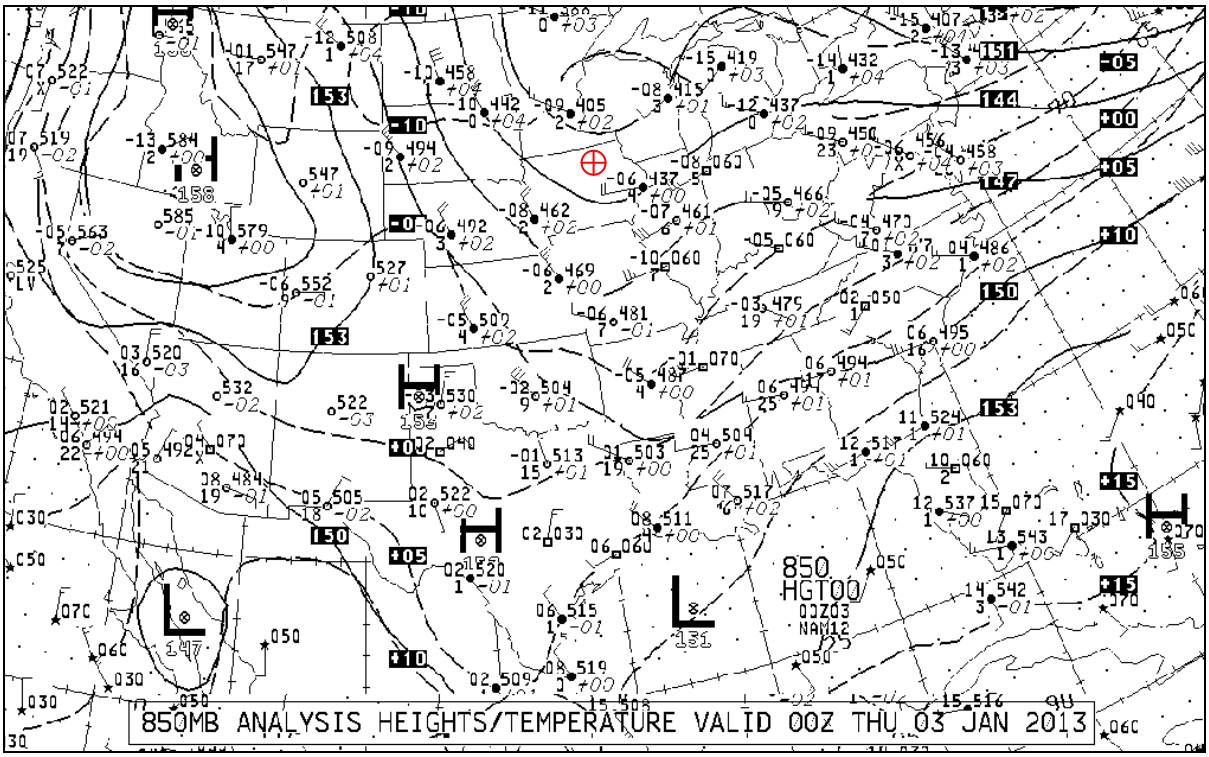

Figure 5- NWS 850-hPa Constant Pressure Chart for 1800 CST

2.0 Flight Track

Figure 6 is a plot of the helicopter flight path based on position reports provided by the helicopters global positioning system (GPS).

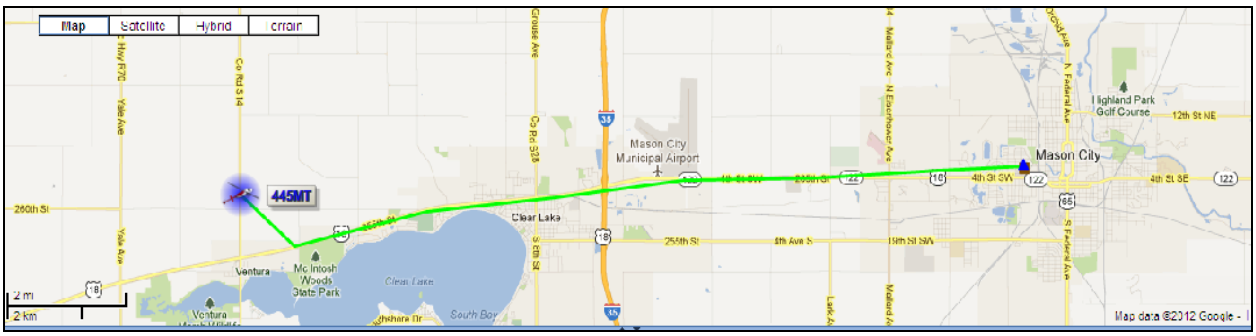

Figure 6 - Flight Track of N445MT

3.0 Surface Observations

The official NWS Meteorological Aerodrome Reports (METARs) and special reports (SPECIs) surrounding the period were documented for the departure and the closest airport to the accident site. The cloud heights are reported above ground level (agl).

3.1 Mason City Municipal Airport (KMCW), Mason City, Iowa

The closest official NWS reporting location to the accident site was from Mason City Municipal (KMCW), Iowa was located approximately 3 miles east of the accident site at an elevation of 1214 feet, and with a listed magnetic variation of 5° E. The airport was equipped with an Automated Surface Observation System (ASOS)[5] which was not augmented by any human observers and reported the following conditions:

Mason City Airport weather at 2053 CST, automated observation, wind from 300° at 8 knots, visibility 8 statute miles, ceiling broken at 1,700 feet agl, temperature -3° C, dew point -5° C, altimeter 30.05 inches of mercury. Remarks: automated weather observation system, sea level pressure 1019.4-hPa, temperature -2.8° C, dew point -5.0° C, 3-hour pressure tendency fallen 0.09-hPa. The relative humidity was calculated as 86 percent during the period.

