NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

June 3, 2015

Group Chairman's Weather Study Report

METEOROLOGY

ERA15FA220

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A. ACCIDENT

Location: A half mile southeast of Rowdy, Kentucky
Date: May 21, 2015
Time: approximately 1855 eastern daylight time (2255 UTC[1])
Aircraft: Grumman AA-5A, registration: N26886

B. METEOROLOGY GROUP

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C. SUMMARY

For a summary of the accident, refer to the *Accident Summary* report, which is available in the docket for this investigation.

D. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) Meteorologist was not on scene for this investigation and gathered all the weather data for this investigation from the NTSB's Washington D.C. office and from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the National Climatic Data Center (NCDC). All times are eastern daylight time (EDT) on May 21, 2015, and are based upon the 24-hour clock, where local time is -4 hours from UTC, and UTC=Z (unless otherwise noted). Directions are referenced to true north and distances in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The accident site was located at latitude 37.39° N, longitude 83.24° W, approximately elevation: 915 feet.

[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), and the Weather Prediction Center (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, joint NWS and Federal Aviation Administration (FAA) Advisory Circular "Aviation Weather Services", AC-0045G CHG 1.

1.1 Surface Analysis Chart

The NWS Surface Analysis Chart for 2000 EDT is provided as figure 1 with the approximate location of the accident site marked. The chart depicted a surface trough[2] to the east of the Appalachian Mountains oriented from north to south through central Virginia and North Carolina. A surface low pressure center with a pressure of 1008-hectopascals (hPa) was located in northern South Carolina and a surface high pressure center with a pressure of 1023 hPa was located in southeastern Missouri. The station models around the accident site depicted air temperatures in the low 50's Fahrenheit (F), with temperature-dew point spreads of 8° F or less, a west to northwest wind between 5 and 10 knots, cloudy skies, and areas of mist. Combined with the mid- and upper-level environment (section 1.2), the accident site was located in an area favored for widespread clouds and precipitation.

[2] Trough – An elongated area of relatively low atmospheric pressure or heights.

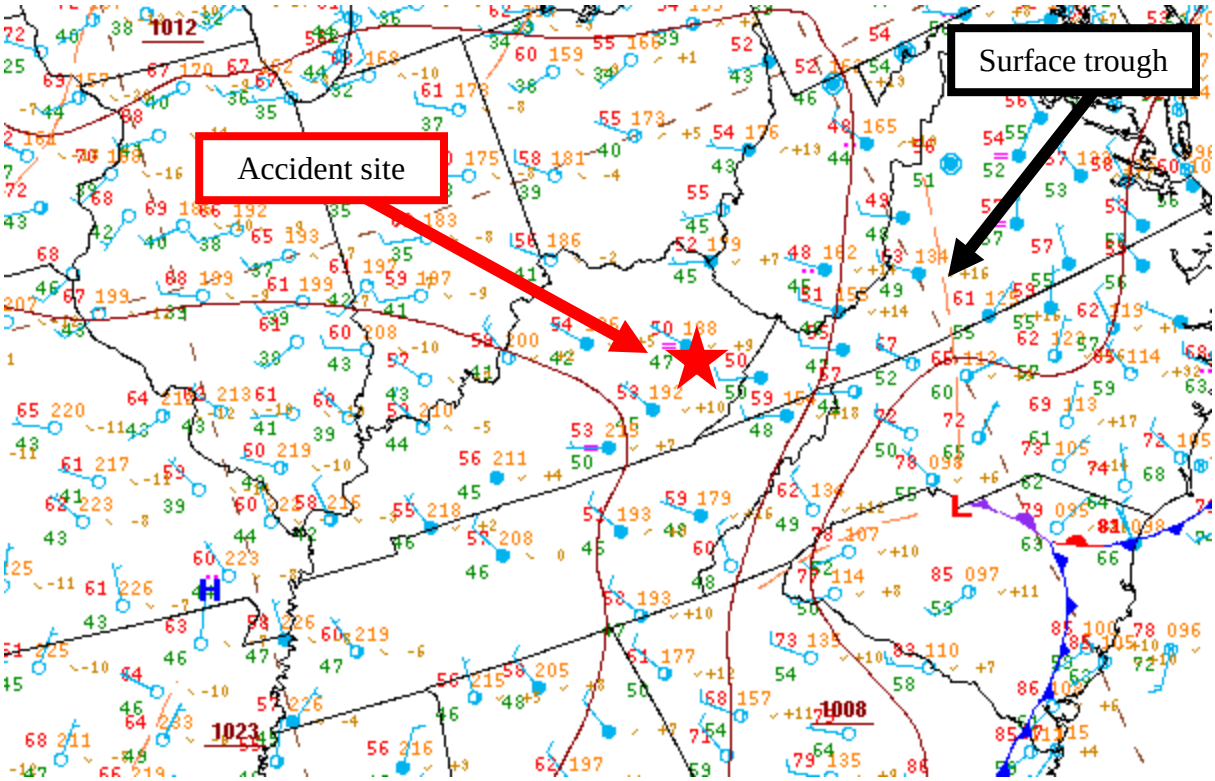

Figure 1 – NWS Surface Analysis Chart for 2000 EDT

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 2000 EDT at 925-, 850-, 700-, 500-, and 300-hPa are presented in figures 2 through 6. There was a mid-level trough at 850- and 700-hPa east of the accident site oriented north to south along the East Coast (figures 3 and 4). The wind directly behind the trough was moving west-northwestward around the accident site and into the rising terrain of the Appalachian Mountains. The movement of the wind into the rising terrain along with the relatively moist low-level environment increased the likelihood of clouds and precipitation near the accident site at the accident time. Given that the mid-level trough was already east of the accident site, moderate and heavier precipitation would not be expected. The west wind increased to over 100 knots by 300-hPa (figure 6). The low- and mid-level environment were conducive for widespread clouds and precipitation near the accident site at the accident time.

