NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

September 3, 2014

Group Chairman's Weather Study Report

METEOROLOGY

ERA14FA288

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A. ACCIDENT

Location: 3 miles east-northeast of White Plains, New York
Date: June 13, 2014
Time: approximately 0808 eastern daylight time (1208 UTC[1])
Aircraft: Piper PA-46-500TP, registration: N5335R

B. METEOROLOGY GROUP

Paul Suffern
Senior Meteorologist
National Transportation Safety Board
Operational Factors Division, AS-30
Washington, D.C. 20594-2000

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 June 13, 2014, 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 41.05° N, longitude 73.71° W, elevation: 328 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 0800 EDT is provided as figure 1, with the approximate location of the accident site marked. The chart depicted a warm front stretched from Ontario, Canada, southeastward into central New Jersey, then eastward into the western Atlantic Ocean. A surface low pressure center with a pressure of 1009-hectopascals (hPa) was located in eastern Pennsylvania. The station models around the accident site depicted air temperatures in the mid 60's Fahrenheit (F), with temperature-dew point spreads of 2° F or less, an east to southeast wind between 5 to 10 knots, clouds skies, and areas of drizzle. The accident site was located in a favorable area for clouds and precipitation given the proximity of the warm front. The warm front acted as a favorable lifting mechanism to aid in the development of clouds and precipitation and will be further discussion in section 1.2.

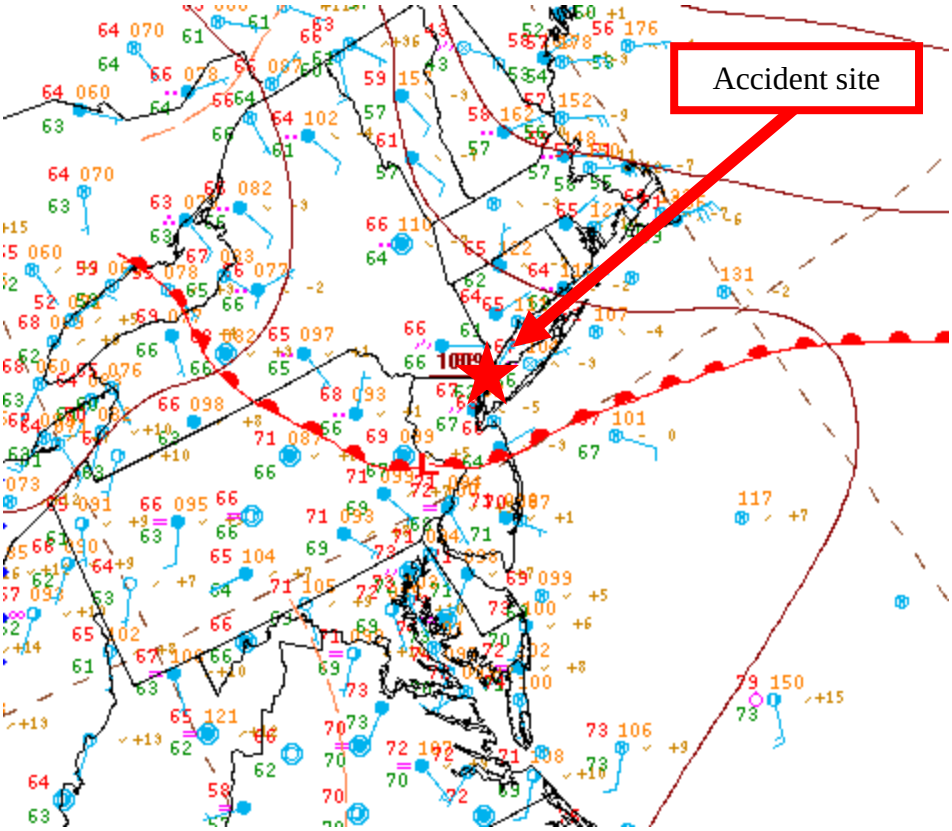

Figure 1 – NWS Surface Analysis Chart for 0800 EDT

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 0800 EDT at 925-, 850-, 700-, 500-, and 300-hPa are presented in figures 2 through 6. The 925- and 850-hPa charts depicted a low-level trough[2] located near the accident site at 0800 EDT. Additionally, there was a mid-level trough located at 700- and 500-hPa just south of the accident site with winds out of the south near the accident site at that altitude. This trough would have acted as a lifting mechanism along with the warm front (section 1.1), and helped to be a focusing point for the development of clouds and precipitation. The wind remained out of the south to southwest from 850- through 300-hPa with the wind magnitude near 40 knots at 300-hPa.