The raw observation transmitted surrounding the period were as follows with the corresponding general flight category noted at the beginning of the report:

SPECI KMCW 022222Z AUTO 25006KT 3SM -SN BR SCT014 BKN024 OVC034 M06/M08 A3000 RMK AO2 SNB16 P0000=

SPECI KMCW 022234Z AUTO 24006KT 4SM HZ BKN014 OVC024 M05/M08 A3000 RMK AO2 SNB16E33 P0000=

METAR KMCW 022253Z AUTO 24005KT 3SM -SN BR OVC012 M05/M07 A3000 RMK AO2 SNB16 SLP179 P0000 T10501072=

SPECI KMCW 022314Z AUTO 22006KT 4SM BR BKN008 OVC012 M05/M07 A3001 RMK AO2 SNE10 P0000=

METAR KMCW 022353Z AUTO 24008KT 6SM BR OVC008 M04/M06 A3002 RMK AO2 SNE29 SLP186 P0000 60000 T10441061 11044 21094 53009=

SPECI KMCW 030017Z AUTO 26007KT 6SM BR SCT008 OVC014 M04/M06 A3003 RMK AO2=

SPECI KMCW 030039Z AUTO 25006KT 6SM BR BKN016 BKN031 OVC042 M03/M06 A3003 RMK AO2=

METAR KMCW 030053Z AUTO 25006KT 7SM SCT016 BKN020 OVC042 M03/M06 A3003 RMK AO2 SLP188 T10331056=

SPECI KMCW 030127Z AUTO 25005KT 7SM OVC014 M03/M05 A3004 RMK AO2=

METAR KMCW 030153Z AUTO 27005KT 5SM BR OVC014 M03/M05 A3004=

SPECI KMCW 030231Z AUTO 29006KT 5SM BR FEW007 BKN015 OVC033M03/M04 A3004 RMK AO2=

[5] It should be noted that ASOS have a documented problem reporting light freezing drizzle (-FZDZ).

METAR KMCW 030253Z AUTO 30008KT 8SM BKN017 OVC033 M03/M05 A3005 RMK AO2 SLP194 T10281050 51009=

Accident 0257Z

SPECI KMCW 030317Z AUTO 32009KT 8SM BKN013 OVC018 M03/M05A3005 RMK AO2=

METAR KMCW 030353Z AUTO 30013KT 10SM OVC011 M03/M06 A3007 RMK AO2 SLP200 T10281056=

The observations showed a short period of IFR conditions and snow at KMCW prior to the accident with no significant accumulation, and marginal VFR ceilings and visibilities restricted in mist prevailing prior to the accident with low ceilings continuing after the accident. Temperatures were below freezing the entire day with a low temperature of -18° C (-0.4° F) with the warmest temperature of -3° C (26° F) at the time of the accident, with a relative humidity of 88 percent.

The 5-minute ASOS data for Mason City was obtained from the National Climatic Data Center (NCDC) surrounding the time of the accident for further details on the weather conditions. These observations would have been broadcasted locally only when the system updated. Local time is included at the beginning of the report and are in standard code as the METARs with the pressure altitude, relative humidity, density altitude, and magnetic wind following after the altimeter setting and before the remarks section of the report. The raw observations were as follows:

20:30:31 5-MIN KMCW 030230Z AUTO 29006KT 5SM BR SCT010 BKN015 OVC033 M03/M04 A3004 1100 88 -700 290/06 RMK AO2

20:35:31 5-MIN KMCW 030235Z AUTO 29007KT 5SM BR FEW009 BKN015 OVC031 M03/M04 A3004 1100 88 -700 290/07 RMK AO2

20:40:31 5-MIN KMCW 030240Z AUTO 29007KT 6SM BR BKN015 OVC031 M03/M04 A3005 1100 88 -700 290/07 RMK AO2

20:45:31 5-MIN KMCW 030245Z AUTO 29008KT 7SM BKN017 OVC033 M03/M04 A3005 1100 88 -700 290/08 RMK AO2

20:50:31 5-MIN KMCW 030250Z AUTO 30008KT 8SM BKN017 OVC033 M03/M05 A3005 1100 85 -700 300/08 RMK AO2 SLP194 T10281050 53009

20:55:31 5-MIN KMCW 030255Z AUTO 30007KT 9SM BKN017 OVC033 M03/M05 A3005 1100 85 -700 300/07 RMK AO2

Accident 2057

21:00:31 5-MIN KMCW 030300Z AUTO 31009KT 9SM BKN017 OVC033 M03/M05 A3005 1100 85 -700 300/09 RMK AO2

21:05:31 5-MIN KMCW 030305Z AUTO 31010KT 10SM BKN015 OVC020 M03/M05 A3005 1090 85 -700 310/10 RMK AO2

21:10:31 5-MIN KMCW 030310Z AUTO 31012KT 9SM OVC015 M03/M05 A3006 1090 85 -700 310/12 RMK AO2

3.2 Forest City Municipal Airport (KFXY), Forest City, Iowa

The next closest weather reporting location was from Forest City Municipal Airport (KFXY) located 14 miles west of Mason City, which also reported similar weather conditions surrounding the period. Of particular interest was a reported of low ceilings with unknown freezing precipitation at 1955 CST (0155Z) or approximately an hour prior to the accident, with the precipitation moving eastward with the upper level wind flow. The raw observations were as follows:

KFXY 021955Z AUTO 24006KT 5SM -SN BKN011 OVC024 M07/M09 A2995 RMK AO2

KFXY 022015Z AUTO 25005KT 5SM BR SCT011 BKN026 OVC049 M06/M08 A2994 RMK AO2
KFXY 022035Z AUTO 27004KT 7SM -SN SCT011 BKN031 OVC049 M06/M08 A2995 RMK
KFXY 022055Z AUTO 26004KT 7SM SCT011 OVC029 M05/M07 A2995 RMK AO2

KFXY 022115Z AUTO 27003KT 5SM BR OVC031 M05/M07 A2995 RMK AO2
KFXY 022135Z AUTO 25003KT 7SM BKN014 OVC033 M04/M06 A2996 RMK AO2
KFXY 022155Z AUTO 24003KT 7SM OVC014 M04/M06 A2997 RMK AO2

KFXY 022215Z AUTO 23003KT 7SM OVC010 M04/M06 A2997 RMK AO2
KFXY 022235Z AUTO 24003KT 7SM OVC008 M03/M06 A2998 RMK AO2
KFXY 022255Z AUTO 22004KT 7SM OVC008 M03/M05 A2998 RMK AO2

KFXY 022315Z AUTO 23004KT 7SM BKN008 OVC012 M03/M05 A2999 RMK AO2
KFXY 022335Z AUTO 23004KT 7SM OVC010 M03/M05 A2999 RMK AO2
KFXY 022355Z AUTO 25003KT 7SM OVC010 M03/M04 A3001 RMK AO2

KFXY 030015Z AUTO 00000KT 7SM OVC012 M02/M04 A3001 RMK AO2
KFXY 030035Z AUTO 00000KT 7SM BKN014 OVC024 M02/M04 A3001 RMK AO2
KFXY 030055Z AUTO 27004KT 10SM SCT018 BKN024 OVC037 M02/M03 A3001 RMK AO2