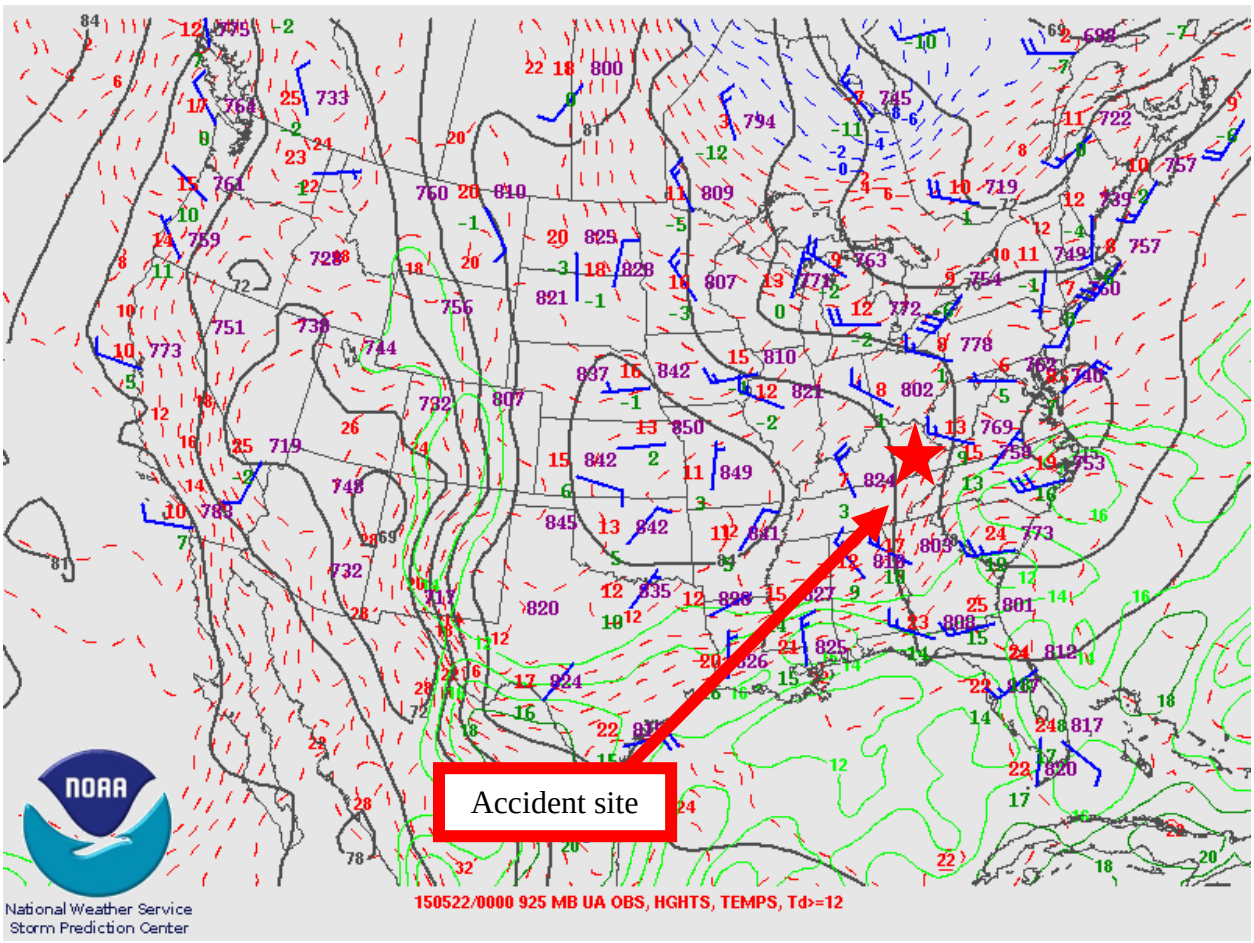

Figure 2 – 925-hPa Constant Pressure Chart for 2000 EDT

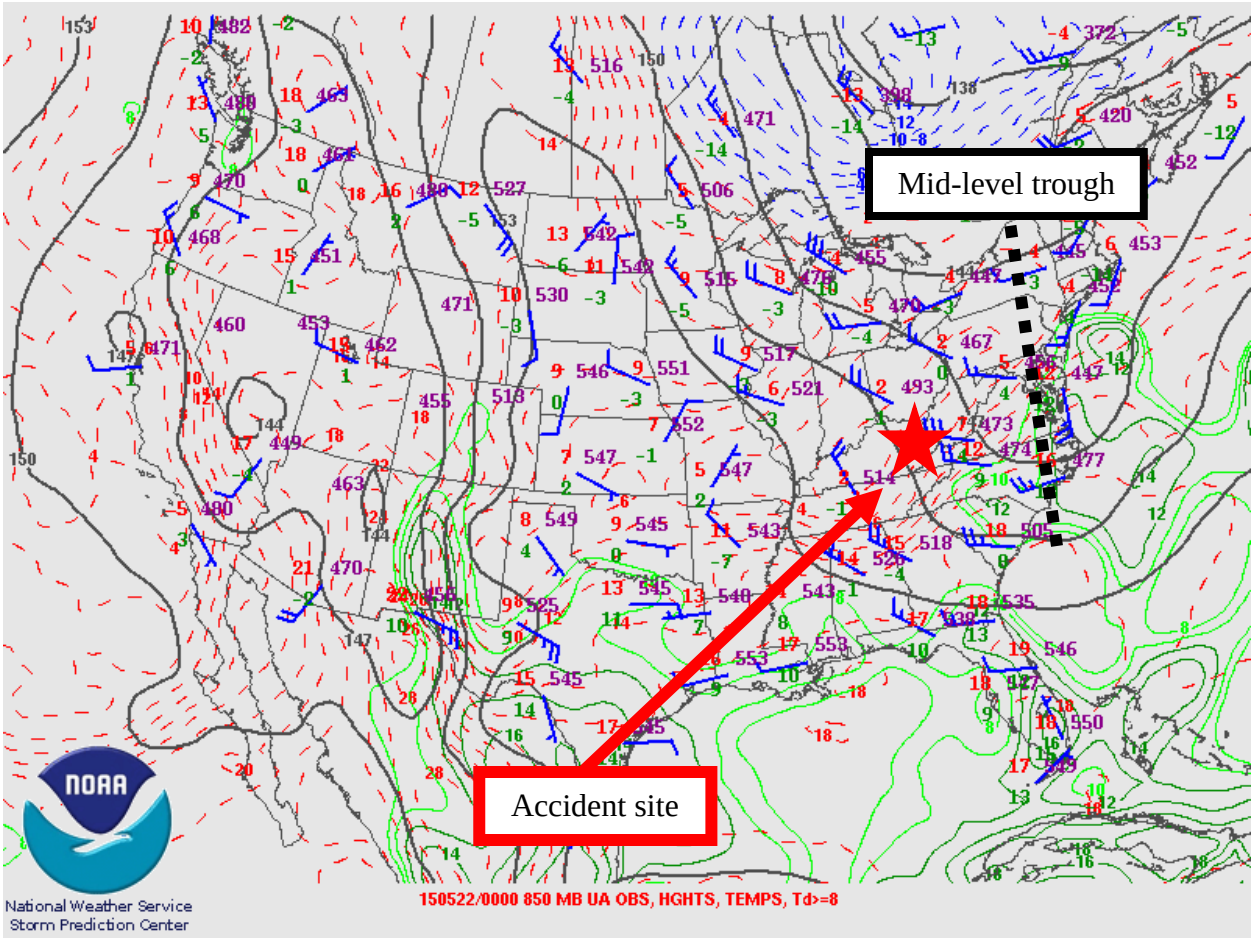

Figure 3 – 850-hPa Constant Pressure Chart for 2000 EDT

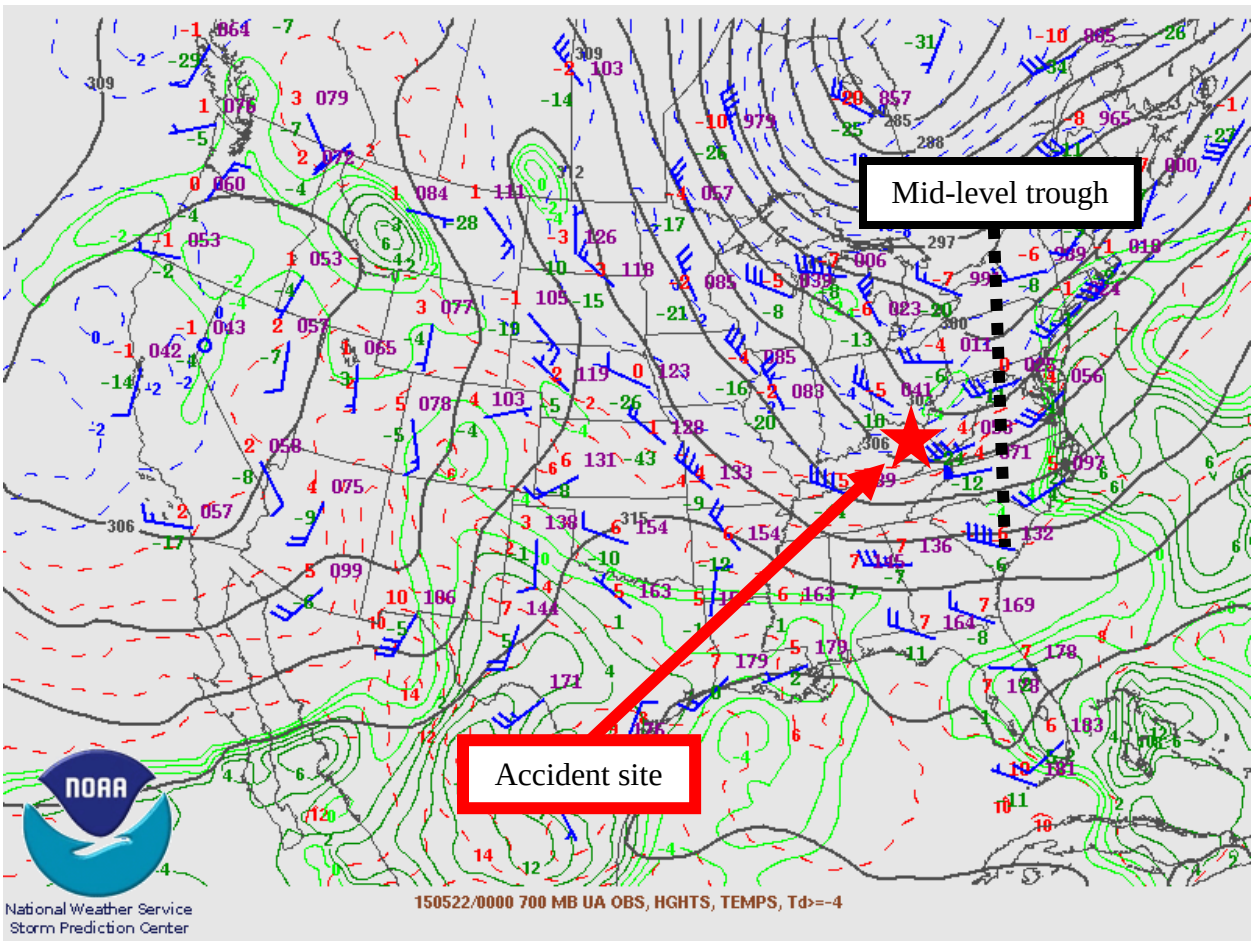

Figure 4 – 700-hPa Constant Pressure Chart for 2000 EDT

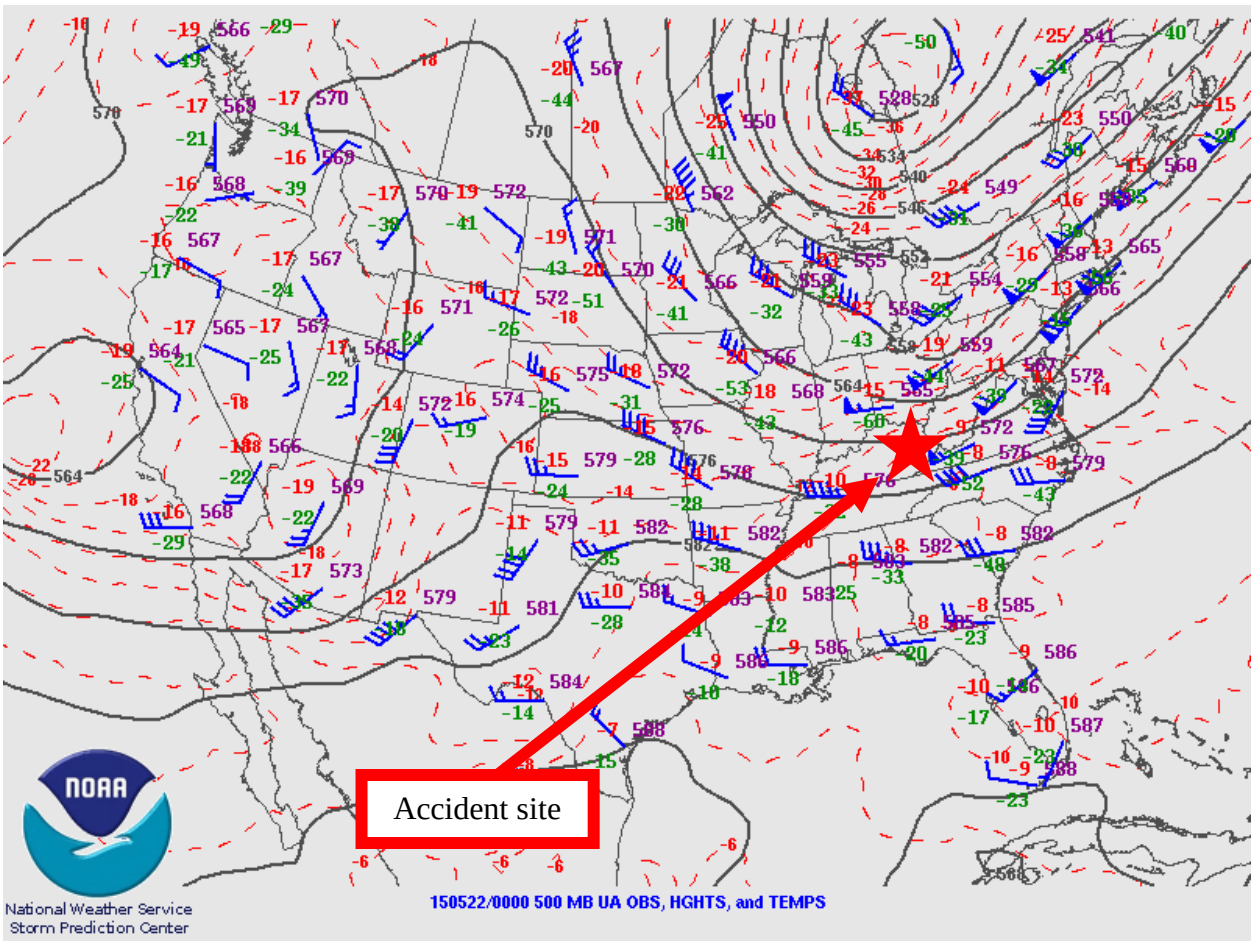

Figure 5 – 500-hPa Constant Pressure Chart for 2000 EDT

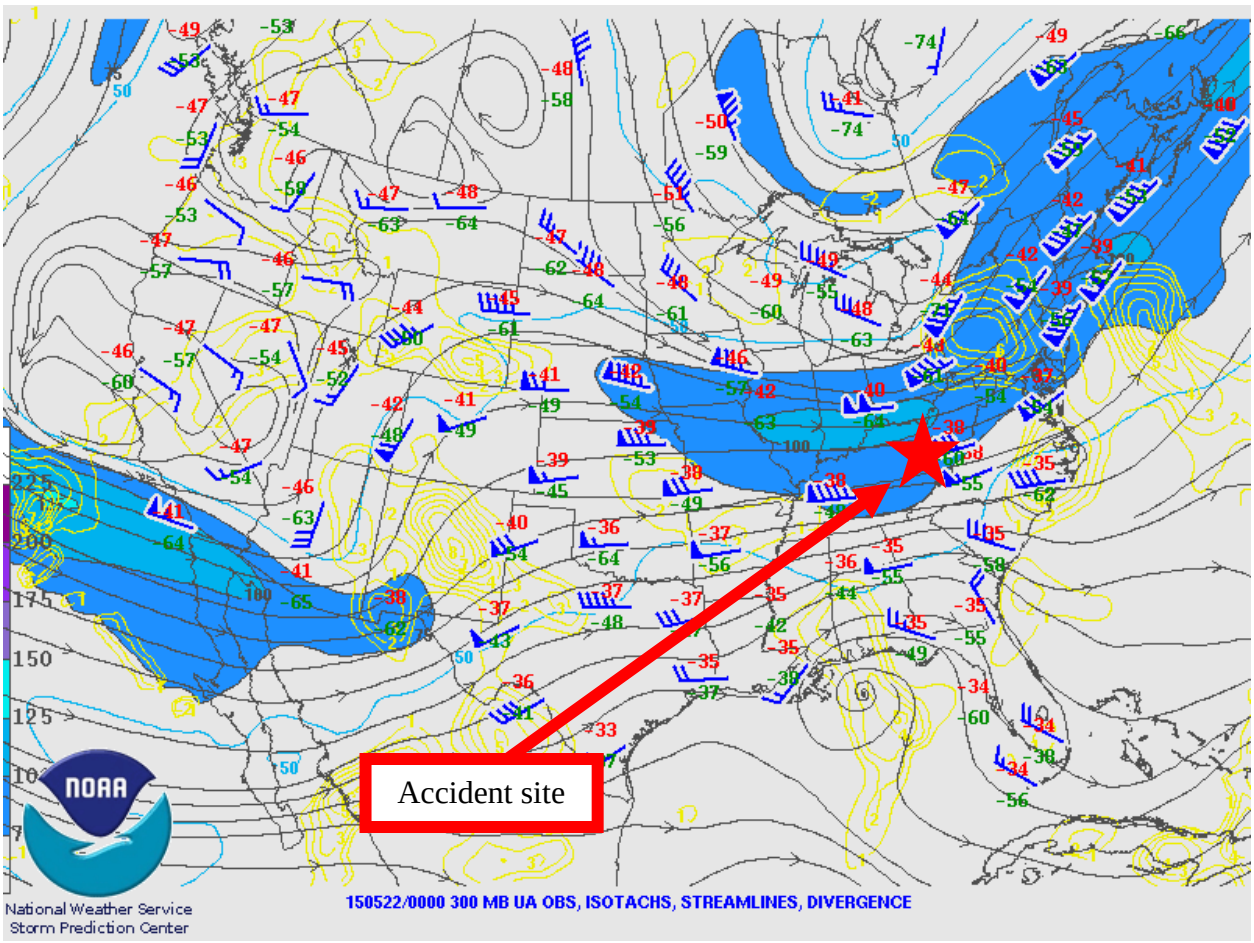

Figure 6 – 300-hPa Constant Pressure Chart for 2000 EDT

2.0 Storm Prediction Center Products

There was no SPC Day 1 Convective Outlook issued for the accident site at the accident time.

3.0 Surface Observations

The area surrounding the accident site was documented utilizing official NWS Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). The following observations were taken from standard code and are provided in plain language.

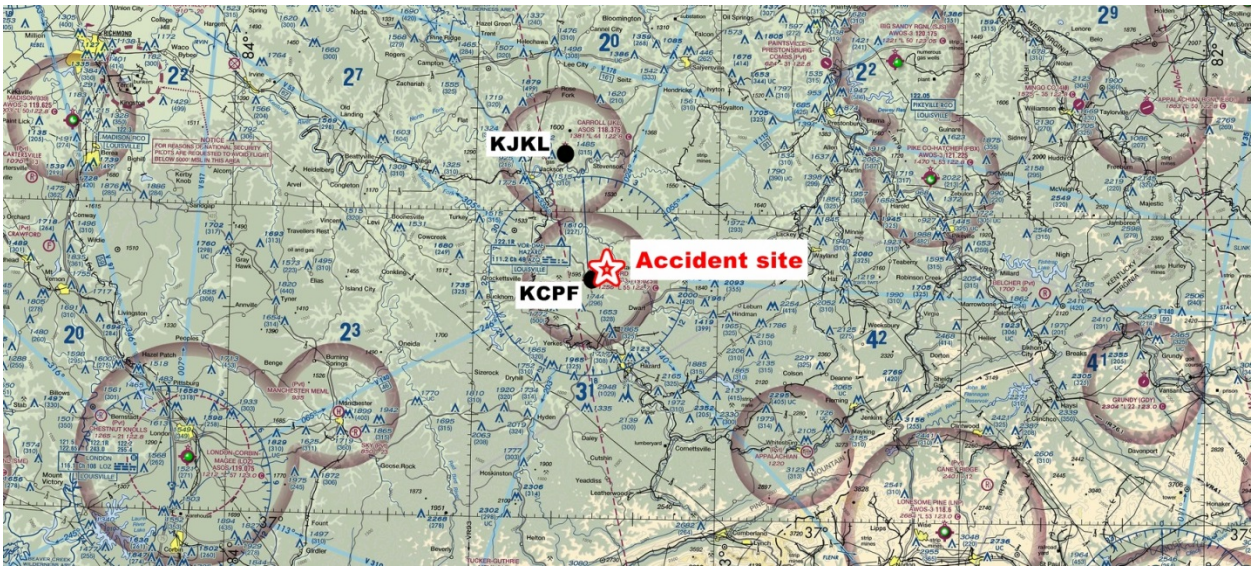

Figure 7 – Map of Kentucky with the location of the accident site and surface observation sites

Wendell H Ford Airport (KCPF) was the closest official weather station to the accident site. KCPF was located 10 miles northwest of Hazard, Kentucky, and had an Automated Weather Observing System (AWOS[3]) whose reports were not supplemented. KCPF was located 1 mile west of the accident site, at an elevation of 1,256 feet, and had a 6° westerly magnetic variation (figure 7). The following observations were taken and disseminated during the times surrounding the accident: [4]

[1745 EDT] KCPF 212145Z 31007KT 5SM BKN010 OVC015 12/11 A3006=

[1805 EDT] KCPF 212205Z 33007KT 3SM -RA BKN006 OVC012 11/11 A3007=

[1825 EDT] KCPF 212225Z 33006KT 3SM DZ OVC008 11/11 A3008=

[1845 EDT] KCPF 212245Z 33004KT 3SM –DZ SCT008 BKN014 OVC021 11/11 A3008=

ACCIDENT TIME 1855 EDT

[1905 EDT] KCPF 212305Z 32004KT 3SM DZ BKN008 BKN012 OVC020 11/11 A3008=

[1925 EDT] KCPF 212325Z 32004KT 4SM –RA BKN006 OVC013 11/11 A3008=

[3] AWOS – Automated Weather Observing System is equipped with meteorological instruments to observe and report temperature, dewpoint, wind speed and direction, visibility, cloud coverage and ceiling up to twelve thousand feet, and altimeter setting.

[4] The bold sections in this NWS product and the rest of products in the weather study report are to highlight the individual sections that directly reference the weather conditions that are or will affect the accident location around the accident time.