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

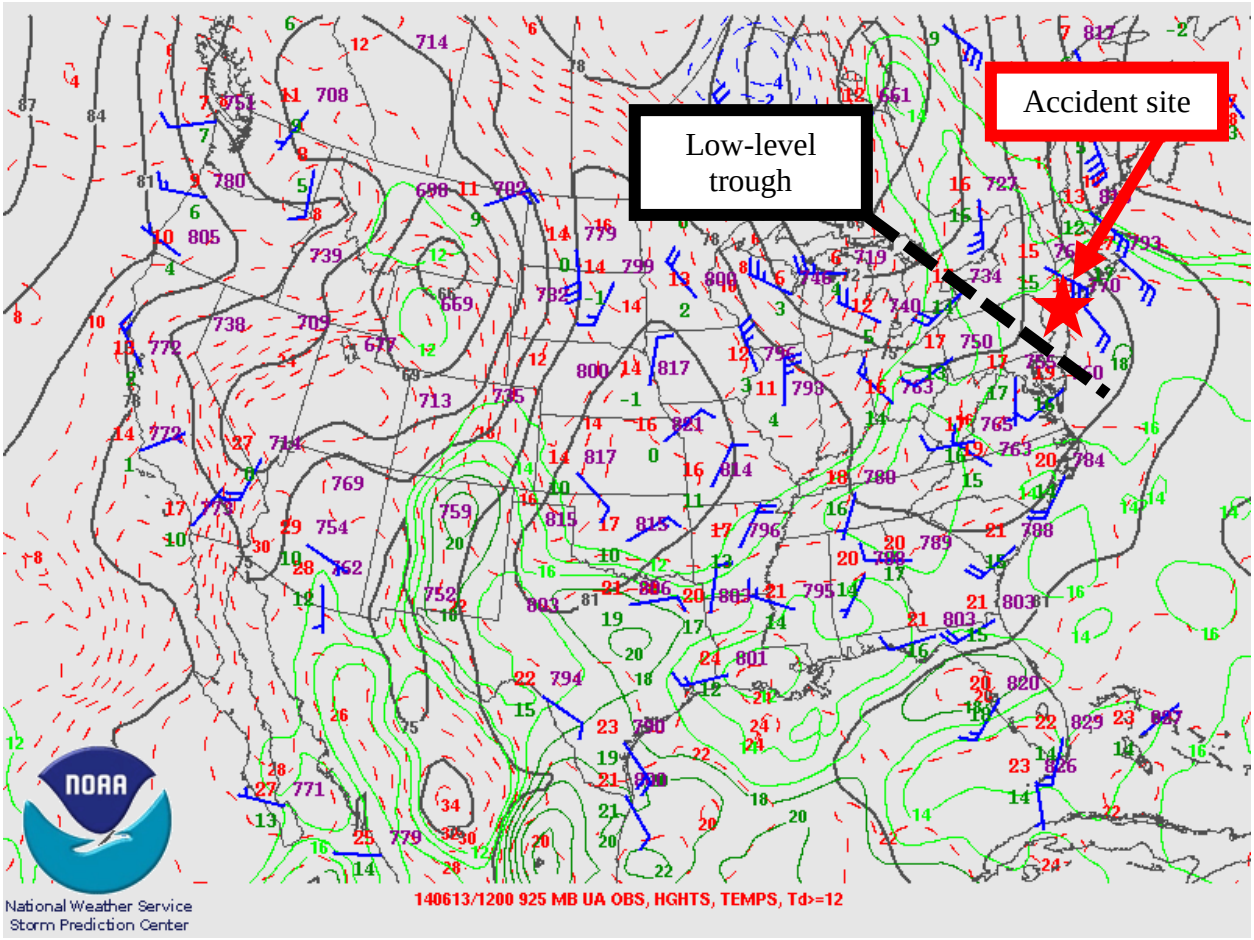

Figure 2 – 925-hPa Constant Pressure Chart for 0800 EDT

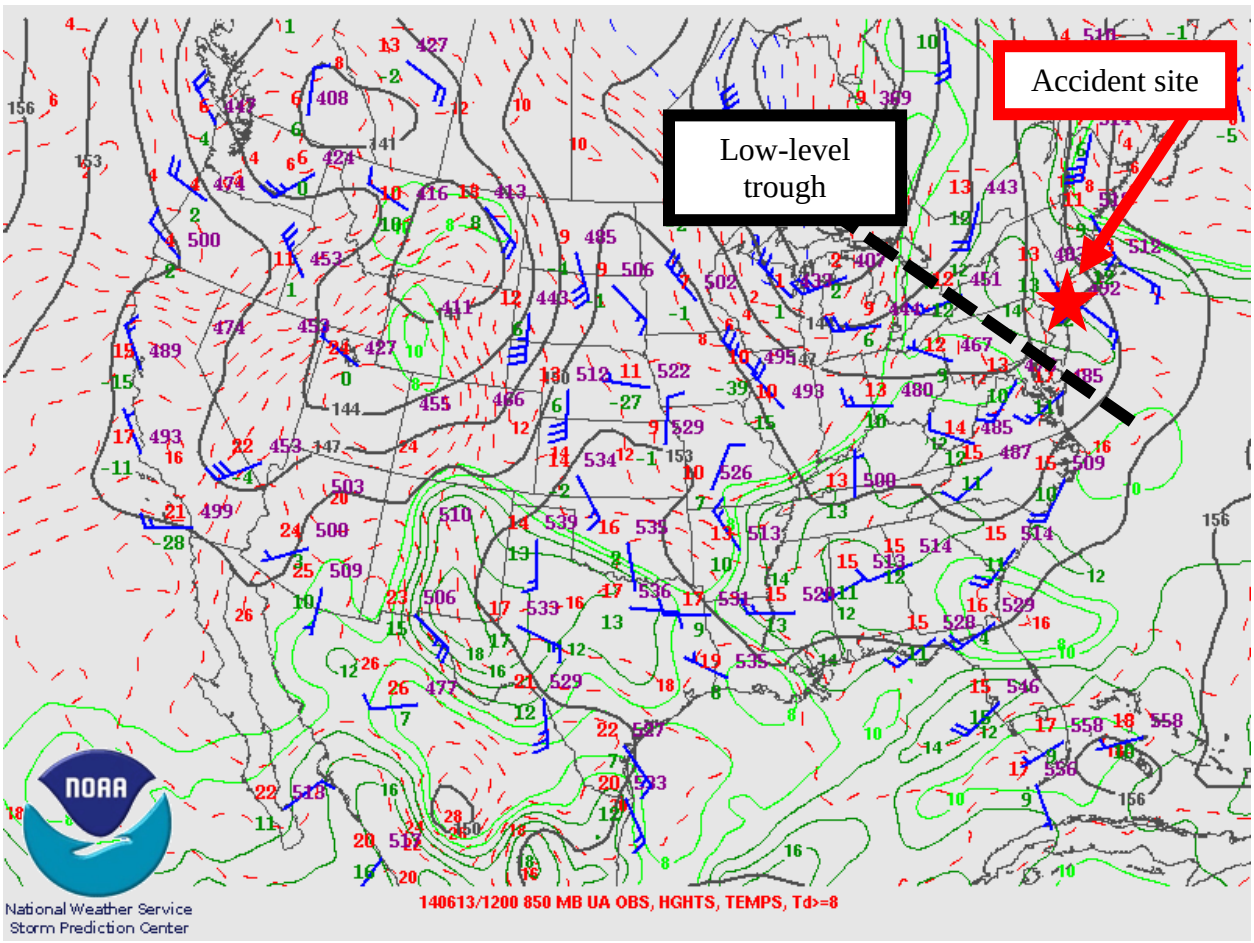

Figure 3 – 850-hPa Constant Pressure Chart for 0800 EDT

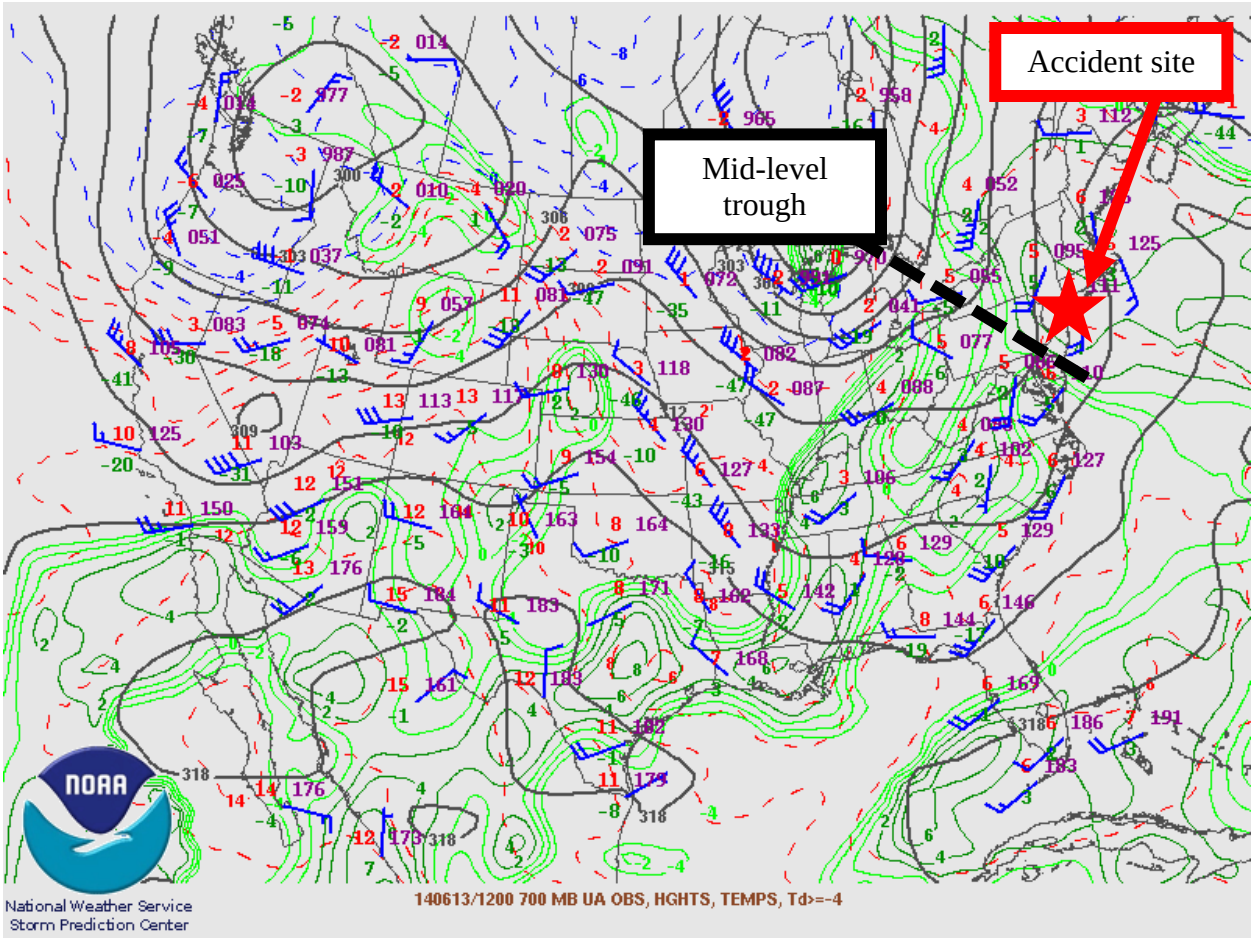

Figure 4 – 700-hPa Constant Pressure Chart for 0800 EDT

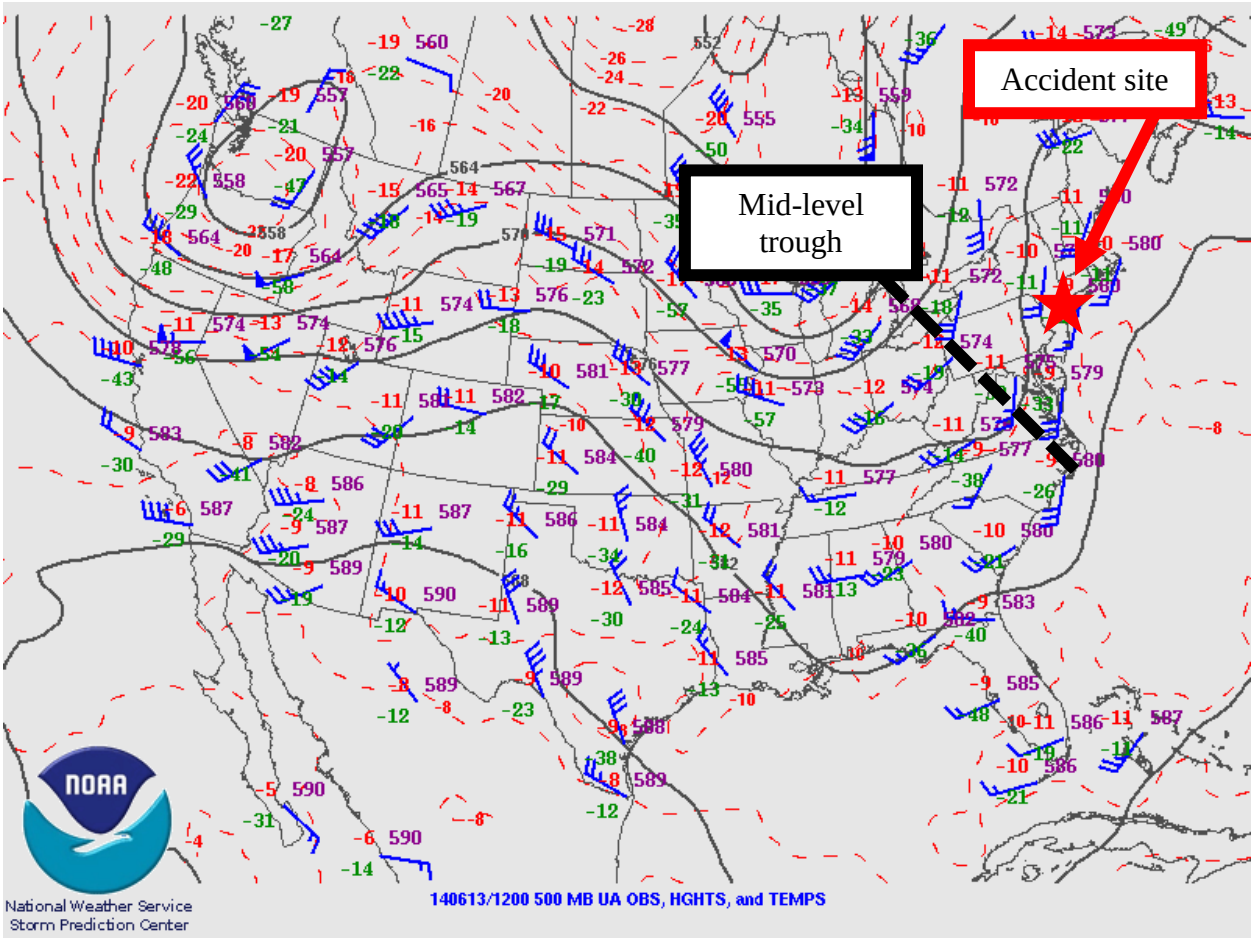

Figure 5 – 500-hPa Constant Pressure Chart for 0800 EDT

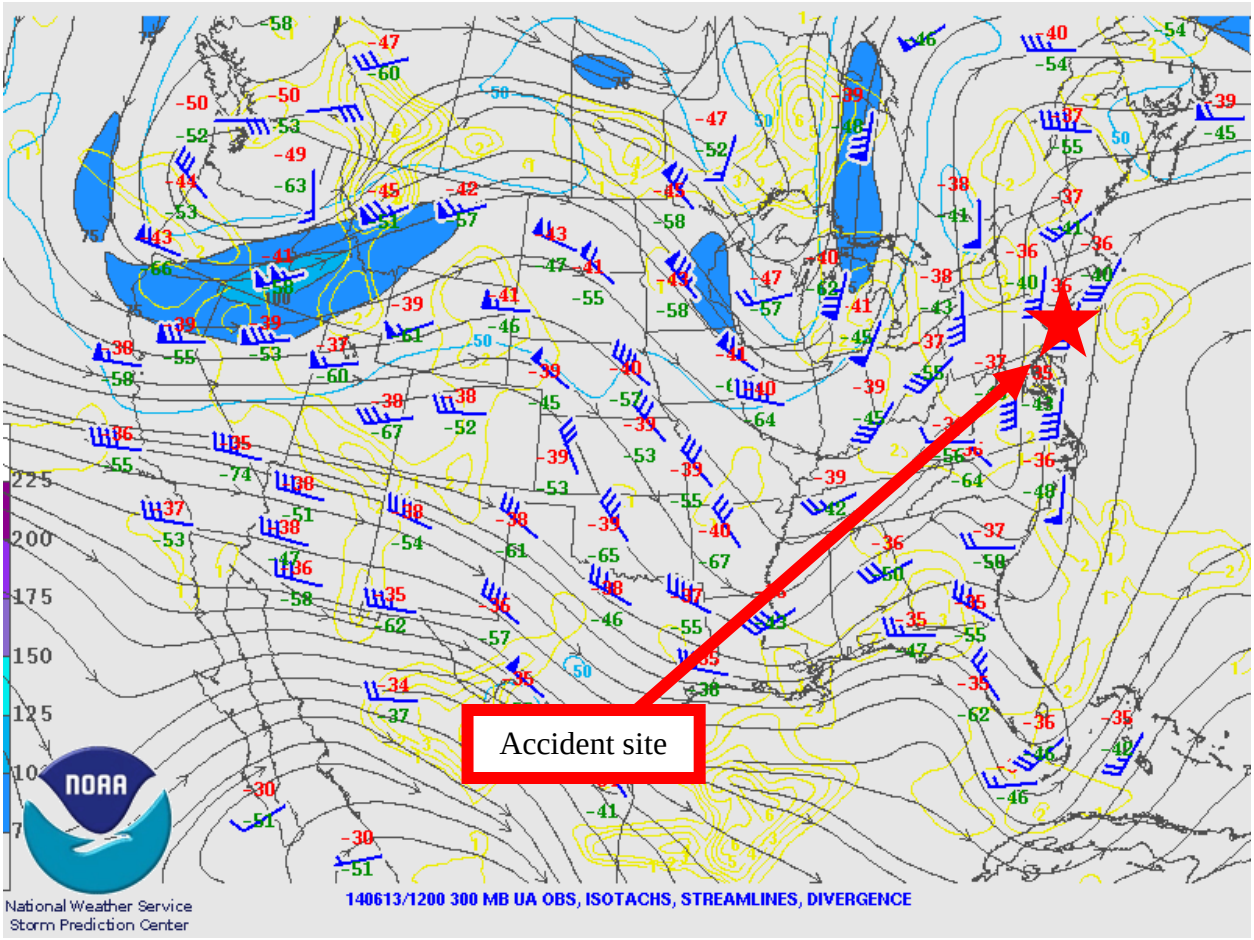

Figure 6 – 300-hPa Constant Pressure Chart for 0800 EDT

2.0 Storm Prediction Center Products

SPC issued the following day 1 Convective Outlook at 0200 EDT (figures 7 and 8) with areas of thunderstorms forecasted for the accident site with an elevated chance of severe thunderstorms forecasted for the accident site as well. The accident site was located in an area where SPC forecasted a 5 percent chance of damaging thunderstorm winds or wind gusts 50 knots or greater within 25 miles of a point[3]. The severe thunderstorms were forecasted to affect the accident site area during the late morning and afternoon hours[4]:

SPC AC 130600

DAY 1 CONVECTIVE OUTLOOK
NWS STORM PREDICTION CENTER NORMAN OK
0100 AM CDT FRI JUN 13 2014

[3] For more information on severe weather within 25 miles of a point see: http://www.spc.noaa.gov/products/outlook/probinfo.html

[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.

VALID 131200Z - 141200Z

...THERE IS A SLGT RISK OF SVR TSTMS ACROSS THE NRN PLAINS...

...THERE IS A SLGT RISK OF SVR TSTMS ACROSS THE SRN HIGH PLAINS...

...SUMMARY...