KFXY 030115Z AUTO 28008KT 7SM BKN021 OVC035 M02/M03 A3002 RMK AO2
KFXY 030135Z AUTO 28006KT 7SM BKN010 OVC019 M02/M03 A3003 RMK AO2
KFXY 030155Z AUTO 30006KT 4SM UP OVC008 M02/M02 A3003 RMK AO2

KFXY 030215Z AUTO 31006KT 7SM OVC006 M02/M03 A3003 RMK AO2
KFXY 030235Z AUTO 32007KT 10SM SCT006 OVC013 M02/M03 A3004 RMK AO2
KFXY 030255Z AUTO 30009KT 10SM OVC010 M02/M03 A3004 RMK AO2

Accident 0257Z

KFXY 030315Z AUTO 31012KT 10SM SCT010 OVC044 M03/M05 A3004 RMK AO2
KFXY 030335Z AUTO 30013KT 10SM OVC044 M03/M06 A3005 RMK AO2
KFXY 030355Z AUTO 30011KT 10SM OVC042 M03/M06 A3006 RMK AO2

3.3 Northeast regional Airport (KCCY), Charles City, Iowa

The next closest reporting station was from Northeast Regional Airport (KCCY), Charles City located approximately 35 miles east of the accident site. The airport was equipped with an Automated Weather Observation System (AWOS-3) which reported similar conditions with light snow reported between 1715 to 1855 CST. The following conditions were reported:

KCCY 030055Z AUTO 22005KT 4SM -SN BKN009 OVC014 M05/M07 A3003 RMK AO2

KCCY 030115Z AUTO 22007KT 3SM BR OVC009 M05/M07 A3003 RMK AO2
KCCY 030135Z AUTO 24006KT 4SM BR OVC007 M05/M06 A3003 RMK AO2
KCCY 030155Z AUTO 24005KT 4SM BR BKN007 OVC012 M05/M06 A3003 RMK AO2

KCCY 030215Z AUTO 24005KT 4SM BR OVC012 M04/M06 A3003 RMK AO2
KCCY 030235Z AUTO 25006KT 5SM BR BKN013 OVC045 M04/M05 A3003 RMK AO2
KCCY 030255Z AUTO 25006KT 5SM BR SCT013 OVC026 M03/M05 A3003 RMK AO2

Accident 0257Z

KCCY 030315Z AUTO 27008KT 6SM BR SCT026 OVC036 M03/M05 A3004 RMK AO2
KCCY 030335Z AUTO 27008KT 6SM BR SCT027 OVC035 M03/M04 A3004 RMK AO2

The observations indicated visibility between 5 to 6 miles in mist, with multiple layers of clouds with below freezing temperatures.

3.4 Albert Lea Airport (KAEL), Albert Lee, Minnesota

Albert Lea Municipal Airport (KAEL), Albert Lee, Minnesota was located approximately 31 miles north of the accident site at an elevation 1,261 feet. The airport had an AWOS system installed and reported the following conditions at the approximate time of the accident:

Albert Lee weather at 2112 CST, automated, wind from 280° at 5 knots, visibility 10 miles, ceiling overcast at 1,200 feet agl, temperature -3° C, dew point -4° C, altimeter 30.02 inches of Hg.

The raw observations were as follows:

METAR KAEL 022132Z AUTO 25004KT 3SM -SN OVC013 M06/M07 A2995 RMK AO2=
METAR KAEL 022153Z AUTO 24004KT 5SM BR OVC011 M06/M07 A2996 RMK AO2=

METAR KAEL 022212Z AUTO 00000KT 5SM BR OVC011 M06/M07 A2996 RMK AO2=
METAR KAEL 022232Z AUTO 21003KT 4SM BR OVC009 M06/M07 A2996 RMK AO2=
METAR KAEL 022252Z AUTO 21003KT 5SM BR OVC007 M06/M06 A2997 RMK AO2=

METAR KAEL 022312Z AUTO 20004KT 7SM OVC005 M05/M06 A2998 RMK AO2=
METAR KAEL 022333Z AUTO 24003KT 5SM BR OVC005 M04/M06 A2998 RMK AO2=
METAR KAEL 022352Z AUTO 00000KT 5SM BR OVC007 M04/M04 A2999 RMK AO2=

METAR KAEL 030012Z AUTO 26003KT 5SM BR OVC009 M03/M04 A2999 RMK AO2=
METAR KAEL 030033Z AUTO 27003KT 5SM BR OVC009 M03/M04 A2999 RMK AO2=
METAR KAEL 030052Z AUTO 29004KT 7SM OVC009 M03/M03 A3000 RMK AO2=

METAR KAEL 030112Z AUTO 29006KT 7SM BKN009 OVC034 M03/M03 A3001 RMK AO2=
METAR KAEL 030133Z AUTO 29006KT 7SM SCT009 OVC034 M03/M03 A3001 RMK AO2=
METAR KAEL 030152Z AUTO 30005KT 7SM SCT009 OVC032 M03/M04A3001 RMK AO2=

METAR KAEL 030212Z AUTO 29004KT 7SM BKN022 OVC032 M03/M04 A3001 RMK AO2=
METAR KAEL 030232Z AUTO 29005KT 5SM UP BKN018 OVC026 M03/M04 A3002 RMK AO2=
METAR KAEL 030252Z AUTO 28003KT 10SM OVC016 M03/M04 A3002 RMK AO2=

Accident 0257Z

METAR KAEL 030312Z AUTO 28005KT 10SM OVC012 M03/M04 A3002 RMK AO2=

The observations from Albert Lee indicated a similar period of low ceilings between 1600 and 2000 CST, with unknown freezing precipitation being reported at 2032 CST or within ½ hour prior to the accident. At the time of the accident MVFR conditions with an overcast cloud conditions with temperature below freezing were reported.

4.0 Upper Air Data

The closest upper air sounding or rawinsonde observation (RAOB) was from the NWS Davenport (KDVN), Iowa, site number 74455, located approximately 153 miles southeast of the accident site at an elevation of 751 feet. The 1800 CST (0000Z on January 3, 2013) sounding was plotted on a standard Skew-T log P diagram[6] utilizing RAOB[7] software is included as figure 7 from the surface to 500-hPa or 18,000 feet. The sounding depicted the entire depth of the sounding below freezing even with several temperature inversions noted below 18,000 feet. The estimated base of the clouds of lifted condensation level (LCL)[8] was at 1,435 feet agl. The sounding had a relative humidity greater than 75 percent from the LCL to approximately 8,000 feet. The sounding was stable with a lifted index (LI)[9] of 18 which support stratiform type clouds with the potential for snow showers. The precipitable water content of the sounding was 0.27 inches.