[1945 EDT] KCPF 212345Z 32004KT 5SM BR BKN008 OVC012 11/11 A3010=

[2005 EDT] KCPF 220005Z 30005KT 7SM BR SCT008 BKN025 OVC050 11/11 A3010=

KCPF weather at 1825 EDT, wind from 330° at 6 knots, 3 miles visibility, drizzle, an overcast ceiling at 800 feet above ground level (agl), temperature of 11° Celsius (C), dew point temperature of 11° C, and an altimeter setting of 30.08 inches of mercury.

KCPF weather at 1845 EDT, wind from 330° at 4 knots, 3 miles visibility, light drizzle, scattered clouds at 800 feet agl, a broken ceiling at 1,400 feet agl, overcast skies at 2,100 feet agl, temperature of 11° C, dew point temperature of 11° C, and an altimeter setting of 30.08 inches of mercury.

KCPF weather at 1905 EDT, wind from 320° at 4 knots, 3 miles visibility, drizzle, a broken ceiling at 800 feet agl, broken skies at 1,200 feet agl, overcast skies at 2,000 feet agl, temperature of 11° C, dew point temperature of 11° C, and an altimeter setting of 30.08 inches of mercury.

KCPF weather at 1925 EDT, wind from 320° at 4 knots, 4 miles visibility, light rain, a broken ceiling at 600 feet agl, overcast skies at 1,300 feet agl, temperature of 11° C, dew point temperature of 11° C, and an altimeter setting of 30.08 inches of mercury.

Julian Carroll Airport (KJKL) was the closest official site north of the accident site, located 3 miles northeast of Jackson, Kentucky, and had an Automated Surface Observing System (ASOS[5]) whose reports were not supplemented. KJKL was located 13 miles north-northwest of the accident site, at an elevation of 1,381 feet, and had a 4° westerly magnetic variation (figure 7). The following observations were taken and disseminated during the times surrounding the accident:

[1744 EDT] KJKL 212144Z AUTO 33007KT 300V020 2SM -RA BR BKN006 OVC011 11/09 A3007 RMK AO2 CIG 002V010 P0004 T01060094=

[1753 EDT] KJKL 212153Z AUTO 32006KT 4SM BR BKN006 OVC018 11/09 A3007 RMK AO2 RAE53 CIG 002V010 SLP178 P0005 T01060089=

[1816 EDT] KJKL 212216Z AUTO 32006KT 5SM BR SCT008 SCT011 OVC019 11/09 A3007 RMK AO2 T01060089=

[1848 EDT] KJKL 212248Z AUTO VRB05KT 5SM BR BKN008 BKN025 OVC030 11/09 A3008 RMK AO2 CIG 004V011=

[1853 EDT] KJKL 212253Z AUTO 31005KT 5SM BR BKN008 BKN027 OVC035 11/09 A3008 RMK AO2 CIG 004V011 SLP182 T01060089=

[5] ASOS – Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, ceiling, temperature, dewpoint, altimeter, and barometric pressure.