SCATTERED SEVERE THUNDERSTORMS ARE POSSIBLE ACROSS PORTIONS OF THE NORTHERN PLAINS BY LATE THIS AFTERNOON THROUGH THE EVENING. LARGE HAIL /SOME VERY LARGE/...STRONG WINDS...AND A TORNADO THREAT CAN BE EXPECTED WITH THESE INITIAL STORMS. A COMPLEX OF STORMS PRODUCING LARGE HAIL AND STRONG WIND GUSTS WILL BE POSSIBLE ADVANCING EASTWARD ACROSS PARTS OF NORTH DAKOTA AND SOUTH DAKOTA TONIGHT. ADDITIONAL STRONG TO ISOLATED SEVERE THUNDERSTORMS ARE POSSIBLE ACROSS THE CENTRAL AND SOUTHERN HIGH PLAINS THIS AFTERNOON AND EVENING WITH VERY LARGE HAIL AND STRONG WIND GUSTS A GREATER THREAT IN EASTERN NEW MEXICO AND WEST TEXAS. MEANWHILE...AN ISOLATED THREAT FOR STRONG TO SEVERE STORMS IS POSSIBLE ALONG THE NORTHWEST TO CENTRAL GULF COAST AND THE MID-ATLANTIC STATES.

...SYNOPSIS...
A NRN STREAM SHORTWAVE TROUGH...NOW MOVING THROUGH THE WRN GREAT LAKES...WILL WILL PHASE WITH A WEAKENING SRN STREAM TROUGH IN THE OH VALLEY AND CONTINUE THROUGH THE GREAT LAKES AND NERN STATES THIS FORECAST PERIOD. FARTHER WEST...THE UPPER LOW/TROUGH... CURRENTLY MOVING THROUGH THE PACIFIC NW WILL ADVANCE THROUGH THE NRN ROCKY MOUNTAIN REGION AND GREAT BASIN. MEANWHILE...LOW AMPLITUDE IMPULSES SHOULD MOVE EWD THROUGH THE NRN HIGH PLAINS AND SRN ROCKIES/HIGH PLAINS THIS AFTERNOON.

AT THE SURFACE...A COLD FRONT ATTENDANT TO THE NWRN STATES TROUGH WILL ADVANCE EWD THROUGH MT/WY WITH THE SRN EXTENT MOVING THROUGH THE GREAT BASIN. BY LATE THIS AFTERNOON...THIS COLD FRONT SHOULD EXTEND FROM THE MT/ND BORDER SSWWD INTO NERN TO SWRN WY...WITH AN AREA OF LOW PRESSURE LOCATED IN VICINITY OF SERN MT/NERN WY. FARTHER EAST...A COLD FRONT INITIALLY FROM THE GREAT LAKES SWWD THROUGH TX WILL CONTINUE EWD AND SEWD. THE TX PORTION OF THIS BOUNDARY WILL LIKELY BECOME STATIONARY AND BEGIN LIFTING NWD AS A WARM FRONT ACROSS WRN TX AS A LEE TROUGH DEVELOPS OVER THE HIGH PLAINS.