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

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

[9] Lifted Index (LI) - A common measure of atmospheric instability. Its value is obtained by computing the temperature that air near the ground would have if it were lifted to 500-hPa or approximately 18,000 feet and comparing that temperature to the actual temperature at that level. Negative values indicate instability - the more negative, the more unstable the air is, and the stronger the updrafts are likely to be with any developing thunderstorms.

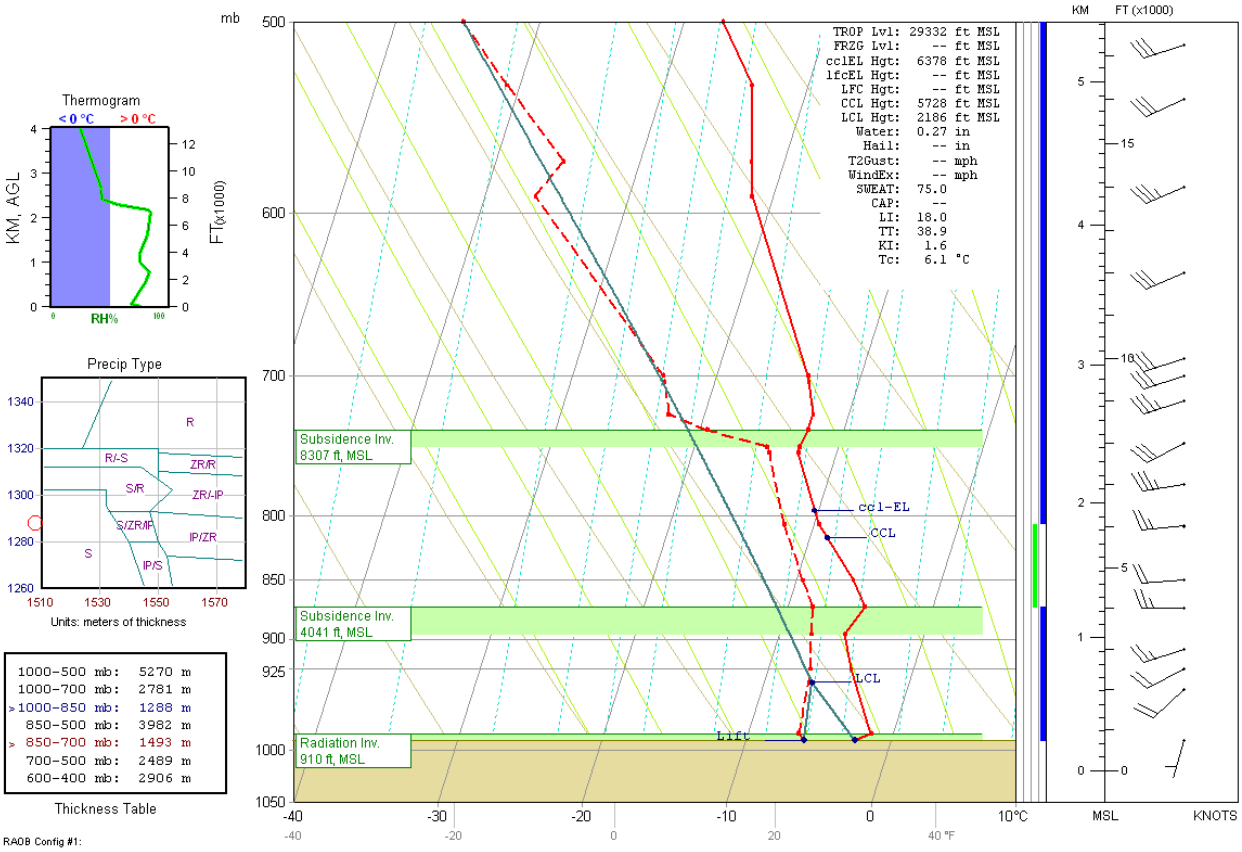

Figure 7 - Davenport, Iowa 1800 CST sounding

The wind profile indicated a surface wind from the south or 195° at 6 knots with winds veering to the west above the surface and increasing in speed. The mean 0 to 6 kilometer wind was from 250° at 28 knots.

5.0 Satellite Data

The Geostationary Operational Environmental Satellite number 13 (GOES-13) data was obtained and displayed on the National Transportation Safety Board's Man-computer Interactive Data Access System (McIDAS) workstation. Both the infrared long wave and visible band imagery were obtained surrounding the time of the accident. The infrared long wave imagery (band 4) at a wavelength of 10.7 microns (μm) provided standard satellite image with radiative cloud top temperatures with a resolution of 4 km. The visible imagery (band 1) at a wavelength of 0.65 μm provided a resolution of 1 km. However, due to low Sun elevation angle the visible images were of little to no value and have not been included in this report.

Figure 8 is the GOES-13 infrared image for 2115 CST (0315Z) at 4X magnification. The image depicted an overcast layer of low stratiform clouds over the region with a radiative cloud top temperature of 257° Kelvin or -16.16° C, which corresponded to cloud tops near 11,000 feet. The NWS frontal positions from 2100 CST are also overlaid on the image along with the accident site.