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[1917 EDT] KJKL 212317Z AUTO 30003KT 5SM BR FEW008 BKN017 OVC037 11/09 A3008 RMK AO2 T01060089=

[1953 EDT] KJKL 212353Z AUTO 32004KT 6SM BR FEW010 OVC020 10/08 A3009 RMK AO2 RAB22E46 SLP188 P0000 60005 T01000083 10122 20100 53009=

[2010 EDT] KJKL 220010Z AUTO 31004KT 7SM SCT020 OVC033 10/08 A3010 RMK AO2 T01000083=

[2053 EDT] KJKL 220053Z AUTO 28003KT 8SM FEW025 OVC037 10/08 A3011 RMK AO2 SLP194 T01000083=

[2113 EDT] KJKL 220113Z AUTO 00000KT 7SM BKN028 OVC034 10/08 A3012 RMK AO2 T01000083=

[2120 EDT] KJKL 220120Z AUTO 30003KT 7SM SCT030 BKN037 OVC045 10/08 A3013 RMK AO2 T01000083=

KJKL weather at 1848 EDT, wind variable at 5 knots, 5 miles visibility, mist, a broken ceiling at 800 feet agl, broken skies at 2,500 feet agl, overcast skies at 3,000 feet agl, temperature of 11° C, dew point temperature of 9° C, and an altimeter setting of 30.08 inches of mercury. Remarks: automated station with a precipitation discriminator, ceiling varying between 400 and 1,100 feet agl.

KJKL weather at 1853 EDT, wind from 310° at 5 knots, 5 miles visibility, mist, a broken ceiling at 800 feet agl, broken skies at 2,700 feet agl, overcast skies at 3,500 feet agl, temperature of 11° C, dew point temperature of 9° C, and an altimeter setting of 30.08 inches of mercury. Remarks: automated station with a precipitation discriminator, ceiling varying between 400 and 1,100 feet agl, sea level pressure 1018.2 hPa, temperature 10.6° C, dew point temperature 8.9° C.

KJKL weather at 1917 EDT, wind from 300° at 3 knots, 5 miles visibility, mist, few clouds at 800 feet agl, a broken ceiling at 1,700 feet agl, overcast skies at 3,700 feet agl, temperature of 11° C, dew point temperature of 9° C, and an altimeter setting of 30.08 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 10.6° C, dew point temperature 8.9° C.

KJKL weather at 1953 EDT, wind from 320° at 4 knots, 6 miles visibility, mist, few clouds at 1,000 feet agl, an overcast ceiling at 2,000 feet agl, temperature of 10° C, dew point temperature of 8° C, and an altimeter setting of 30.09 inches of mercury. Remarks: automated station with a precipitation discriminator, rain began at 1922 EDT and ended at 1946 EDT, sea level pressure 1018.8 hPa, one-hourly precipitation of a trace, 6-hourly precipitation of 0.05 inches, temperature 10.0° C, dew point temperature 8.3° C, 6-hourly maximum temperature of 12.2° C, 6-hourly minimum temperature of 10.0° C, 3-hourly pressure increase of 0.9 hPa.

The observations from KCPF and KJKL indicated IFR[6] to MVFR[7] ceilings around the accident site at the accident time. In addition, forward visibility was restricted by light rain, drizzle, and mist in the hilly terrain of the accident site. The IFR conditions had persisted over the accident site and eastern Kentucky throughout the day with intermittent light rain, drizzle, and misty conditions moving from northwest to southeast (Section 6.4).

4.0 Upper Air Data

A North American Mesoscale (NAM) computer model upper air sounding for the accident site was generated for 2000 EDT. The 2000 EDT sounding was plotted on a standard Skew-T log P diagram[8] with the derived stability parameters included in figure 7 (with data from the surface to 400-hPa, or 23,000 feet msl.) This data was analyzed utilizing the RAOB[9] software package. The sounding depicted the Lifted Condensation Level (LCL)[10] at 1,644 feet msl, a Convective Condensation Level (CCL)[11] of 3,002 feet, and a Level of Free Convection (LFC)[12] at 2,588 feet. The freezing level was located at 7,015 feet. The precipitable water value was 0.69 inches.

[6] Instrument Flight Rules – Refers to the general weather conditions pilots can expect at the surface. IFR criteria means a ceiling below 1,000 feet agl and/or less than 3 miles visibility.
[7] Marginal Visual Flight Rules – Refers to the general weather conditions pilots can expect at the surface. MVFR criteria means a ceiling between 1,000 and 3,000 feet agl and/or 3 to 5 miles visibility.
[8] Skew T log P diagram – is a standard meteorological plot using temperature and the logarithmic of pressure as coordinates, used to display winds, temperature, dew point, and various indices used to define the vertical structure of the atmosphere.
[9] RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamopras, Pennsylvania.
[10] Lifting Condensation Level (LCL) - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.
[11] Convective Condensation Level (CCL) – The level in the atmosphere to which an air parcel, if heated from below, will rise dry adiabatically, without becoming colder than its environment just before the parcel becomes saturated.
[12] Level of Free Convection (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.

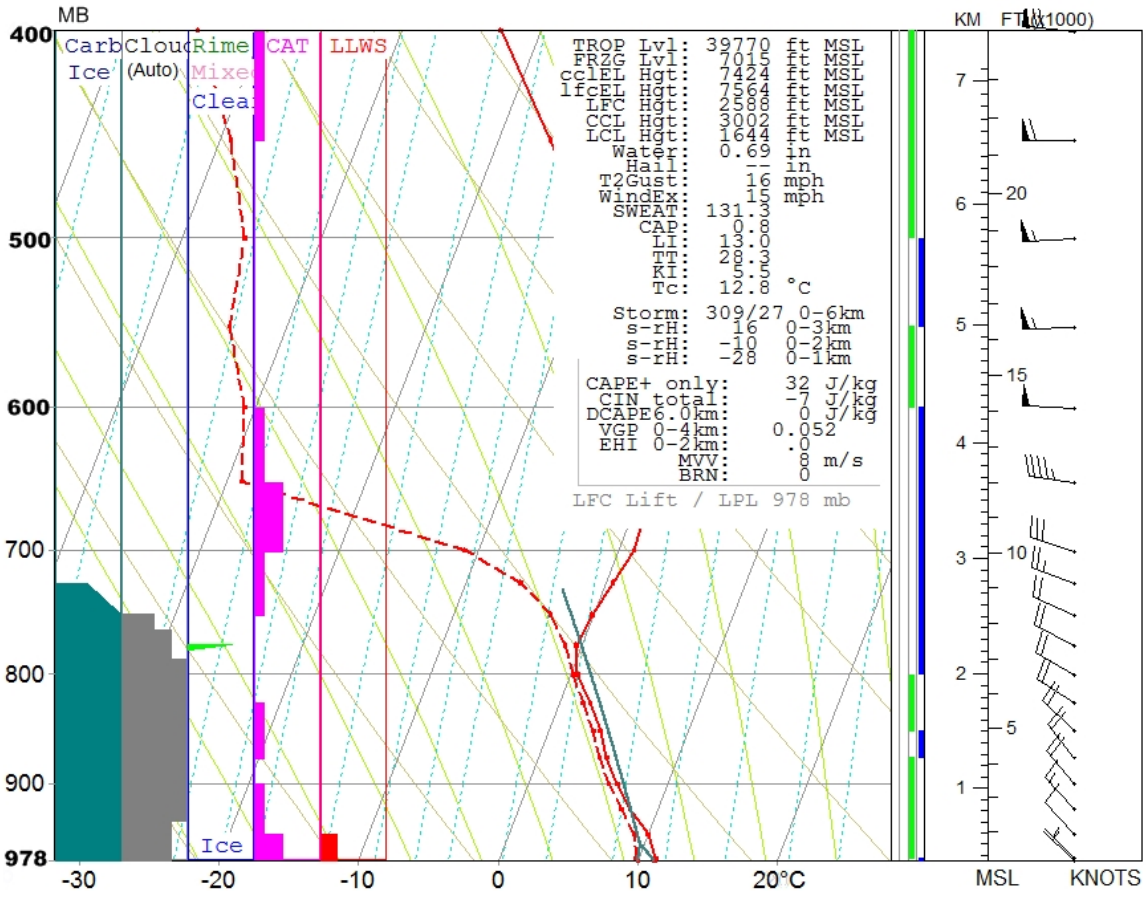


Figure 8 – 2000 EDT NAM sounding for the accident site

The 2000 EDT NAM sounding indicated a relatively moist environment from the surface through 8,000 feet msl in a conditionally unstable environment. RAOB indicated that clouds were likely from the surface through 8,000 feet msl. The environment was relatively unstable from the surface through 8,000 feet msl, which would allow for air to rise and fall easily with lifting mechanisms in the area of the accident site or within mountainous or hilly terrain (sections 1.1 and 1.2). With the loss of a moist environment above 0° C (and 8,000 feet msl) no Bergeron process would be expected hence why only drizzle or light rain would be expected with any shower activity or low clouds in and around the accident site at the accident time.

The sounding wind profile indicated a surface wind from 317° at 5 knots with the wind increasing to 15 knots by 1,500 feet msl while remaining out of the northwest. The wind continued to increase through 23,000 feet to near 70 knots with the wind slowly becoming more westerly. LLWS was identified by RAOB between the surface and 2,000 feet msl, with several layers of clear air turbulence from the surface through 23,000 feet. Given the vertical environment of the lowest 2,000 feet msl, weak LLWS and some gusty wind conditions could be expected at the accident site at the accident time.

5.0 Satellite Data

Visible and infrared data from the Geostationary Operational Environmental Satellite number 13 (GOES-13) data was obtained from the NCDC and processed with the NTSB's Man-computer Interactive Data Access System (McIDAS) workstation. Visible and infrared imagery (GOES-13 band 1 and 4) at wavelengths of 0.65 microns (μm) and 10.7 μm retrieved brightness temperatures for the scene. Satellite imagery surrounding the time of the accident, from 1500 EDT through 2000 EDT at approximately 15-minute intervals, were reviewed and the closest images to the time of the accident are documented here.

Figures 9 and 10 present the GOES-13 visible imagery from 1840 and 1855 EDT at 2X magnification with the accident site marked by a red square. The visible imagery indicated abundant cloud cover over and around the accident site at the accident time with that cloud cover moving from west to east. Figure 11 presents the GOES-13 infrared imagery from 1855 EDT at 6X magnification. Inspection of the infrared imagery indicated the more enhanced bands (yellows and greens, higher cloud tops) were located south and southwest of the accident site around the accident time. Based on the brightness temperatures above the accident site and the vertical temperature profile provided by the 2000 EDT NAM sounding, the approximate cloud-top heights over the accident site were 16,000 feet at 1855 EDT.