...NRN PLAINS...
MODEST LOW-LEVEL MOISTURE WITH SURFACE DEWPOINTS IN THE 50S WILL BE ADVECTED NWD BY INCREASING SLY WINDS EAST OF THE DEVELOPING LEE LOW AND HIGH PLAINS TROUGH. AN ELEVATED MIXED LAYER WITH VERY STEEP LAPSE RATES /8-9 C/KM IN THE 700-500 MB LAYER/ WILL SPREAD EWD ABOVE THE MOISTURE RETURN...CONTRIBUTING TO A CORRIDOR OF MODERATE INSTABILITY /MLCAPE OF 1500-2000 J PER KG/ AS THE BOUNDARY LAYER WARMS. WARM AIR AT THE BASE OF THE EML IS EXPECTED TO CAP THE ATMOSPHERE TO SURFACE-BASED STORMS INTO MUCH OF THE AFTERNOON. MEANWHILE...LOW-AMPLITUDE IMPULSE IS FORECAST TO EJECT THROUGH THE NRN HIGH PLAINS AS SWLY MIDLEVEL WINDS STRENGTHEN TO 50 KT WITH THE APPROACH OF THE UPSTREAM TROUGH. ASCENT WITH THE IMPULSE WILL FURTHER AID STORM DEVELOPMENT THAT IS EXPECTED OVER THE HIGHER TERRAIN OF WY AND POSSIBLY THE BLACK HILLS OF SD BY MID-LATE AFTERNOON. THE MODERATE INSTABILITY AND EFFECTIVE BULK SHEAR OF

40-50 KT WILL PROVE FAVORABLE FOR SOME OF THE INITIAL STORMS TO TAKE ON SUPERCELL STRUCTURES. VERY LARGE HAIL /EXCEEDING 2 INCH DIAMETER/...STRONG WIND GUSTS AND A TORNADO THREAT WILL BE POSSIBLE WITH THE AFTERNOON AND EARLY EVENING STORMS.

A CONTINUED SEVERE WEATHER THREAT...MAINLY HAIL AND DAMAGING WIND GUSTS...IS EXPECTED LATER THIS EVENING THROUGH TONIGHT WITH ACTIVITY EVOLVING INTO AN EWD MOVING MCS ACROSS THE DAKOTAS. THIS WILL OCCUR AS A SLY LLJ STRENGTHENS ACROSS THE GREAT PLAINS WITH LOW-LEVEL WAA INCREASING ACROSS THE DAKOTAS. ELEVATED MODERATE INSTABILITY AND THE PLUME OF STEEP MIDLEVEL LAPSE RATES ADVANCING EWD WILL SUPPORT A THREAT FOR HAIL AND STRONG WIND GUSTS.

...SRN HIGH PLAINS...
STEEP LAPSE RATES WILL ADVECT ABOVE A CORRIDOR OF RICHER MOISTURE THAT WILL RESIDE ACROSS WRN TX AND ERN NM IN VICINITY OF AND NORTH OF A STALLED FRONT THAT WILL EVENTUALLY BEGIN TO MOVE NWD AS A WARM FRONT. AS THE ENVIRONMENT DESTABILIZES...MLCAPE SHOULD RANGE FROM 2000-2500 J/KG DURING THE AFTERNOON. A LOW AMPLITUDE IMPULSE SHOULD ADVANCE THROUGH THE SRN ROCKIES AND SRN HIGH PLAINS. WIDELY SCATTERED STORMS ARE EXPECTED TO INITIATE OVER THE HIGH TERRAIN OF NM AND SWRN TX AND SPREAD INTO THE SRN HIGH PLAINS DURING THE LATE AFTERNOON AND EVENING. THE STRONG INSTABILITY AND 0-6 KM VERTICAL SHEAR FROM 30-40 KT WILL SUPPORT A FEW SUPERCELLS WITH LARGE HAIL...SOME VERY LARGE...AND DAMAGING WIND GUSTS AS THE MAIN THREATS.

...SERN TX TO THE CENTRAL GULF COAST REGION...
REMNANT OUTFLOW BOUNDARIES ACROSS THIS REGION TODAY AND A SWD MOVING FRONT WILL PROVIDE A FOCUS FOR BOTH ANY ONGOING STORMS THIS MORNING AND ISOLATED TO SCATTERED TSTM DEVELOPMENT INTO THE AFTERNOON. MODERATE INSTABILITY WILL SUPPORT THESE STORMS...THOUGH WEAK FORCING ALOFT AND WEAK BULK SHEAR SHOULD LIMIT THE POTENTIAL FOR A GREATER SEVERE WEATHER THREAT.

...ERN VA/MD AND DELMARVA NWD TO SERN NY...
A WEAK TROUGH PRECEDING THE GREAT LAKES/OH VALLEY TROUGH MAY PROVE SUFFICIENT IN PROVIDING SOME LARGE SCALE ASCENT FOR A FEW STRONGER TO SEVERE STORMS IN THIS REGION INTO THE AFTERNOON. SURFACE DEWPOINTS IN THE LOWER 70S ALREADY RESIDE ACROSS THE SRN PORTION OF THIS REGION. MOISTENING WILL OCCUR POLEWARD TODAY GIVEN SLY WINDS IN ADVANCE OF A N-S ORIENTED SURFACE TROUGH ADVANCING EWD THROUGH THE MID-ATLANTIC STATES AND NY. LAPSE RATES WILL TEND TO BE WEAK DUE TO WIDESPREAD SHOWERS/TSTMS AND LIMITED SURFACE HEATING...BUT THE MOISTURE RETURN WITH PW VALUES AROUND 1.5 INCHES WILL AID IN DESTABILIZATION WITH MLCAPE NEAR 1000 J/KG. 30 KT OF SLY MIDLEVEL WINDS ACROSS THIS DISCUSSION AREA WILL SUPPORT MODEST BULK SHEAR FOR A FEW STRONG TO SEVERE STORMS...WITH LOCALLY STRONGER WIND GUSTS BEING THE PRIMARY THREAT.

..PETERS/SMITH.. 06/13/2014

CLICK TO GET WUUS01 PTSDY1 PRODUCT

NOTE: THE NEXT DAY 1 OUTLOOK IS SCHEDULED BY 1300Z

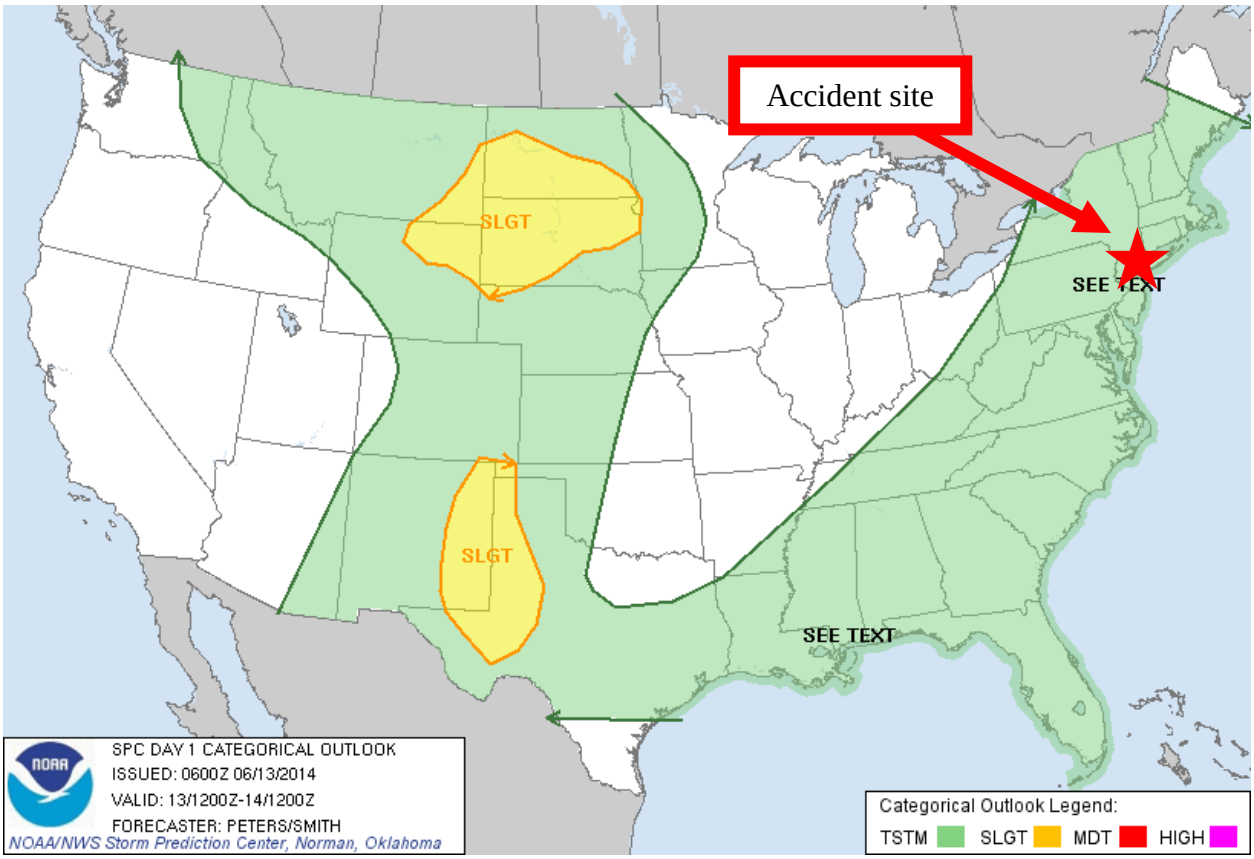

Figure 7 – Storm Prediction Center day 1 Convective Outlook valid at the time of the accident