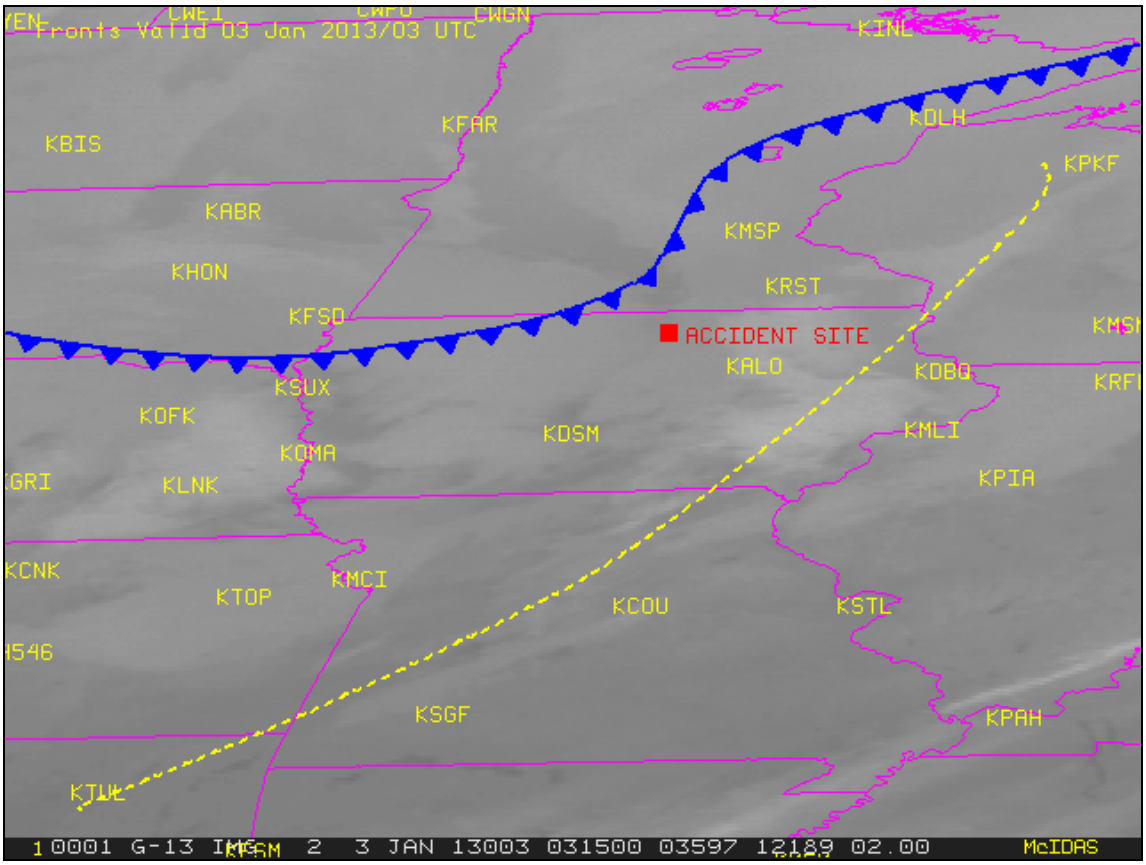

Figure 8 - GOES-13 infrared image at 2115 CST

6.0 Pilot Reports

The following pilot reports (PIREPs) were recorded over Iowa surrounding the period between 1500 and 2400 CST. The reports are as follows:

CID UA /OV CID360010 /TM 2112 /FLUNKN /TP CRJ2 /SK OVC070-TOP080 /TA M12 /IC LGT RIME /RM DURD=

ALO UA /OV ALO270005 /TM 2148 /FL035 /TP C172 /SK OVC030 /TA M07 /IC MOD RIME=

SUX UA /OV SUX130010 /TM 2306 /FLUNKN /TP FA10 /SK OVC-TOP085 /TA M12 /IC LGT-MOD RIME 085-065 /RM DURD=

SPW UA /OV SPW/TM 0200/FL064/TP C208/SK UNKN064-TOP078/TA M12/IC LGT RIME/RM DURC=

DBQ UA /OV DBQ180010/TM 0228/FL060/TP C550/TA M7/TB LGT RIME=

Accident 0257Z

DBQ UA /OV DBQ180020 /TM 0312 /FL040 /TP E135 /TA M07 /IC LGT

DBQ UA /OV DBQ135020/TM 0312/FL040/TP E135/TA M7/IC LGT RIME=

There were 7 pilot reports in the system during the afternoon and evening reported over Iowa all of which indicated some degree of icing conditions encountered between 3,000 and 8,500 feet.

7.0 Terminal Aerodrome Forecast

The NWS Weather Service Forecast Office (WSFO) Des Moines issued the regular scheduled Terminal Aerodrome Forecast (TAF) for Mason City Municipal (KMCW) at 1736 CST (2232Z) expected westerly winds at 10 knots, visibility 4 miles in light snow, with ceiling broken at 800 feet agl, and overcast at 1,200 feet through 2200 CST, with a gradual improving ceiling and visibility restricted in mist through the evening. The forecast was as follows:

TAF KMCW 022326Z 0300/0324 26010KT 4SM -SN BKN008 OVC012
FM030400 31014KT 5SM BR OVC025
FM031500 31012G22KT P6SM SCT025 SCT250
FM031900 28011KT P6SM SCT250=

The forecast for KMCW was amended at 1959 CST (0159Z) to westerly winds at 6 knots, 5 miles visibility in light snow and ceiling overcast at 1,400 feet agl, or MVFR conditions prevailing. The forecast was as follows:

TAF AMD KMCW 030159Z 0302/0324 25006KT 5SM -SN OVC014
FM030400 31014KT 6SM BR OVC025
FM031500 31012G22KT P6SM SCT025 SCT250
FM031900 28011KT P6SM SCT250=

8.0 Area Forecast

The Area Forecast (FA) is a forecast of visual Flight Rules (VFR) clouds and weather conditions over an area as large as the size of several states. It must be used in conjunction with the AIRMET Sierra (IFR) bulletin for the same area in order to get a complete picture of the weather. The area forecast together with the AIRMET Sierra bulletin are used to determine forecast enroute weather and to interpolate conditions at airports which do not have a terminal forecast (TAF) issued. The NWS Aviation Weather Center (AWC) located in Kansas City, Missouri, issues the FA at regular intervals and issues specials reports as necessary usually in the form of an AIRMET. The Chicago (KCHI) regional forecast that was current at the time of the accident was issued at 2045 CST and valid through 0900 CST on January 3, 2013. The forecast was as follows:

FAUS43 KKCI 030245 2013003 0231
FA3W
-CHIC FA 030245
SYNOPSIS AND VFR CLDS/WX
SYNOPSIS VALID UNTIL 032100
CLDS/WX VALID UNTIL 031500...OTLK VALID 031500-032100
ND SD NE KS MN IA MO WI LM LS MI LH IL IN KY
.
SEE AIRMET SIERRA FOR IFR CONDS AND MTN OBSCN.
TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS.

NON MSL HGTS DENOTED BY AGL OR CIG.

.

SYNOPSIS...03Z CDFNT FM LOW 30NNE YQT ACRS W LS-SW MN-N CNTRL NEB-NEB PNHDL. WRMFNT FM LOW 30NNE YQT ACRS N LS-N LH CONTG SEWD AS STNR FNT INTO W NY. TROF CNTRL WI-NW IL-SW MO-E CNTRL OK. TROF NERN TN-W SC CONTG SEWD. HIGHS NERN MT AND SERN OH. 21Z CDFNT FM LOW 150N YVV ACRS N LH-CNTRL WI. WRMFNT FM EXTRM NERN ND NWD INTO MAN. TROF FM SW SD THRU LOW CNTRL CO TO CNTRL NM. HIGH SW KS.

..

MN

N 1/2...OVC025 TOP 100. VIS 3-5SM -SN BR. BECMG 1214 SCT CI W 1/3 AREA...BKN030 TOP 100 E 2/3 AREA. OTLK...VFR W 1/3...MVFR CIG E 2/3.