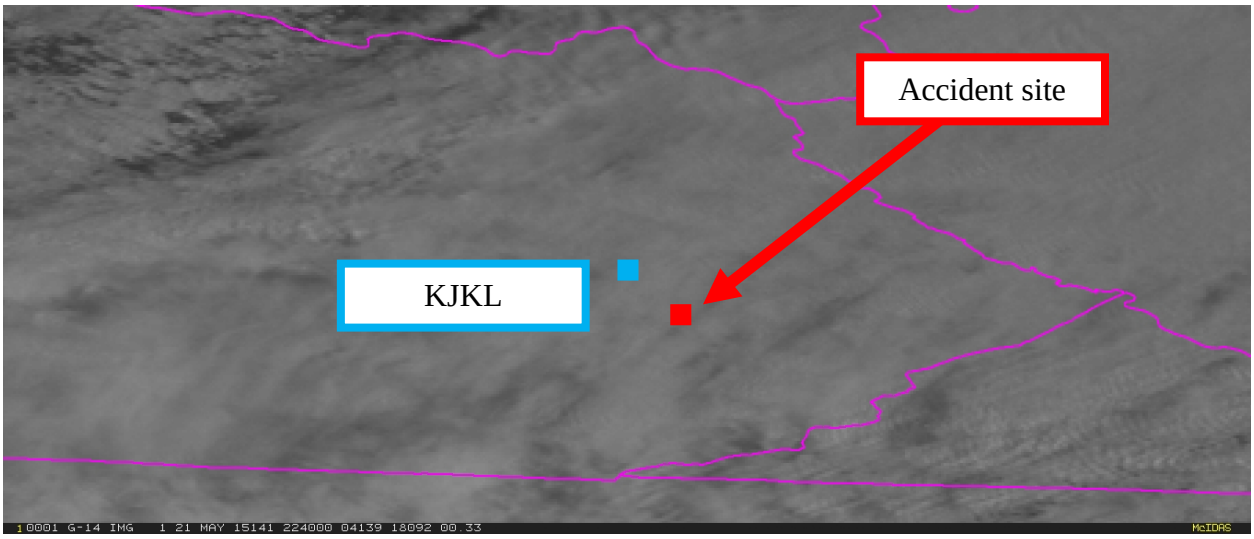


Figure 9 – GOES-13 visible image at 1840 EDT

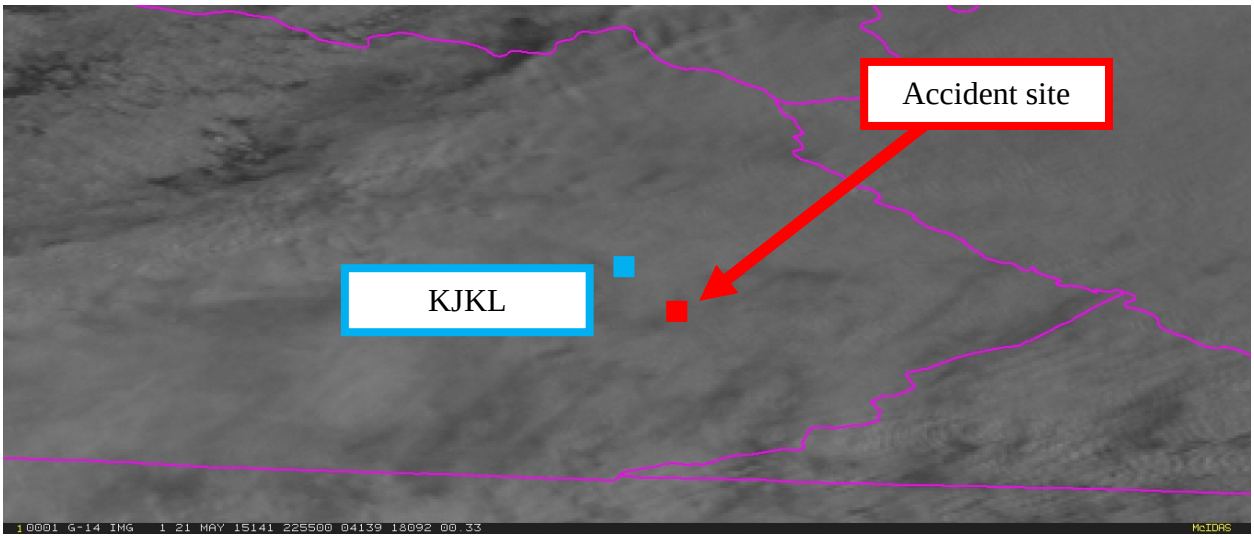


Figure 10 – GOES-13 visible image at 1855 EDT

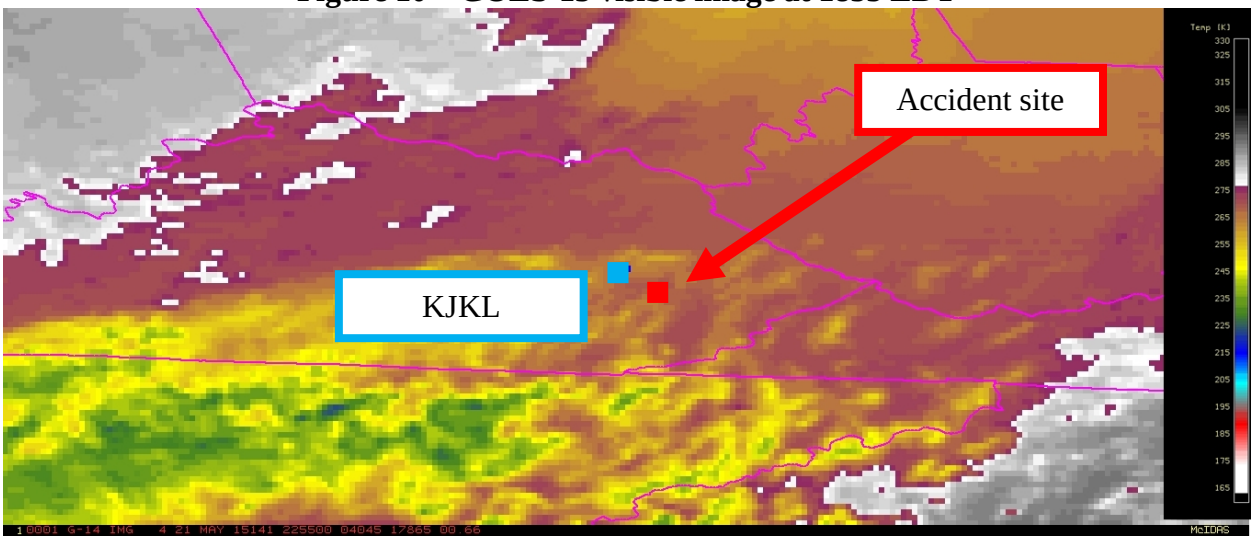


Figure 11 – GOES-13 infrared image at 1855 EDT

6.0 Radar Imagery Information

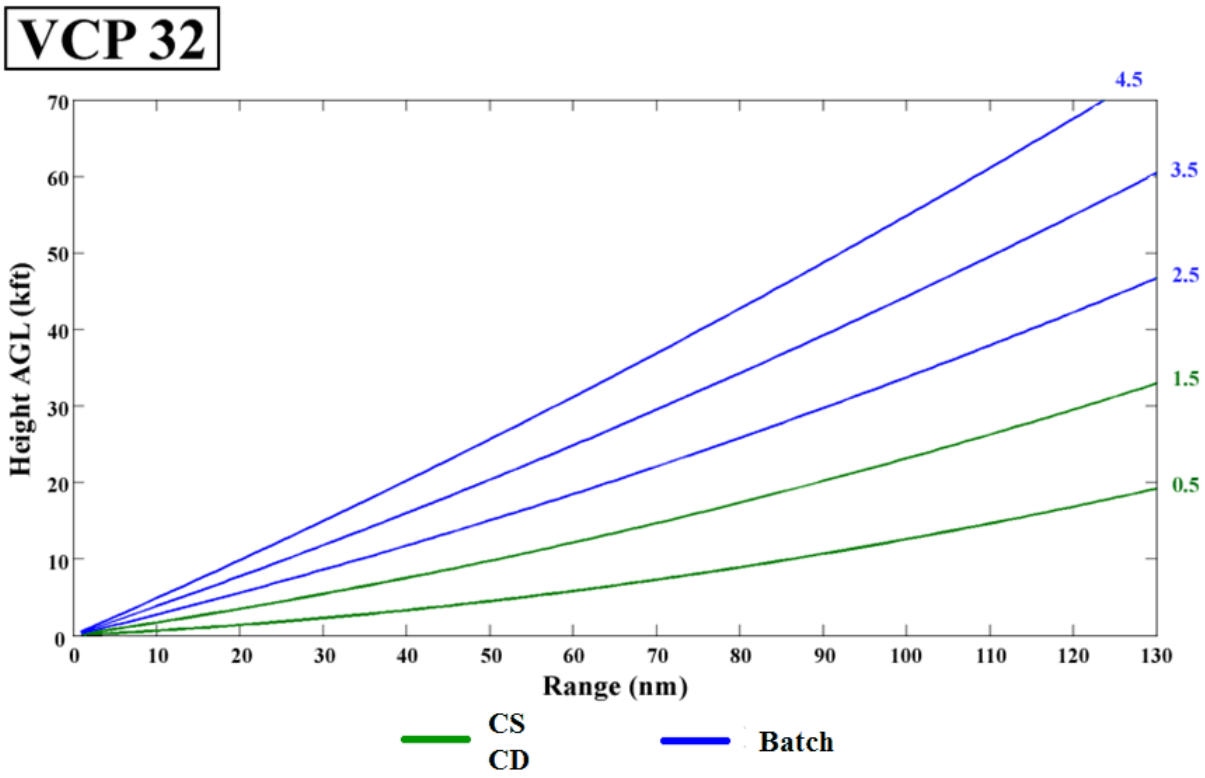
The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)[13] was from KJKL. Level II and III archive radar data was obtained from the NCDC utilizing the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software.

[13] The WSR-88D is an S-band 10-centimeter wavelength radar with a power output of 750,000 watts, and with a 28-foot parabolic antenna that concentrates the energy between a 0.87° and 0.96° beam width. The radar produces three basic types of products: base reflectivity, base radial velocity, and base spectral width.

6.1 Volume Scan Strategy

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

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



VCP-32 Clear-air Mode Scan Strategy

6.2 Beam Height Calculation

Assuming standard refraction[14] of the WSR-88D 0.95° wide radar beam, the following table shows the approximate beam height and width[15] information[16] of the radar display over the site of the accident. The heights have been rounded to the nearest 10 feet.