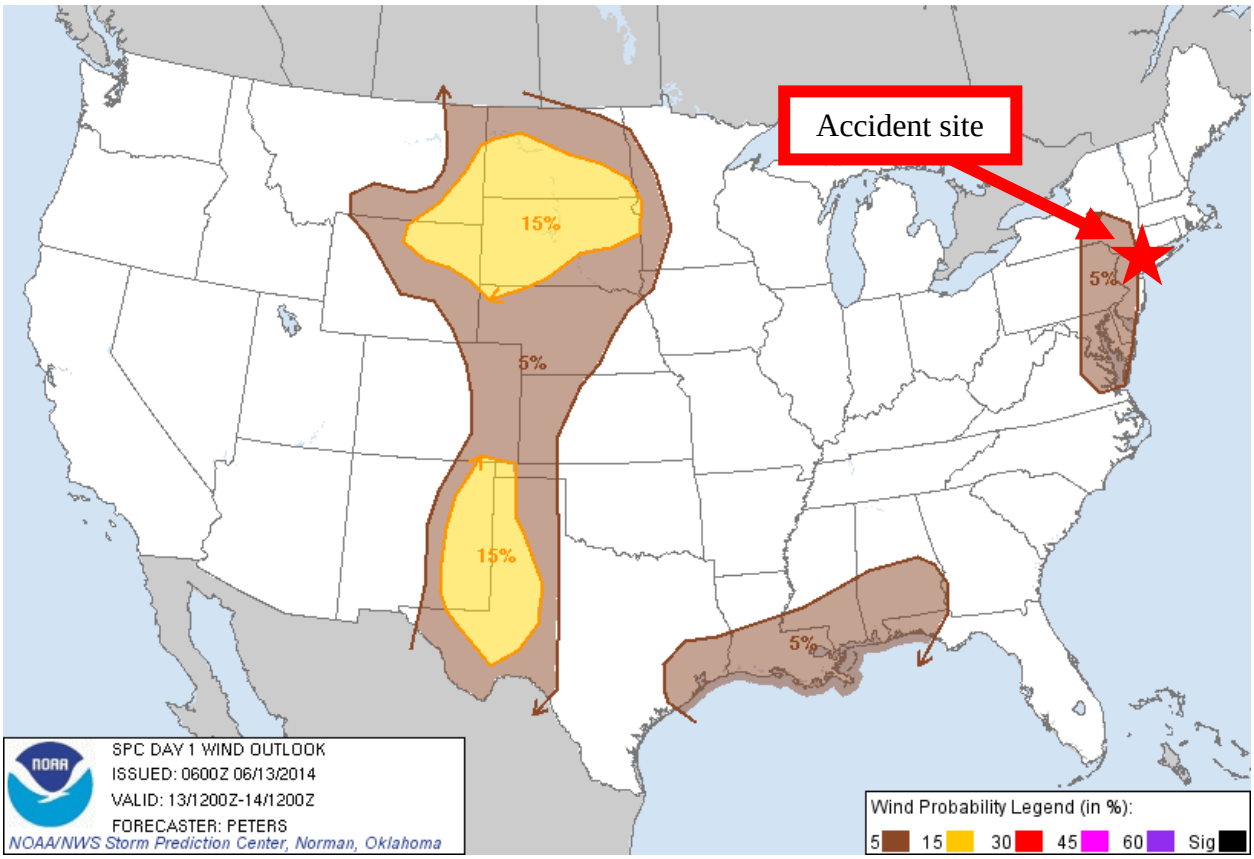

Figure 8 – Storm Prediction Center day 1 probability of damaging thunderstorm winds valid at the time of the accident

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.

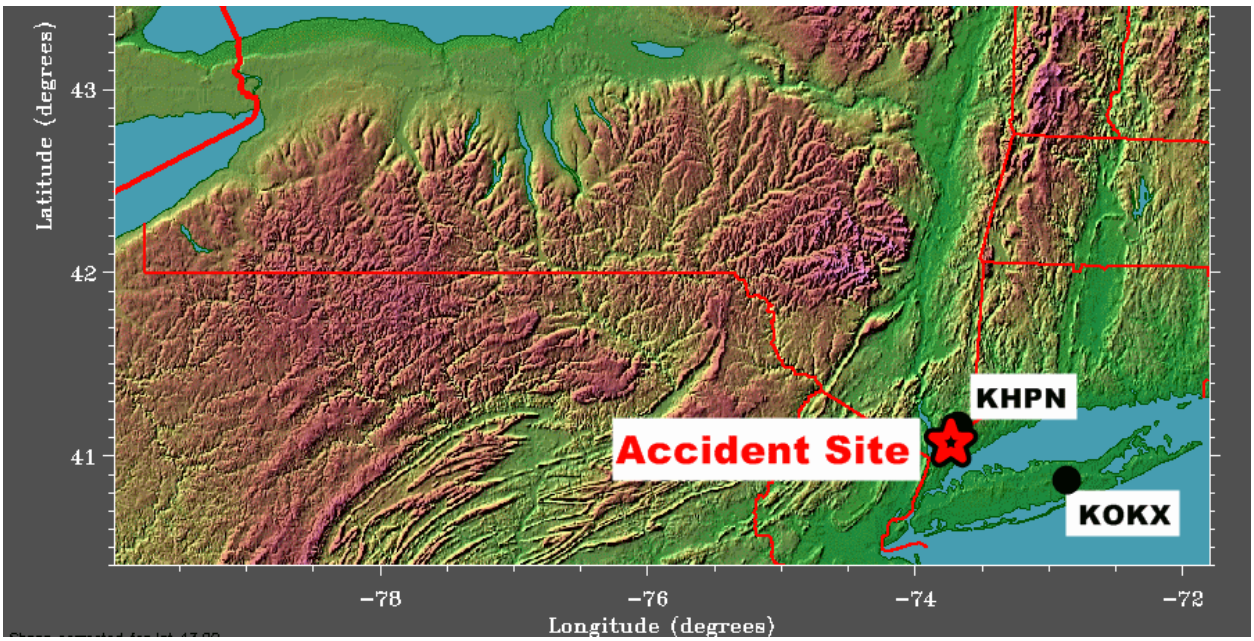

Figure 9 – Map of New York with the location of the accident site, surface observation sites, upper air sounding, and weather radar site

Westchester County Airport (KHPN) was located 3 miles northeast of White Plains, New York, and had an Automated Surface Observing System (ASOS[5]) whose reports were supplemented by an official weather observer. KHPN was located 1 mile northeast of the accident site, at an elevation of 439 feet, and had a 12° westerly magnetic variation (figure 9). The following observations were taken and disseminated during the times surrounding the accident:

[0610 EDT] KHPN 131010Z 08008KT 1 1/2SM FG OVC002 17/17 A2986 RMK AO2 RAE09 P0000=

[0632 EDT] KHPN 131032Z 08007KT 3/4SM R16/4000V5500FT -RA FG OVC002 17/17 A2986 RMK AO2 P0001=

[0656 EDT] KHPN 131056Z 09006KT 3/4SM R16/5000V6000FT FG OVC002 17/17 A2986 RMK AO2 RAE42 SLP107 P0001 T01720167=

[0707 EDT] KHPN 131107Z 09007KT 1SM R16/5000V5500FT FG OVC002 17/17 A2986 RMK AO2=

[0718 EDT] KHPN 131118Z 08006KT 3/4SM R16/4000V5000FT -RA FG OVC002 17/17 A2985 RMK AO2 RAB15 P0000=

[0756 EDT] KHPN 131156Z 10006KT 1/2SM R16/3000V4500FT FG OVC002 17/17 A2985=

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

ACCIDENT TIME 0808 EDT

[0815 EDT] KHPN 131215Z 09006KT 1/4SM R16/2200V3000FT FG OVC002 17/17 A2985 RMK AO2=

[0842 EDT] KHPN 131242Z 09005KT 1/4SM R16/2200V2600FT FG OVC001 17/17 A2985 RMK AO2=

[0856 EDT] KHPN 131256Z 09004KT 1/4SM R16/2000V2600FT FG VV002 18/17 A2984 RMK AO2 SLP102 T01780172=

[0921 EDT] KHPN 131321Z 08006KT 1/4SM R16/2000V2200FT FG VV002 18/17 A2984 RMK AO2=

[0937 EDT] KHPN 131337Z 08005KT 1/4SM R16/2000V2600FT -RA FG VV002 18/17 A2983 RMK AO2 RAB30 P0001=

[0945 EDT] KHPN 131345Z 08006KT 1/2SM R16/2400V3500FT RA FG OVC001 18/17 A2983 RMK AO2 RAB30 P0003=

KHPN weather at 0718 EDT, wind from 080° at 6 knots, three quarters of a mile visibility, 10-min runway 16 visual range varying between 4,000 and 5,000 feet, light rain, fog, an overcast ceiling at 200 feet above ground level (agl), temperature of 17° Celsius (C), dew point temperature of 17° C, and an altimeter setting of 29.85 inches of mercury. Remarks: automated station with a precipitation discriminator, rain began at 0715 EDT, one-hourly precipitation of a trace.

KHPN weather at 0756 EDT, wind from 100° at 6 knots, a half mile visibility, 10-min runway 16 visual range varying between 3,000 and 4,500 feet, fog, an overcast ceiling at 200 feet agl, temperature of 17° C, dew point temperature of 17° C, and an altimeter setting of 29.85 inches of mercury.

KHPN weather at 0815 EDT, wind from 090° at 6 knots, a quarter mile visibility, 10-min runway 16 visual range varying between 2,200 and 3,000 feet, fog, an overcast ceiling at 200 feet agl, temperature of 17° C, dew point temperature of 17° C, and an altimeter setting of 29.85 inches of mercury. Remarks: automated station with a precipitation discriminator.