S 1/2...OVC020-025 TOP 130. VIS 3-5SM BR. 12Z BKN035. OTLK...MVFR CIG EXTRM SE...MVFR CIG BECMG 16Z VFR RMNDR

.

IA

W 1/2...BKN035 OVC070 TOP 150. WDLY SCT -SHSN. 08Z OVC030. WDLY SCT -SHSN. OTLK...MVFR CIG...16Z VFR.

NERN 1/4...OVC025 TOP 150. VIS 3-5SM SCT -SHSN. 09Z OVC030. WDLY SCT -SHSN. OTLK...MVFR CIG...18Z VFR.

SE 1/4...OVC050 TOP 100. 09Z OVC030. OTLK...MVFR CIG...18Z VFR.

.

The forecast for northeastern Iowa expected overcast clouds at 2,500 feet with tops to 15,000 feet, with widely scattered light snow showers.

9.0 In-Flight Weather Advisories

The NWS issues in-flight weather advisories designated as Severe Weather Forecast Alerts (AWW's), Convective SIGMET's (WST's), SIGMET's (WS's), Center Weather Advisories (CWA's), and AIRMET's (WA's). In-flight advisories serve to notify en route pilots of the possibility of encountering hazardous flying conditions, which may not have been forecast at the time of the preflight briefing. Whether or not the condition described is potentially hazardous to a particular flight is for the pilot to evaluate on the basis of experience and the operational limits of the aircraft.

Severe Weather Forecast Alert (AWW) - None

Convective SIGMETs - None

Center Weather Advisories (CWA) - None

AIRMETs – the following advisories were current surrounding the period:

WAUS43 KKCI 030245 2013003 0236

WA3S

-CHIS WA 030245

AIRMET SIERRA FOR IFR AND MTN OBSCN VALID UNTIL 030900

.

AIRMET IFR*...ND MN IA WI LM LS MI LH*

FROM 60NW INL TO YQT TO 20E SSM TO 20ENE TVC TO 30SSW MKG TO
30ENE DBQ TO 30NE DSM TO 20NW MCW TO 30WNW GFK TO 60NW INL
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 09Z THRU 15Z.
.
AIRMET MTN OBSCN...KY TN
FROM 50WSW BKW TO HMV TO GQO TO LOZ TO 50WSW BKW
MTNS OBSC BY CLDS/BR. CONDS CONTG BYD 09Z ENDG 09-12Z.
.
OTLK VALID 0900-1500Z...IFR MN IA WI LM LS MI LH IL IN
BOUNDED BY 50WNW INL-20NW YQT-SSM-60ESE SSM-20WSW ECK-40SE GIJ-
30SSE JOT-50SW BAE-20WSW MCW-50WNW INL
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG THRU 15Z.
....

WAUS43 KKCI 030245 2013003 0242
WA3T
-CHIT WA 030245
AIRMET TANGO FOR TURB VALID UNTIL 030900
.
AIRMET TURB...ND SD NE KS MN IA WI LS MI
FROM 80ESE YWG TO YQT TO 70N SAW TO 30NNE OVR TO GLD TO BFF TO
70SW RAP TO 70NW RAP TO 80ESE YWG
MOD TURB BTN FL200 AND FL400. CONDS CONTG BYD 09Z THRU 15Z.
.
AIRMET TURB...KS IA MO WI LM MI LH IL IN KY
FROM YVV TO 30SE ECK TO FWA TO CVG TO HNN TO HMV TO RZC TO 20SSW
OSW TO 50E MCI TO 50E DBQ TO 20S ASP TO YVV
MOD TURB BTN FL180 AND FL400. CONDS CONTG BYD 09Z THRU 15Z.
.
OTLK VALID 0900-1500Z...TURB ND SD NE KS MN IA MO WI LM LS MI LH IL IN
BOUNDED BY 40ENE INL-20ESE YQT-SSM-50ESE SSM-DXO-40WNW AXC-60ENE
ICT-50W LBL-GLD-BFF-70SW RAP-PIR-40ENE INL
MOD TURB BTN FL200 AND FL400. CONDS CONTG THRU 15Z.
....
WAUS43 KKCI 030245 2013003 0238
WA3Z
-CHIZ WA 030245
***AIRMET ZULU** FOR ICE AND FRZLVL VALID UNTIL 030900*
.
AIRMET ICE...ND SD NE KS MN IA MO WI LM LS MI LH IL IN
FROM 60SE YWG TO 30N INL TO YQT TO SSM TO YVV TO 30SE ECK TO 20N FWA TO 30WNW BVT
TO 40ESE UIN TO 30E IRK TO 30ESE SLN TO 20SSW PIR TO 50N PIR TO 60SE YWG
MOD ICE BLW 100. CONDS CONTG BYD 09Z THRU 15Z.
.
OTLK VALID 0900-1500Z...ICE SD NE KS MN IA MO WI LM LS MI LH IL IN
BOUNDED BY 80ENE INL-YQT-SSM-YVV-30SSE ECK-FWA-IND-30NE STL-40SE DSM-
20NE SLN-30S ONL-50NNW ONL-40WSW ABR-50WNW RWF-60SSE INL-80ENE INL
MOD ICE BLW 100. CONDS CONTG THRU 15Z.
.
FRZLVL...RANGING FROM SFC-040 ACRS AREA
MULT FRZLVL BLW 040 BOUNDED BY 20SW PWE-30W MCI-40W BUM-30NE
OSW-60S MLC-20ESE CDS-70SE LBL-50ESE GCK-40WNW SLN-20SW PWE
....

The NWS had AIRMET Sierra current for IFR conditions or ceilings below 1,000 feet and/or visibility less than 3 miles in mist, and moderate icing conditions below 10,000 feet over the

accident site. Figure 9is a plot of the advisory over the GOES-13 infrared satellite image for 2045 CST when the advisories were issued.