ANTENNA ELEVATION	BEAM CENTER	BEAM BASE	BEAM TOP	BEAM WIDTH
0.5°	2,170 feet	1,530 feet	2,810 feet	1,280 feet

Based on the beam heights, the 0.5° elevation scan depicted the conditions between 1,530 feet and 2,810 feet msl over the accident site and these are the closest altitudes[17] to the accident flight level before the accident occurred.

[14] Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.
[15] Beam width – A measure of the angular width of a radar beam.
[16] Beamwidth values are shown for legacy resolution products. Super resolution products would an effective beamwidth that would be approximately half these values.
[17] For more information please see the ATC data.

6.3 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors[18] it is a function of the drop size distribution, number of particles per unit volume, physical state (ice or water), shape, and aspect. Reflectivity is normally displayed in decibels (dBZ[19]), and is a general measure of echo intensity. The chart below relates the NWS video integrator and processor (VIP) intensity levels versus the WSR-88D's display levels, precipitation mode reflectivity in decibels, and rainfall rates.

NWS VIP/DBZ CONVERSION TABLE

NWS VIP	WSR-88D LEVEL	PREC MODE DBZ	RAINFALL
0	0	< 5	
	1	5 to 9	
	2	10 to 14	
1	3	15 to 19	.01 in/hr
Very Light	4	20 to 24	.02 in/hr
	5	25 to 29	.04 in/hr
2	6	30 to 34	.09 in/hr
Light to	7	35 to 39	.21 in/hr
Moderate			
3	8	40 to 44	.48 in/hr
Strong			
4	9	45 to 49	1.10 in/hr
Very Strong			
5	10	50 to 54	2.49 in/hr
Intense			
6	11	55 to 59	>5.67 in/hr
Extreme	12	60 to 64	
	13	65 to 69	
	14	70 to 74	
	15	> 75	

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

[19] dBZ – A non-dimensional "unit" of radar reflectivity which represents a logarithmic power ratio (in decibels , or dB) with respect to radar reflectivity factor, Z.

The Federal Aviation Administration (FAA) Advisory Circular AC 00-24B titled "Thunderstorms" dated January 2, 1983, also defines the echo intensity levels and potential weather phenomena associated with those levels. If the maximum VIP Level is 1 "weak" and 2 "moderate", then light to moderate turbulence is possible with lightning. VIP Level 3 is "strong" and severe turbulence is possible with lightning. VIP Level 4 is "very heavy" and severe turbulence is likely with lightning. VIP Level 5 is "intense" with severe turbulence, lightning, hail likely, and organized surface wind gusts. VIP Level 6 is "extreme" with severe turbulence, lightning, large hail, extensive surface wind gusts and turbulence.

6.4 Base Reflectivity

Figures 12 and 13 presents the KJKL WSR-88D base reflectivity images for the 0.5° elevation scan initiated at 1848 and 1858 EDT with a resolution of 0.5° X 250 m and the ATC flight track. There were reflectivity targets at the accident site with those reflectivity targets moving from northwest to southeast across the accident site at the accident time. The reflectivity values were between 5 to 25 dBZ and that would correlate to very light echoes and precipitation. These precipitation values matched the surface observations at the accident time (section 3.0). There were no lightning strikes at or near the accident site at the accident time.

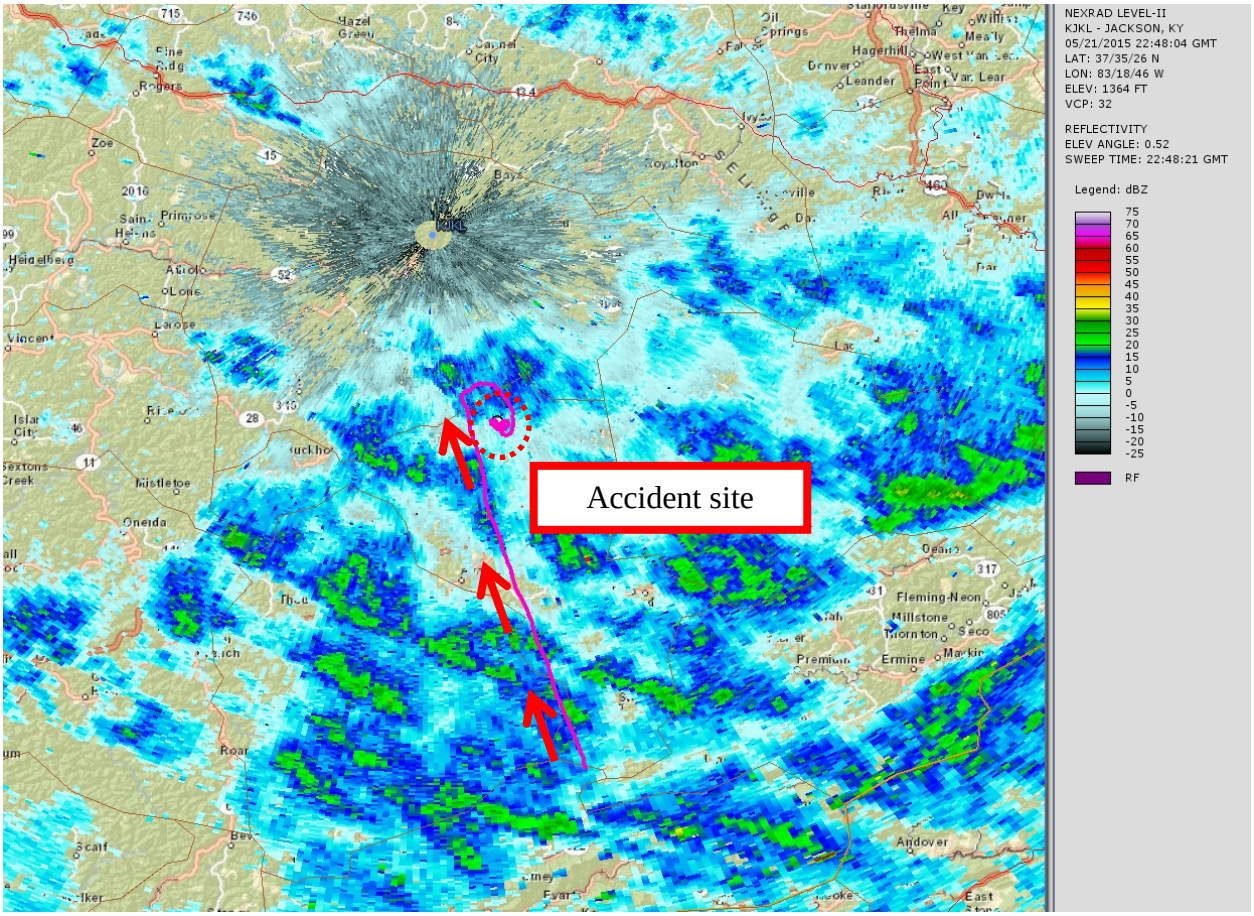


Figure 12 – KJKL WSR-88D reflectivity for the 0.5° elevation scan initiated at 1848 EDT with the ATC flight track

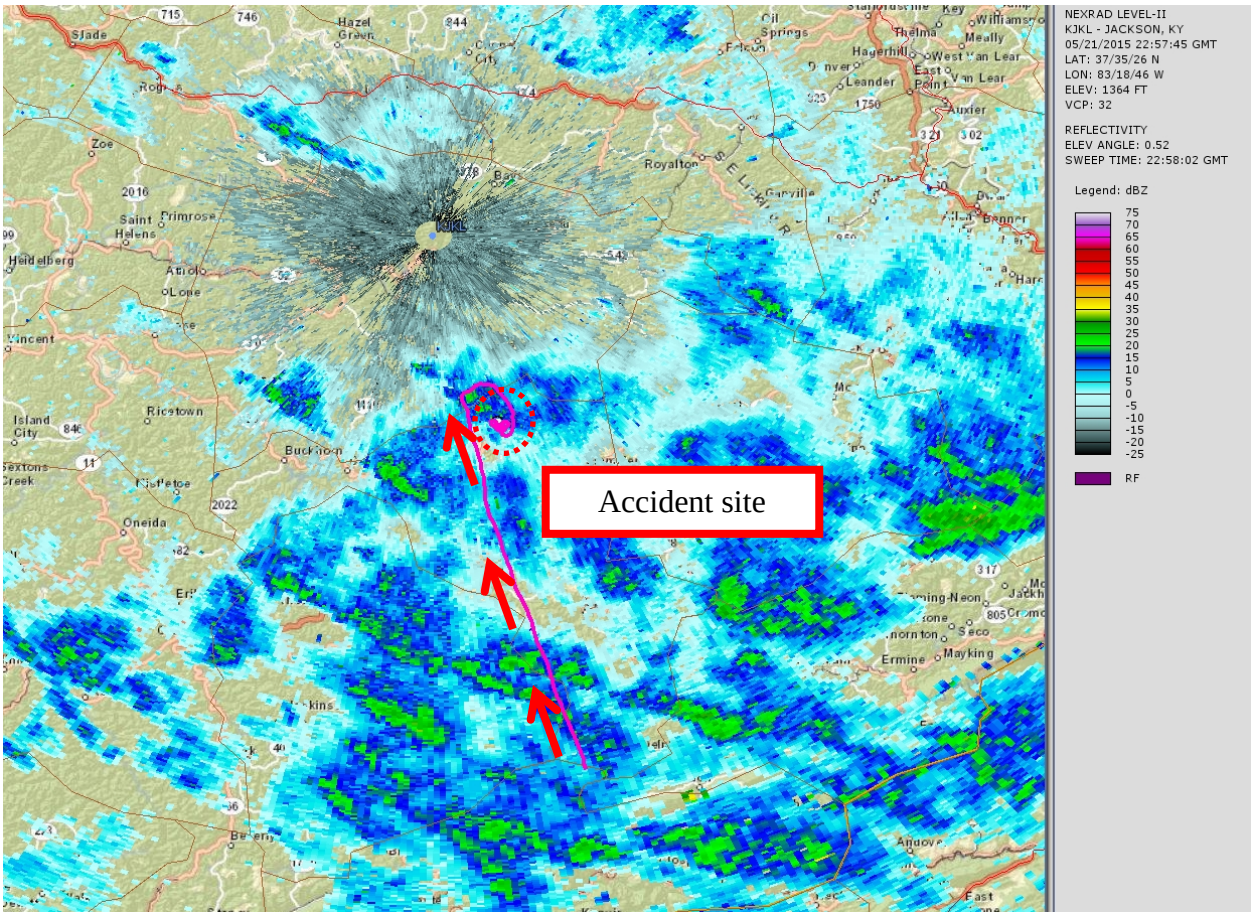


Figure 13 – KJKL WSR-88D reflectivity for the 0.5° elevation scan initiated at 1858 EDT with the ATC flight track