KHPN weather at 0842 EDT, wind from 090° at 5 knots, a quarter mile visibility, 10-min runway 16 visual range varying between 2,200 and 2,600 feet, fog, an overcast ceiling at 100 feet agl, temperature of 17° C, dew point temperature of 17° C, and an altimeter setting of 29.85 inches of mercury. Remarks: automated station with a precipitation discriminator.

Portland International Jetport (KPWM) was located 2 miles west of Portland, Maine, and had an ASOS whose reports were supplemented by air traffic control. KPWM was the destination airport, was located 217 miles northeast of the accident site, at an elevation of 76 feet, and had a 17° westerly magnetic variation. The following observations were taken and disseminated during the times surrounding the accident:

[0430 EDT] KPWM 130830Z AUTO 14005KT 10SM SCT026 OVC060 14/12 A3008 RMK AO2 T01440117=

[0451 EDT] KPWM 130851Z 13004KT 10SM SCT026 OVC060 14/12 A3007=

[0515 EDT] KPWM 130951Z 13004KT 10SM BKN029 OVC055 14/12 A3008=

[0651 EDT] KPWM 131051Z 08008KT 10SM BKN031 BKN042 OVC060 14/12 A3007=

[0708 EDT] KPWM 131108Z 10008KT 10SM BKN018 BKN031 OVC060 14/12 A3007 RMK AO2 T01440117=

[0751 EDT] KPWM 131151Z 09007KT 10SM OVC016 14/12 A3007=

ACCIDENT TIME 0808 EDT

[0837 EDT] KPWM 131237Z 09007KT 1SM -RA BR OVC013 14/12 A3008 RMK AO2 RAB34 P0000 T01390122=

[0840 EDT] KPWM 131240Z 09006KT 1SM -RA BR BKN009 OVC013 14/12 A3008 RMK AO2 RAB34 P0000 T01390122=

[0851 EDT] KPWM 131251Z 09006KT 1SM -RA BR BKN006 OVC012 13/12 A3008=

[0904 EDT] KPWM 131304Z 09006KT 1 1/2SM -RA BR OVC006 13/12 A3007 RMK AO2 P0000 T01330122=

[0914 EDT] KPWM 131314Z 08008KT 1 1/2SM -RA BR OVC004 13/12 A3007 RMK AO2 P0001 T01330122=

[0951 EDT] KPWM 131351Z 09010KT 1 1/2SM -RA BR OVC003 13/12 A3006=

KPWM weather at 0708 EDT, wind from 100° at 8 knots, 10 miles visibility, a broken ceiling at 1,800 feet agl, broken skies at 3,100 feet agl, overcast skies at 6,000 feet agl, temperature of 14° C, dew point temperature of 12° C, and an altimeter setting of 30.07 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 14.4° C, dew point temperature 11.7° C.

KPWM weather at 0751 EDT, wind from 090° at 7 knots, 10 miles visibility, an overcast ceiling at 1,600 feet agl, temperature of 14° C, dew point temperature of 12° C, and an altimeter setting of 30.07 inches of mercury.

KPWM weather at 0837 EDT, wind from 090° at 7 knots, 1 mile visibility, light rain and mist, an overcast ceiling at 1,300 feet agl, temperature of 14° C, dew point temperature of 12° C, and an altimeter setting of 30.08 inches of mercury. Remarks: automated station with a precipitation discriminator, rain began at 0834 EDT, one-hourly precipitation of a trace, temperature 13.9° C, dew point temperature 12.2° C.

KPWM weather at 0840 EDT, wind from 090° at 6 knots, 1 mile visibility, light rain and mist, a broken ceiling at 900 feet agl, overcast skies at 1,300 feet agl, temperature of 14° C, dew point temperature of 12° C, and an altimeter setting of 30.08 inches of mercury. Remarks: automated station with a precipitation discriminator, rain began at 0834 EDT, one-hourly precipitation of a trace, temperature 13.9° C, dew point temperature 12.2° C.

The observations from KHPN indicated very low IFR[6] ceilings at the time of the accident with rain increasing after the accident time. This is consistent with the overall larger scale weather pattern seen in sections 1.1 and 1.2. Conditions were also deteriorating with time at KPWM with IFR ceilings by 0840 EDT with ceilings and visibility continuing to remain low or decrease thereafter. TAF forecast will be examined for both of these airports in section 11.0, however, the observations at KHPN and KPWM do not indicate optimal flying weather with regards to ceiling or visibility.

4.0 Upper Air Data

The closest official upper air sounding to the accident site was from Upton, New York, (KOKX), which was approximately 40 miles east-southeast of the accident site, with a site number 72501, and a station elevation of 66 feet (figure 9). The 0800 EDT sounding from KOKX was plotted on a standard Skew-T log P diagram[7] with the derived stability parameters included in figure 10 (with data from the surface to 600-hPa, or 14,000 feet msl). This data was analyzed utilizing the RAOB[8] software package. The sounding depicted the Lifted Condensation Level (LCL)[9] at 66 feet msl, a Convective Condensation Level (CCL)[10] of 3,022 feet, and a Level of Free Convection (LFC)[11] at 66 feet. The freezing level was located at 13,617 feet msl. The precipitable water value was 1.90 inches.

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[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] 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.

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

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

[10] 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.

[11] 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.

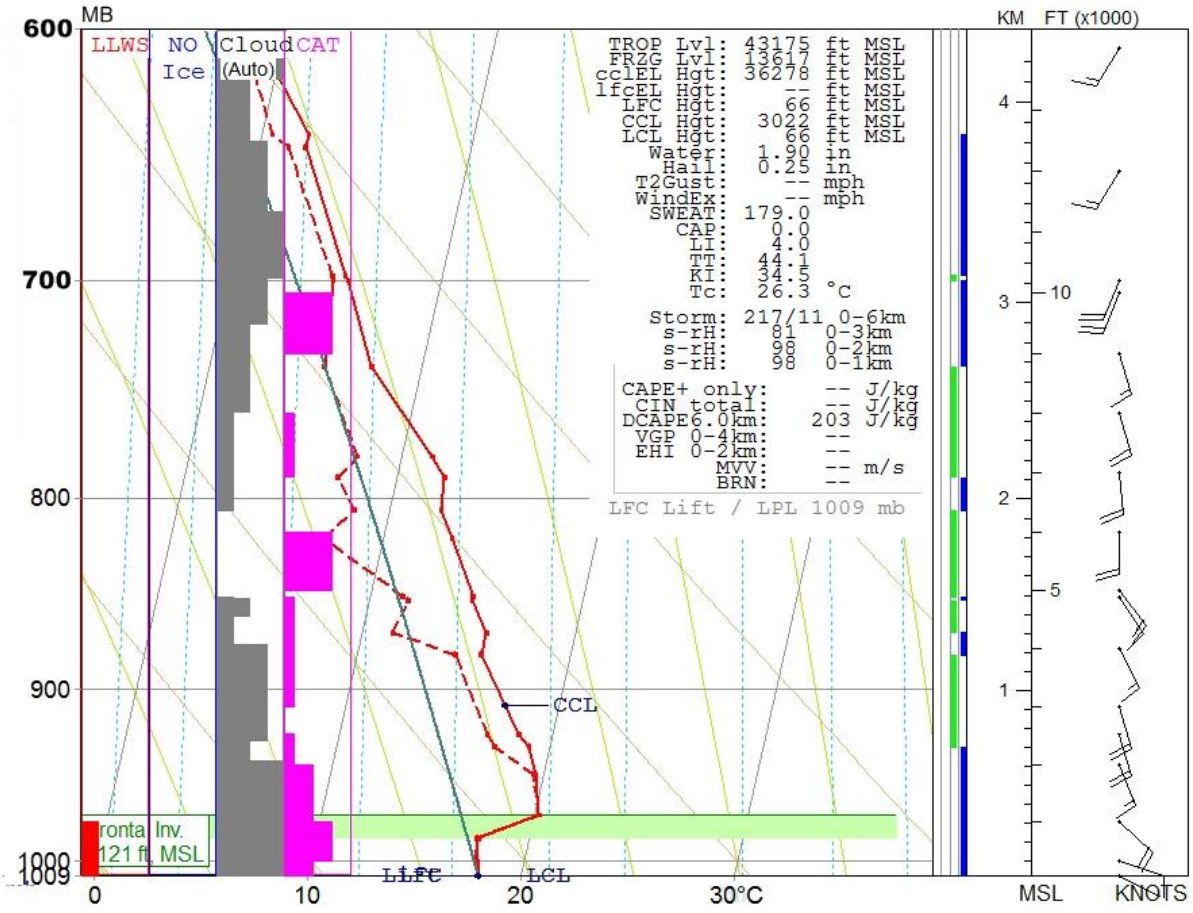


Figure 10 – 0800 EDT KOKX sounding

The 0800 EDT KOKX sounding indicated a relatively moist environment from the surface through 14,000 feet msl with several layers of stable and conditionally unstable air. In addition, there was a frontal inversion around 1121 feet msl. This environment would have been supportive of cloud formation and precipitation especially given the lifting mechanisms discussed in section 1.1 and 1.2. The potential for clouds was indicated by RAOB between the surface and 14,000 feet. No icing conditions were indicated by RAOB below 14,000 feet.