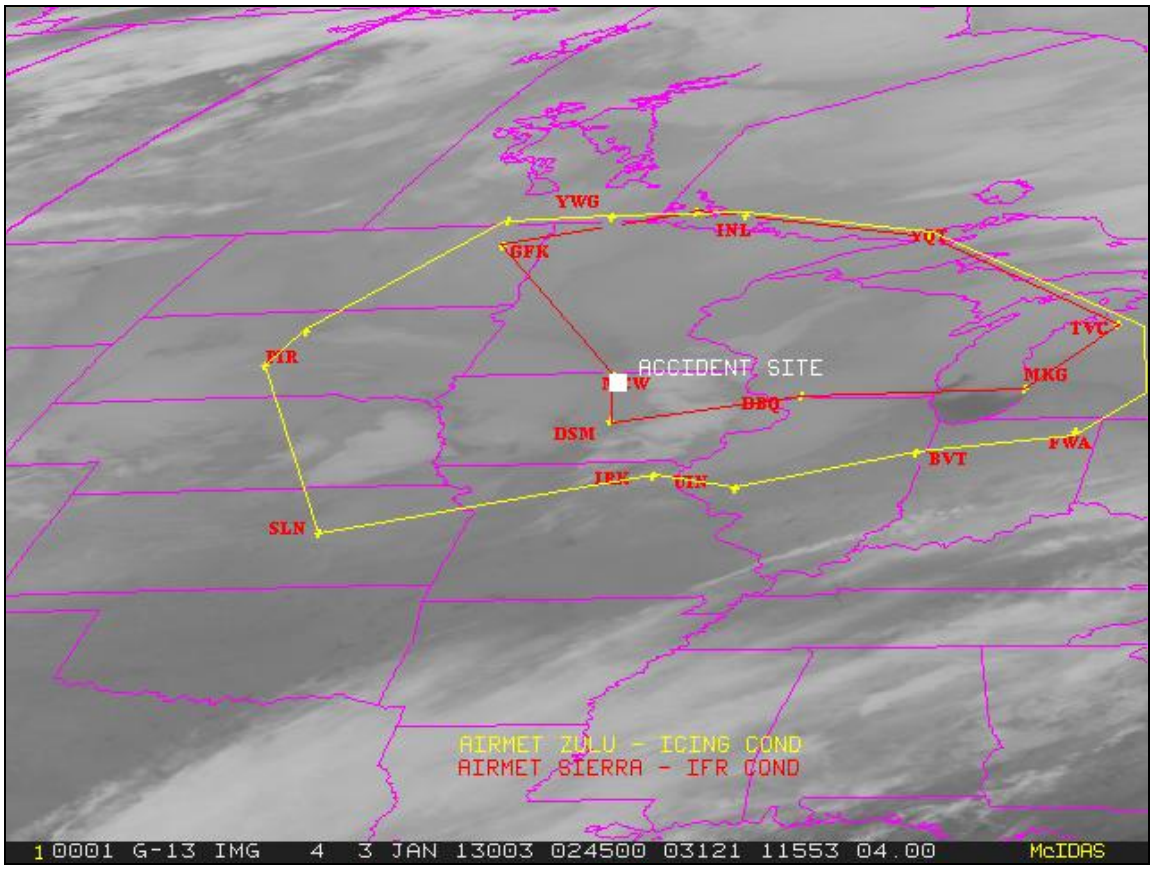

Figure 9 - AIRMETs issued at 2045 CST

10.0 Center Weather Service Unit (CWSU)

The Minneapolis Air Route Traffic Control Center (ARTCC) Center Weather Service Unit (CWSU) issued a Meteorological Impact Statement regarding weather conditions expected in their region at 1930 CST. The advisory was as follows:

FAUS20 KZMP 030130 2013003 0130
ZMP MIS 02 VALID 030130-031330
...FOR ATC PLANNING PURPOSES ONLY...
LOW PRES NR YXL WITH CDFNT INL-STC-MHE MOVG SE 25 KTS. MVFR/IFR
-SN/BR MOST OF ZMP...DMSHG FM W TO E DURG PD. LGT-MOD ICGICIP BLW
080 ALG AND AHD OF CDFNT. JTST ASSOCD LGT PTCHY MOD TURB/CHOP
FL200-390 DKTS/MN/NEB/W WI. NO UPDTS AFT 03Z.=

The advisory indicated a cold front was moving southeast through the area at 25 knots with MVFR to IFR conditions in light snow and mist expected across most of the centers airspace, which was expected to diminish from the west to east during the period. Light to moderate icing-in-clouds and in-precipitation was expected below 8,000 feet along and ahead of the cold front. The jet stream associated turbulence was expected above 20,000 feet.

11.0 Astronomical Data

The United Stated Naval Observatory website provided the following astronomical data for Mason City, Iowa on January 2, 2013:

SUN	
Beginning of civil twilight	0713 CST
Sunrise	0745 CST
Sun transit	1217 CST
Sunset	1650 CST
End of civil twilight	1722 CST
Accident	2057 CST

MOON	
Moonset	1018 CST
Moonrise	2232 CST

At the time of the accident both the Sun and the Moon were more than 15° below the horizon.

12.0 Witness Statements

Several witnesses provided some details of the weather conditions and are summarized below.

A pilot who had flown into Mason City at 1800 CST indicated he had encountered icing conditions descending into the airport. He indicate at the time he departed the airport at 1930 CST a Beechjet was departing and the weather was 5 miles visibility with ceilings 1,200 feet overcast. As he was departing the airport he observed the helicopter flew by at approximately 300 feet, he estimated visibility to be about 3 to 5 miles with a slightly lower ceiling. He also commented that his Jeep had about ¼ inch of ice on it when he departed and that there was **freezing drizzle at that time**. He also had to drive in four wheel drive to get out of the airport and also reporting sliding on the road towards Mason City.

A police officer who flew into Mason City Airport around 1830 CST also reported encountering rime icing conditions in the clouds. He also witnesses the helicopter fly over the airport westbound at approximately 300 feet with the landing light. When he was departing the airport between 2100 and 2130 CST he indicated the pavement was slick with a glaze of ice on his truck's headlights. When he departed the airport he further indicated he had to put his truck into four wheel drive due to the road conditions. He indicated the road was a coat of sheer ice and that his truck was sliding all over the place eastbound on highway 18 towards Mason City. He **had his windshield wipers on due to a mist or very light rain at the time**.

Another witness at the airport also observed the helicopter fly over with the landing light on. He also had **coating of ice on his truck and that the ice was "speckled"** and not uniform. He also reported driving difficulty and reported **encountering a short period of freezing rain** when he left and getting onto highway 18, and reported sliding sideways when he turned.

An Iowa Department of Transportation employee and volunteer in the Clear Lake Fire Department indicated that at 2053 CST he received a call to treat a section of Interstate 35 and Highway 18 because the roadway was becoming icy. He noted the **mist in the air appeared to be freezing on the pavement**. He observed the helicopter about 2100 CST with the landing light on while he was driving on Highway 18 towards Mason City. He subsequently received a call from the fire department approximately 5 miles away. He reported a **very light drizzle at the time, and he ran the windshield wipers periodically**. He further described it as hazy with no rain or snow.