7.0 Pilot Reports

All pilot reports (PIREPs) were reviewed close to the accident site from around two hours prior to the accident time to around two hours after the accident time and the PIREPs displayed below are the PIREPs valid below 15,000 feet:

LWB UA /OV LWB/TM 2057/FL035/TP B350/RM BASES / 035

CVG UA /OV CVG195007/TM 2101/FLUNKN/TP E135/SK BKN045-TOP057/RM DURGD AWC-WEB/CVG

PKB UA /OV JPU240010/TM 2108/FL110/TP C182/TA M02/IC LGT RIME

LWB UA /OV LWB/TM 2139/FL048/TP C56X/RM BASES RAGGED / 048

CVG UA /OV CVG360010/TM 2203/FLUNKN/TP CRJ2/SK BKN045-TOP070/RM DURGC/ CLEAR ABOVE CLOUDS AWC-WEB/CVG

TRI UA /OV TRI230015/TM 2204/FL100/TP VELO/SK OVC-TOP090/SKC

CVG UA /OV CVG240020/TM 2246/FLUNKN/TP CRJ9/SK BKN050-TOP060/RM DURGD CABV AWC-WEB/CVG

CVG UA /OV CVG270010/TM 2249/FLUNKN/TP MD88/SK BKN047-TOP067/RM DURGC CABV AWC-WEB/CVG

Routine pilot report (UA); Over Lewisburg, West Virginia; Time – 1657 EDT (2057Z); Altitude – 3,500 feet msl; Type aircraft – Beechcraft Super King Air 350; Remarks – Bases at 3,500 feet msl.

Routine pilot report (UA); 7 miles from Covington, Kentucky, on the 195° radial; Time – 1701 EDT (2101Z); Altitude – Unknown; Type aircraft – Embraer ERJ-135; Sky – Broken ceiling at 4,500 feet msl with tops at 5,700 feet msl; Remarks – During descent.

Routine pilot report (UA); 10 miles from Parkersburg, West Virginia, on the 240° radial; Time – 1708 EDT (2108Z); Altitude – 11,000 feet; Type aircraft – Cessna 182; Temperature – -2° C; Icing – Light rime.

Routine pilot report (UA); Over Lewisburg, West Virginia; Time – 1739 EDT (2139Z); Altitude – 4,800 feet msl; Type aircraft – Cessna Citation Excel; Remarks – Bases ragged at 4,800 feet msl.

Routine pilot report (UA); 10 miles from Covington, Kentucky, on the 360° radial; Time – 1803 EDT (2203Z); Altitude – Unknown; Type aircraft – Canadair Regional Jet CRJ-200; Sky – Broken ceiling at 4,500 feet msl with tops at 7,000 feet msl; Remarks – During climb, clear above clouds.

Routine pilot report (UA); 15 miles from Bristol, Tennessee, on the 230° radial; Time – 1804 EDT (2204Z); Altitude – 10,000 feet msl; Type aircraft – Velocity Velocity; Sky – Overcast with tops at 9,000 feet msl, sky clear above.

Routine pilot report (UA); 20 miles from Covington, Kentucky, on the 240° radial; Time – 1846 EDT (2246Z); Altitude – Unknown; Type aircraft – Canadair Regional Jet CRJ-900; Sky – Broken ceiling at 5,000 feet msl with tops at 6,000 feet msl; Remarks – During descent, clear above.

Routine pilot report (UA); 10 miles from Covington, Kentucky, on the 270° radial; Time – 1849 EDT (2249Z); Altitude – Unknown; Type aircraft – McDonnell Douglas MD-88; Sky – Broken ceiling at 4,700 feet msl with tops at 6,700 feet msl; Remarks – During climb, clear above.

8.0 SIGMET and CWSU Advisory

No SIGMET was valid for the accident site at the accident time.

A meteorological impact statement (MIS) was valid for the accident area at the accident time but it did not forecast for any weather conditions below 15,000 feet msl:

FAUS20 KZID

ZID MIS 01 VALID 211713-220130
...FOR ATC PLANNING PURPOSES ONLY...
IN ZID S OF A LN FM 25NE BWG-20NW EKN OCNL MOD CHOP ISOL MOD TURB
LYRS FL330-430 IMPVG BY 00Z. REST OF ZID...LGT ISOL MOD CHOP/TURB
LYRS FL280-390. N OF A LN FM 30NW PXV-35SW AIR ZONE OF OCNL MOD
CHOP 150-FL240 DVLPG E-SE THRU 00Z.=

No CWSU Advisory (CWA) was valid for the accident site at the accident time.

9.0 AIRMETs

AIRMET Sierra issued at 1645 EDT, and valid at the accident time, was the only AIRMET valid for the accident site at the accident time at the accident flight level. AIRMET Sierra forecasted mountains to be obscured by cloud cover:

WAUS43 KKCI 212045
WA3S
_CHIS WA 212045
AIRMET SIERRA UPDT 3 FOR IFR AND MTN OBSCN VALID UNTIL 220300
.
NO SGFNT IFR EXP OUTSIDE OF CNVTV ACT.
.
AIRMET MTN OBSCN...KY TN
FROM HNN TO HMV TO GQO TO LOZ TO HNN
MTNS OBSC BY CLDS. CONDS CONTG BYD 03Z THRU 09Z.
.
OTLK VALID 0300-0900Z
AREA 1...IFR KY
BOUNDED BY HNN-HMV-60ESE BWG-30NE BWG-HNN
CIG BLW 010/VIS BLW 3SM BR/FG. CONDS DVLPG 06-09Z. CONDS CONTG
THRU 09Z.
.
AREA 2...IFR NE KS OK TX AND CSTL WTRS
BOUNDED BY SNY-20SSE HLC-40ENE CDS-30SSE ADM-50WNW GGG-LFK-BRO-
90W BRO-DLF-50S MRF-60W INK-INK-30ESE TBE-50W LBL-GLD-SNY
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG THRU 09Z.
....

10.0 Area Forecast

The Area Forecast issued at 1445 EDT, valid at the accident time, forecasted an overcast ceiling between 2,000 and 2,500 feet msl with tops between 6,000 and 8,000 feet msl. Occasional visibility down to 5 miles and mist was also forecast:

FAUS43 KKCI
FA3W
_CHIC FA 211845
SYNOPSIS AND VFR CLDS/WX
SYNOPSIS VALID UNTIL 221300
CLDS/WX VALID UNTIL 220700...OTLK VALID 220700-221300
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...CDFNT CURVED FROM NRN LH ACRS NRN LWR MI INTO CNTRL WI..THEN NWWD ACRS CNTRL MN INTO N CNTRL ND. BY 13Z...CDFNT WILL CURVE FROM NWRN OH AND NRN IN INTO NRN IL AND NERN IA INTO SWRN MN. WRMFNT WILL CONT NWD FROM SWRN MN ACRS ERN ND.
.
ND
SKC OCNL SCT120-140. OTLK...VFR.
.
SD
NWRN...SKC. OTLK...VFR.
SWRN AND S CNTRL...FEW100 SCT150 BKN CI. OTLK...VFR.
N CNTRL AND ERN...SKC OCNL FEW120-140. OTLK...VFR.
.
NE
PNHDL...BKN-OVC070-080 TOPS 160. OTLK...VFR BECMG 1013 MVFR CIGS RA BR.
CNTRL...
  SWRN PTNS...BKN-OVC070-080 TOPS 160. OTLK...VFR BECMG 1013 MVFR CIGS RA BR.
  REST OF AREA...SCT-BKN CI. BECMG 0407 BKN100 TOPS 160. OTLK...VFR.
ERN...SKC. BECMG 2201 SCT150. OTLK...VFR.
.
KS
WRN...BKN060 OVC080-100 TOPS FL200. BECMG 0407 OVC050. ISOL -SHRA. OTLK...IFR CIGS RA BR.
CNTRL...SCT060 BKN CI. OTLK...VFR BECMG 1013 MVFR CIGS SHRA.
NERN...SKC. OTLK...VFR.
SERN...BKN-SCT050 TOPS 080. AFT 01Z SCT050 SCT CI. OTLK...VFR.
.
MN
SKC. OTLK...VFR.
.
IA
SKC OCNL FEW050-060. OTLK...VFR.
.
MO
N OF STL-BUM LN...SKC. OTLK...VFR.
S OF STL-BUM LN...BKN035-050 TOPS 080-100. BECMG 2201 SCT-BKN 035-050. AFT 01Z SKC. OTLK...VFR.
.
WI MI LS LM LH
UPR MI/LS...SKC. OTLK...VFR.
NWRN WI...SKC. OTLK...VFR.
NERN WI...SCT080-100. AFT 01Z SKC. OTLK...VFR.
SRN WI/SRN LM...SCT-BKN080-100 TOPS 160. ISOL -TSRA/-SHRA DVLPG CB TOPS FL310. BECMG 0104 SKC OCNL SCT150. OTLK...VFR.
NRN LWR MI/NRN LM/NRN LH...BKN080-100 TOPS 150 ISOL -SHRA. AFT 01Z SKC OCNL SCT100. OTLK...VFR.
SRN LWR MI/SRN LH...SCT-BKN100-120 TOPS 160. ISOL -SHRA. OTLK...VFR.
.
IL

N OF STL-TTH LN...SKC OCNL SCT040-050. BECMG 2201 SKC.
OTLK...VFR.
S OF STL-TTH LN...OVC-BKN035-050 TOPS 080-100. BECMG 2201
SCT035-050. AFT 01Z SKC. OTLK...VFR.
.
IN
NRN...SCT050 BKN100 TOPS 150. BECMG 0104 SCT120-140. OTLK...VFR.
SRN...BKN-OVC035-050 TOPS 080-100. BECMG 0104 SKC. OTLK...VFR.
.
KY
WRN AND CNTRL...OVC-BKN025-030 TOPS 060-080. BECMG 0104 SKC OCNL
SCT030. OTLK...VFR BECMG 0710 MVFR BR.
ERN...OVC020-025 TOPS 060-080. OCNL VIS 5SM BR. BECMG 0407
SCT060. OTLK...VFR BECMG 0710 IFR CIGS BR.
....

11.0 Terminal Aerodrome Forecast

KJKL was the closest site with a NWS TAF. The TAF valid at the time of the accident was issued at 1320 EDT and was valid for a 24-hour period beginning at 1400 EDT. The TAF for KJKL was as follows:

TAF KJKL 211720Z 2118/2218 31006KT 4SM BR OVC006
FM212200 30006KT P6SM OVC015
FM220600 29003KT P6SM FEW050
FM220900 VRB03KT 1/2SM FG OVC002
FM221200 28006KT P6SM FEW250=

The forecast expected wind from 300° at 6 knots, greater than 6 miles visibility, and an overcast ceiling at 1,500 feet agl. This TAF was close to the MVFR conditions that persisted at KJKL around the accident time. However, surface conditions at KCPF were a little lower and IFR around the accident time.