The sounding wind profile indicated a surface wind from 120° at 2 knots that increased to 18 knots by 1,000 feet. The wind then remained around 20 knots veering[12] to the southwest through 14,000 feet. With frontal inversion in place around 1,100 feet msl, low-level wind shear (LLWS) would have been likely below and near the frontal inversion. LLWS was identified by RAOB between the surface and 1,000 feet with potential for clear air turbulence from the surface through 10,000 feet. The highest likelihood of turbulence was located in the first 1,000 feet.

[12] Veering wind – Wind which changes in a clockwise direction with time at a given location, or which changes direction in a clockwise sense with height.

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 0700 EDT through 1100 EDT at approximately 15-minute intervals, were reviewed and the closest images to the time of the accident are documented here.

Figures 11 and 12 present the GOES-13 visible imagery from 0745 and 0815 EDT at 1X magnification with the accident site and KPWM marked. The visible imagery showed abundant cloud cover moving from southwest to northeast across the accident site and most of the Northeast from eastern Pennsylvania northward. Figures 13 and 14 present the GOES-13 infrared imagery from 0745 and 0815 EDT at 6X magnification. The infrared imagery indicated a large amount of high cloud cover over and around the accident site at the accident time with more enhanced clouds moving over the accident site between 0745 and 0815 EDT (with the high cloud tops showing up as a green and blue color). Based on the brightness temperatures above the accident site and the vertical temperature profile provided by the 0800 EDT KOKX sounding, the approximate cloud-top heights over the accident site were 31,000 feet at 0815 EDT.