The witness who called 911 indicated he first heard and then saw the helicopter pass his location westbound while he was walking his dog, and indicated that the helicopter's landing light was on and a **mist or haze appeared in the light**. As the helicopter passed north of his location, the helicopter appeared to slow down and turned northward when he heard a "pop" and witnessed the helicopter go straight down to the ground. He further indicated that there was **moisture in the air** and that he had put his hood up, and that there was no significant wind. He then went inside to call "911".

Another witness in the area who was associated with the fire department was working in his garage and heard the helicopter and what he described as a "thump" and then everything went quiet. He also reported that his trucks **windshield was completely ice covered** when he responded to the accident that required scrapping to remove it. He reported the roads were a little slick, and he witnessed a police car slide through an intersection. He called dispatch to advise them of the slick road conditions. He recalled that there was a haze in the air, but indicated it was not foggy, nor was there any precipitation at the time.

Another fire fighter located approximately a mile southeast of the accident site heard the helicopter and saw an orange glow associated with the fire and fireball from his window, and responded. He also indicated a **thin film of ice** on his vehicles windshield. He was not aware of any precipitation during the period to cause the ice, and encountered no precipitation enroute but found slick road conditions.

A third fire fighter heard the helicopter fly over and shortly thereafter received the page of the accident. He also indicated hazy and foggy conditions, with the roads slippery. No snow or rain at the time, but that the **dew in the air seemed to condense and freeze on the roads**.

The first crew of the Emergency Medical Service (EMS) ambulance on site responded from City of Clear Lake and indicated that was not snowing and that the roads were dry at the time. Enroute to the accident, they received calls from dispatch that first responders had reported slippery road conditions. He indicated the roads did become icy and slippery as they neared Ventura. He did not experience any precipitation at the accident site.

A police officer with the Clear lake Police Department working on the night of the accident also observed the helicopter heading westbound with the landing light on. He indicated shortly after observing the helicopter he received the call regarding the accident and responded to the call. He recalled it was **misting at the time**, and that he needed the **windshield wipers on** intermittently to keep it clear. He also noted the roads were slippery and that about that time

they began to receive reports of cars sliding off the roads. EMS was already on site when he arrived and he proceeded to provide traffic control.

Several other witnesses reported moisture in the air that needed the windshield wipers when driving. Other individuals also reported a thin film of ice on their windshields when they got into their cars.

13.0 Freezing Fog

Fog is a collection of liquid water droplets or ice crystals suspended in the air at or near the Earth's surface. Fog is distinguished from mist only by its density, as expressed in the resulting decrease in visibility. Fog reduced visibility to less than 5/8 of a statute mile, whereas mist reduced visibility to no less than 5/8 of a mile. Fog normally occurs with a relative humidity near 100 percent, and mist with the relative humidity greater than 70 percent; below 70 percent haze is typically reported.

Cloud droplets and liquid precipitation can remain liquid even when the air temperature surrounding the suspended or falling liquid is below freezing. This occurs because the liquid needs a surface to freeze upon. The liquid droplets will freeze without a nuclei surface if the temperature drops low enough. As a general rule, liquid cloud or precipitation drops between freezing and -10° C will remain liquid. When the temperature drops to below -40° C, all liquid droplets will solidify. Droplets that are liquid and are below freezing are referred to as supercooled large droplets (SLD).

When it is foggy outside and the temperature is below freezing. The fog tends to not produce measureable precipitation by itself but it can still wet and moisture objects. In the case of freezing fog, the fog cloud droplets are supercooled. When a droplet contacts an object below freezing it will turn to ice. Often freezing fog will be accompanied with freezing drizzle. In that case, a film of ice will often coat surfaces.

14.0 ASOS Precipitation Sensor Limitations

National Weather Service Automated Surface Observing System (ASOS) stations do not currently report drizzle[10] unless they are augmented by human observers because the precipitation identification sensor, called the light-emitting diode weather identifier (LEDWI), does not to have the capability to detect particles smaller than about 1 mm in diameter.

When the ASOS system was developed in the 90's one of the specifications required that the system detect precipitation 99 percent of the time when the precipitation rates were greater than 0.01 inch per hour (0.25 mm/h), and once detected be able to identify precipitation type in 97

[10] The National Weather Service Handbook No. 7,Surface Weather Observations and Reports (NOAA, 1996) defines drizzle as: "Fairly uniform precipitation composed exclusively of fine drops with diameters of less than 0.5mm very close together. Drizzle appears to float while following air currents, although unlike fog droplets, it falls to the ground."

percent in the solid state (snow), and 90 percent when the precipitation is liquid (rain). With a required false alarm rate of less than 0.2 percent. The current LEDWI sensor exceeds those specifications. LEDWI was not designed to detect drizzle.

The LEDWI determines if and what type of precipitation is falling by measuring the oscillation pattern of the precipitation falling through the sensor's infrared beam and determines from a pattern analysis of the particle size and fall velocity whether the precipitation is rain or snow. If precipitation is determined to be falling, but the pattern is not conclusively identified as either rain or snow, unknown precipitation is reported. The system also only reports one precipitation type at a time. Automated airport weather stations are not yet able to report hail, ice pellets, and various other intermediate forms of precipitation such as drizzle or freezing drizzle. Drizzle particles are small and fall slower than raindrops, and because their power spectrum is weak and smeared pattern the LEDWI is unable to detect them. As a general rule, the ASOS will not detect rain lighter than 0.01 inches per hour.

The ASOS systems also have a freezing rain sensor installed, which also has a limitation with detect freezing drizzle due to the size of the particle. The freezing rain sensor is based on technology initially developed to detect icing on aircraft in flight. The sensing device consists of a small cylindrical probe that is electrically stimulated to vibrate at its resonant frequency. A feedback coil is used to measure the vibration frequency, which is proportional to the mass of the probe. When ice freezes on the probe, the combined mass increases and the resonant vibration frequency decreases. There is a well-defined relationship between the measured frequency and the ice accretion on the probe. The freezing rain instrument is sensitive enough to measure accumulation rates as low as 0.01 of an inch per hour. The freezing rain sensor continuously monitors the resonant frequency of the vibrating probe, obtains a sample once a second, and once each minute averages the results to update the probe’s current resonant frequency. When excessive freezing rain accumulates, (i.e., equal to or greater than 0.08 inch) the sensor goes into a heating cycle to melt the freezing rain from the probe and return it to the base resonating frequency. This process normally takes two to three minutes. During this time, the sensor status is set to “deice” and the output is not updated.

Submitted by:

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