12.0 National Weather Service Area Forecast Discussion

The National Weather Service Office in Jackson, Kentucky, issued the following Area Forecast Discussion at 1537 EDT (closest AFD to the accident time), which discussed IFR conditions continuing into the afternoon and evening hours with a few areas of drizzle. Clearing, or at least higher ceiling conditions, were not expected until around 0200 EDT the following day:

FXUS63 KJKL
AFDJKL
AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE JACKSON KY
337 PM EDT THU MAY 21 2015
.SHORT TERM...(THIS EVENING THROUGH FRIDAY NIGHT)
ISSUED AT 318 PM EDT THU MAY 21 2015
CURRENT CONDITIONS ACROSS EASTERN KENTUCKY FEATURE CONTINUED LOW LEVEL CLOUD COVER AND EVEN A FEW AREAS OF DRIZZLE. THESE CONDITIONS WILL CONTINUE THROUGH THIS EVENING. THEN WITH NORTHWEST FLOW BRINGING RIDGING AND RESULTANT CLEARING IN CENTRAL IL AND NORTHERN IN...THESE CLEARING SKIES WILL EVENTUALLY MAKE IT

INTO EAST KENTUCKY LATE TONIGHT TOWARDS DAWN. THE CLOUD COVER HAS KEPT MAX TEMPS DOWN FROM THE DAY AND THEREFORE WILL DROP INTO THE LOWER 40S LATE TONIGHT. WITH DEW POINTS STILL IN THE UPPER 30S TO LOW 40S UPSTREAM...TEMPS WILL LIKELY FALL LATE TONIGHT TO THEIR DEW POINTS IN MANY LOCATIONS AND WITH THE LIGHT WINDS...DENSE FOG IS LIKELY TO BE AN ISSUE TOWARDS DAWN TONIGHT. WILL BE PUTTING THIS IN THE HWO AND ALLOWING THE EVENING OR EVEN THE NIGHT SHIFT DECIDE IF AN SPS IS NEEDED. THERE IS A POSSIBILITY THAT THE AREA NEVER CLEARS OUT AND STAYS OVERCAST INTO THE EARLY MORNING HOURS BUT WILL GO WITH THE CLEARING SCENARIO LATE TONIGHT.
THE COOLER AIR MASS IN PLACE WILL MAKE FOR A DRY AND COOL DAY FOR TOMORROW AFTERNOON WITH HIGHS ONLY MAKING IT INTO THE LOWER 70S. ALSO TOMORROW AFTERNOON...WITH HIGH PRESSURE ENTERING FROM THE WEST...A WEAK TROUGH WILL BE PASSING BY TO THE NORTHEAST. GIVEN THE RIDGING MOVING IN FROM THE WEST...AND WHAT THE SREF AND NAM ARE ADVERTISING...ANY PRECIP WILL REMAIN TO THE NORTH AND EAST OF THE AREA WITH THE EXCEPTION OF A FEW CLOUDS AND WILL KEEP THE AREA DRY. FRIDAY NIGHT WILL AGAIN FEATURE PARTLY CLOUDY SKIES WITH SLIGHTLY WARMER TEMPS AS THE COOLER AIR MASS MODIFIES AND MIN TEMPS RETURN TO NORMAL. CLOUD COVER SATURDAY MORNING SHOULD HINDER ANY SIGNIFICANT FOG DEVELOPMENT.
.LONG TERM...(SATURDAY THROUGH THURSDAY)
ISSUED AT 336 PM EDT THU MAY 21 2015
A STRONG UPPER LEVEL LOW OVER THE UPPER NEW ENGLAND COAST LINE WILL CONTINUE TO SHIFT NE THROUGH THE WEEKEND...WHILE ANOTHER CLOSED LOW SITS OVER THE 4 CORNER STATES IN THE SW CONUS...FINALLY SHIFTING EASTWARD BY LATE IN THE DAY SUNDAY. THIS WILL PLACE MUCH OF THE OHIO RIVER VALLEY IN A RIDGING PATTERN BETWEEN THE TWO SYSTEMS...PROMOTING WARM SOUTHWEST FLOW AND GENERALLY DRY WEATHER. HOWEVER...AS THE WESTERN TROUGH CONTINUES TO SHIFT EASTWARD...SO TO WILL THE RIDGING PATTERN OVER THE REGION. BY MONDAY...BEST RIDGING WILL BE LOCATED OVER THE APPALACHIANS AND SOUTHERN GULF STATES SHIFTING EAST OF THE OHIO RIVER VALLEY. THIS WILL ALLOW FOR SEVERAL SHORTWAVES TO RIDE UP ALONG THE RIDGE...AND BEGIN AFFECTING THE MISSISSIPPI RIVER VALLEY...AND THEN EVENTUALLY PORTIONS OF CENTRAL AND EASTERN KY. WHILE MODELS ARE GENERALLY IN AGREEMENT FOR THE UPPER LEVEL FEATURES...THE SURFACE FEATURES ARE A BIT MORE DISPLACED...ESPECIALLY WHEN IT COMES TO THE EXTENT OF PRECIPITATION GENERATED BY THESE SHORTWAVES. IF THE ECMWF AND NAM PAN OUT...SOME LATE AFTERNOON CONVECTION COULD POP UP AS EARLY AS LATE SUNDAY AFTERNOON DURING PEAK HEATING...THEN DIMINISH WITH LOSS OF DAYTIME HEATING. HOWEVER...THERE IS A QUITE A LOT OF DRY AIR TO OVERCOME FOR ANY OF THE AFTERNOON CONVECTION TO PAN OUT SUNDAY...SO WILL KEEP WITH INCREASED POPS BUT GENERALLY SUB SLIGHT CHANCES. OTHERWISE... THE GFS TAKES THE LEAD ON BRINGING IN THE MAIN LINE OF PRECIP FASTER...PUSHING IT THROUGH AS EARLY AS LATE MONDAY AFTERNOON AND INTO THE DAY TUESDAY. ECMWF HOLDS OFF UNTIL TUESDAY AFTERNOON. DUE TO THE INCONSISTENCIES...AND THE FACT IT IS SO FAR OUT IN THE FORECAST...DIDN/T DEVIATE MUCH FROM A MODEL BLEND OF THE TWO. BOTH OF WHICH CONTINUE TO KEEP PRECIP ACROSS THE REGION THROUGH THE END OF THE EXTENDED PERIOD.
ONCE THE RAIN DOES MOVE IN...PWATS INCREASE QUITE QUICKLY AND REMAIN 1.5 INCHES OR HIGHER THROUGH THE REMAINDER OF THE EXTENDED. WITH RAIN EXPECTED TO SPAN ACROSS MUCH OF THE CWA THROUGH THE NEXT FEW DAYS...THIS COULD BE QUITE A WET SCENARIO...AND MAYBE SOMETHING TO WATCH OUT FOR ANY POTENTIAL FLOODING CONCERNS. WITH DAYTIME

HEATING...EXPECT BEST CONVECTION DURING THE AFTERNOON...AND DIMINISHING SOMEWHAT DURING THE NIGHTTIME HOURS. GENERALLY...WINDS BOTH AT THE SURFACE AND ALOFT WILL BE FROM THE SOUTHWEST DURING THIS EVENT...GIVING LITTLE LOW LEVEL WIND SHEER...SPEED SHEER...OR EVEN MUCH IN THE WAY OF INSTABILITY. AS SUCH...THIS IS STILL FAIRLY FAR OUT IN THE FORECAST WITH PARAMETERS SUBJECT TO CHANGE...AND WITH WARM SEASON RAIN PROCESSES AND FORCING ALOFT...WOULDN/T RULE OUT SOME ELEVATED RUMBLES OF THUNDER...ESPECIALLY IN THE HEAVIEST RAIN PRODUCERS.
SOUTHWEST FLOW AND THE INITIAL UPPER LEVEL RIDGING WILL ALSO LEAD TO SOME GOOD TEMPERATURE RECOVERIES INTO THE MID 80S DURING THE WEEKEND. AND WITH DRY WEATHER IN PLACE...AGREE WITH PREVIOUS FORECAST THAT OVERNIGHT TEMPERATURE FALLS WILL DISPLAY A GOOD RIDGE VALLEY SPLIT PATTERN THROUGH MEMORIAL DAY. ONCE THE RAIN MOVES INTO THE REGION EARLY IN THE WORK WEEK...CONTINUED WARM SOUTHWEST FLOW WILL ONLY BE HAMPERED BY THE CLOUD COVER AND RAIN...DROPPING TEMPS A FEW DEGREES INTO THE LOWER 80S FOR THE REMAINDER OF THE FORECAST AND KEEPING OVERNIGHT LOWS CONSIDERABLY WARMER.
&&
.AVIATION...(FOR THE 18Z TAFS THROUGH 18Z FRIDAY AFTERNOON)
ISSUED AT 200 PM EDT THU MAY 21 2015
EXPECT IFR CONDITIONS THIS AFTERNOON WITH THE LOW LEVEL CLOUD COVER AND LINGERING MOISTURE KEEPING POOR CONDITIONS INTO THIS EVENING. WITH THE EXCEPTION TO A FEW AREAS OF DRIZZLE REMAINING AND EVEN A SHOWER OR TWO...CONDITIONS WILL BEGIN TO CLEAR OUT A BIT WITH SOME LIFTING CEILINGS TO AT LEAST MVFR AND EVENING CLEAR OUT BY 06Z. HOWEVER...WITH LIFTING CEILINGS...DENSE FOG WILL SOCK IN THE AREA LATE TONIGHT AND CONDITIONS WILL REACH BELOW MINS AT MANY LOCATIONS BY THE PREDAWN HOURS. WINDS SHOULD REMAIN OUT OF THE WEST AND NORTHWEST THE ENTIRE PERIOD BUT BECOMING LIGHT AND VARIABLE LATE TONIGHT.
&&
.JKL WATCHES/WARNINGS/ADVISORIES...
NONE.
&&
$$

13.0 Pilot Weather Briefing

The accident pilot did not receive an official weather briefing from Lockheed Martin Flight Service. There is no record of the accident pilot receiving or retrieving any weather information before the accident flight.

14.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for the accident site on May 21, 2015, indicated the following:

SUN	
Begin civil twilight	0550 EDT
Sunrise	0620 EDT
Sun transit	1330 EDT
Sunset	2040 EDT
End civil twilight	2110 EDT

F. LIST OF ATTACHMENTS

None.

Paul Suffern
NTSB, AS-30