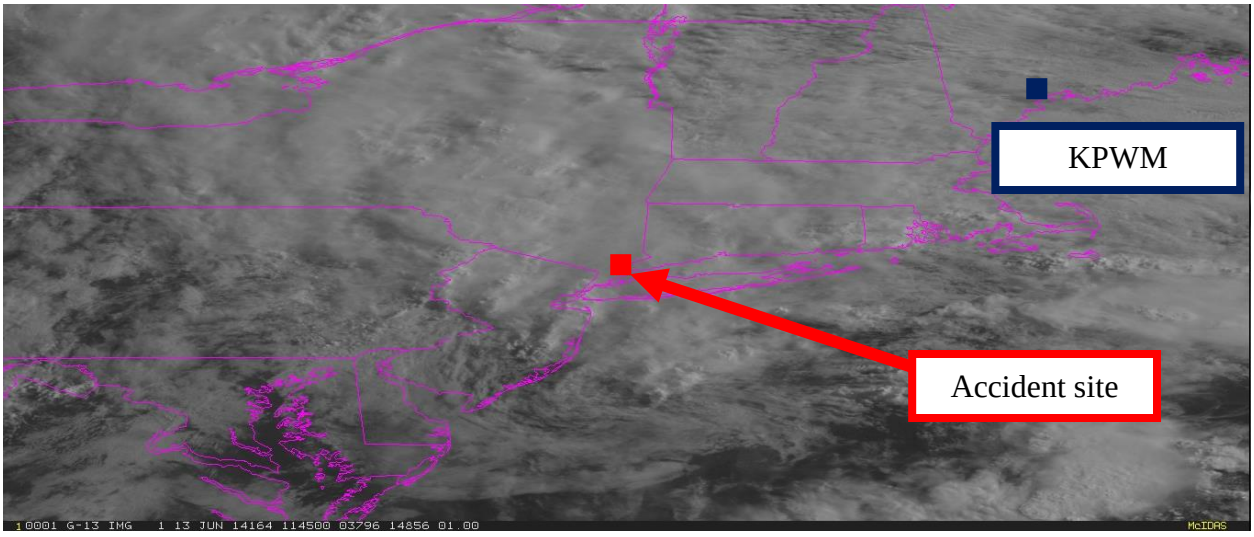


Figure 11 – GOES-13 visible image at 0745 EDT

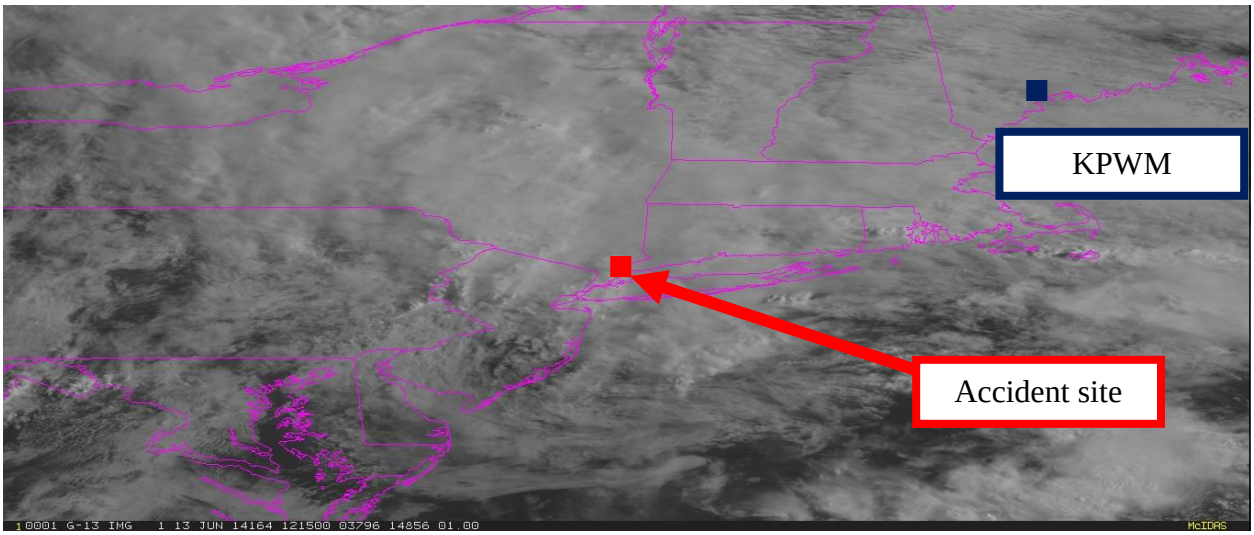


Figure 12 – GOES-13 visible image at 0815 EDT

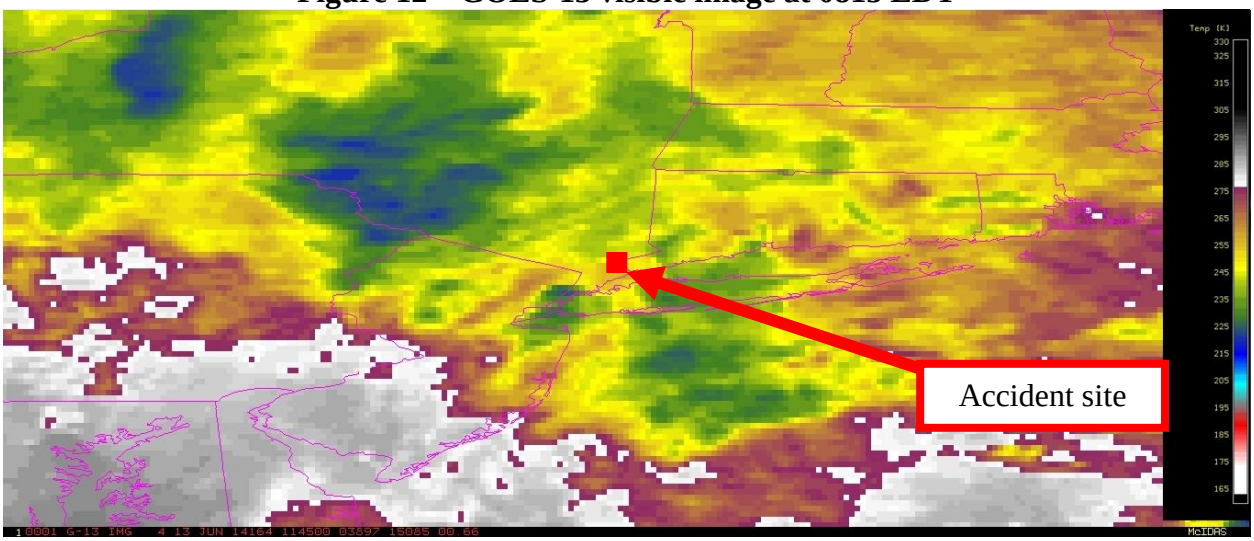


Figure 13 – GOES-13 infrared image at 0745 EDT

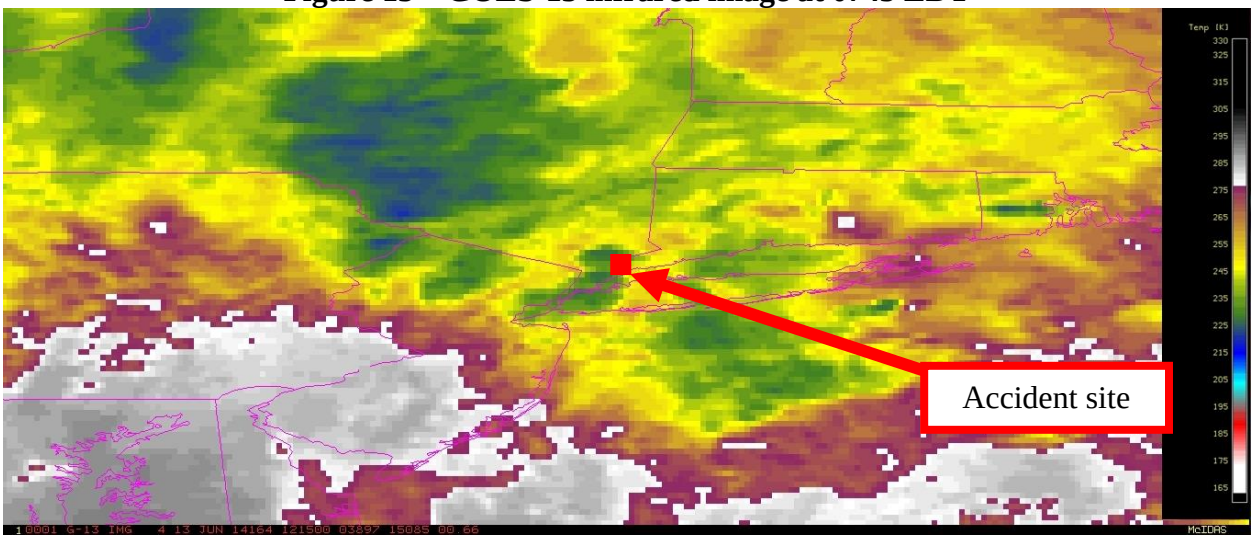


Figure 14 – GOES-13 infrared image at 0815 EDT

6.0 Radar Imagery Information

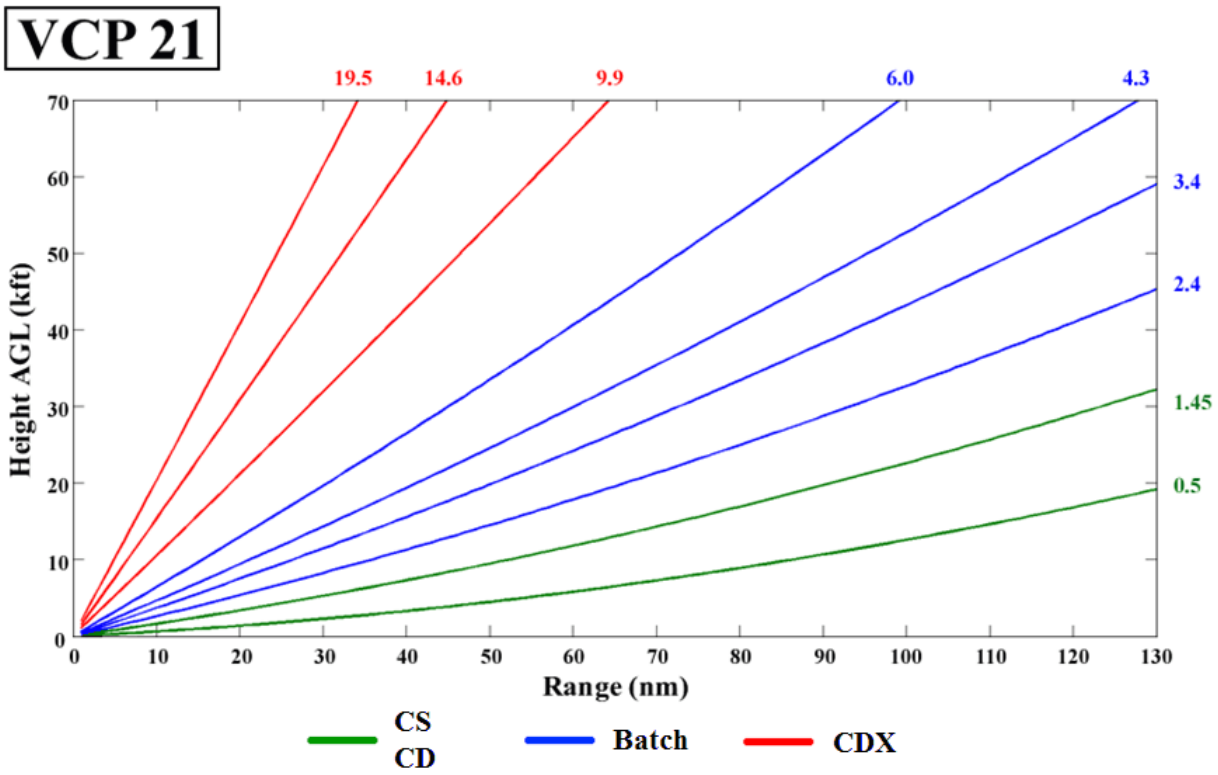
The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D[13]) was KOKX (figure 9). Level II and III archive radar data was obtained from the NCDC utilizing the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software.

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° every six minutes. This particular scanning strategy is documented as volume coverage pattern 21 (VCP-21). Mode B is the clear-air mode, where the radar makes 5 elevation scans during a ten minute period. During the period surrounding the accident, the KOKX WSR-88D radar was operating in the precipitation mode (Mode A, VCP-21). 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.

[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.



VCP-21 Precipitation 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°	3,360 feet	1,390 feet	5,330 feet	3,940 feet

Based on the radar height calculations, the 0.5° elevation scan depicted the conditions between 1,390 feet and 5,330 feet msl over the accident site and this antenna elevation was the closest to accident aircraft's altitude[17] before the aircraft accident.

[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 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 Radar Summary

Figure 15 provides a radar summary image from 0815 EDT with reflectivity values over the northeastern United States, with the accident site located near an area of 30 to 50 dBZ values. These reflectivity values indicate moderate echoes near the accident site around the accident time, however, section 6.5 will show that the intense echoes had not quite made it to the accident site by the accident time.

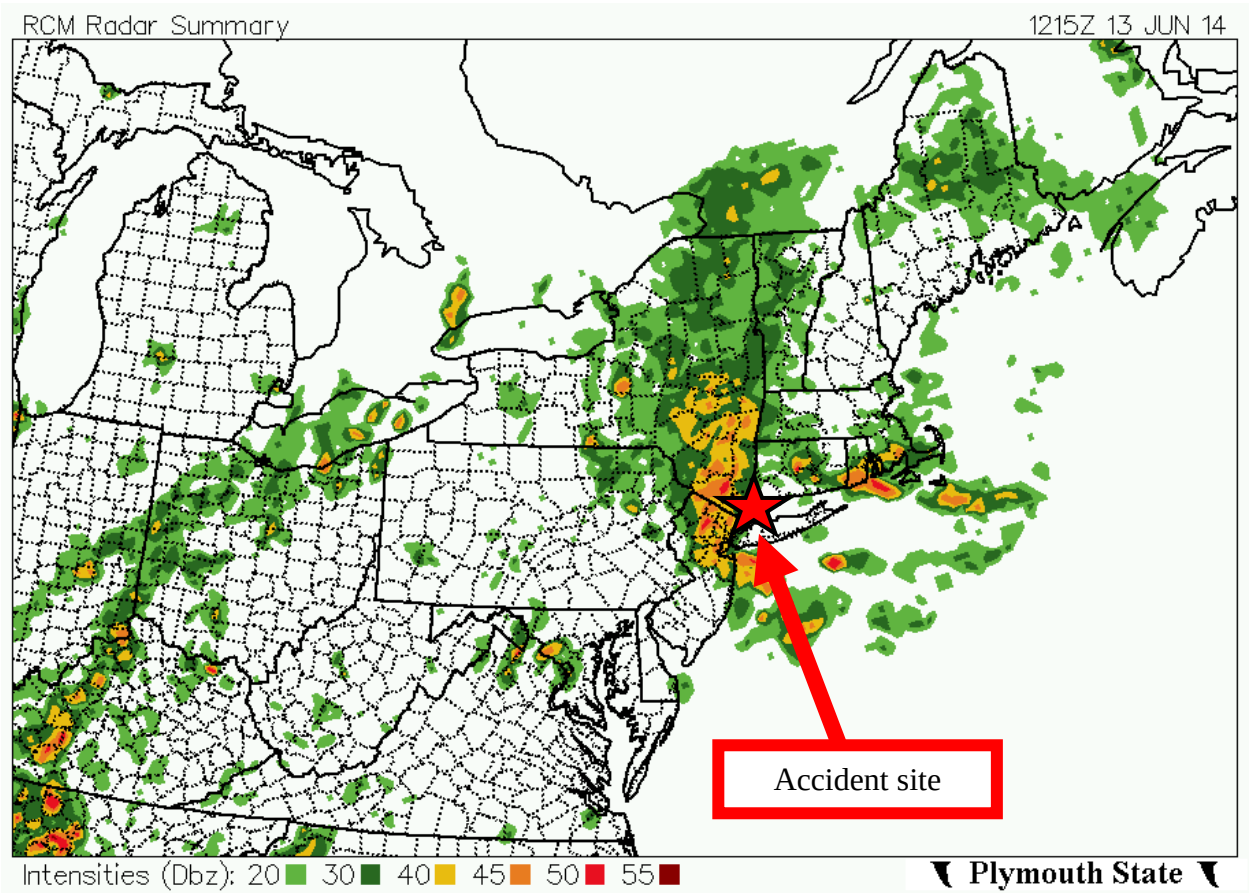


Figure 15 – Radar summary image for 0815 EDT with the accident site

6.5 Base Reflectivity

Figures 16, 17, and 18 present the KOKX WSR-88D base reflectivity image for the 0.5° elevation scans initiated at 0802, 0807, and 0813 EDT with a resolution of 0.5° X 250 m. A line of 20 to 50 dBZ reflectivity values was moving northeastward toward the accident site at the accident time, however at the accident time the line of intense echoes was still located well south of the accident site. Therefore any precipitation close to the ground (below the radar beam) or in the clouds would have been drizzle size or smaller, and there would have not been a lot of those drizzle size, or smaller, rain drops. By 0930 EDT (section 3.0), KHPN reported the rain from the heavier line seen in figures 16 through 18. There were no lightning strikes around the accident site at the accident time.

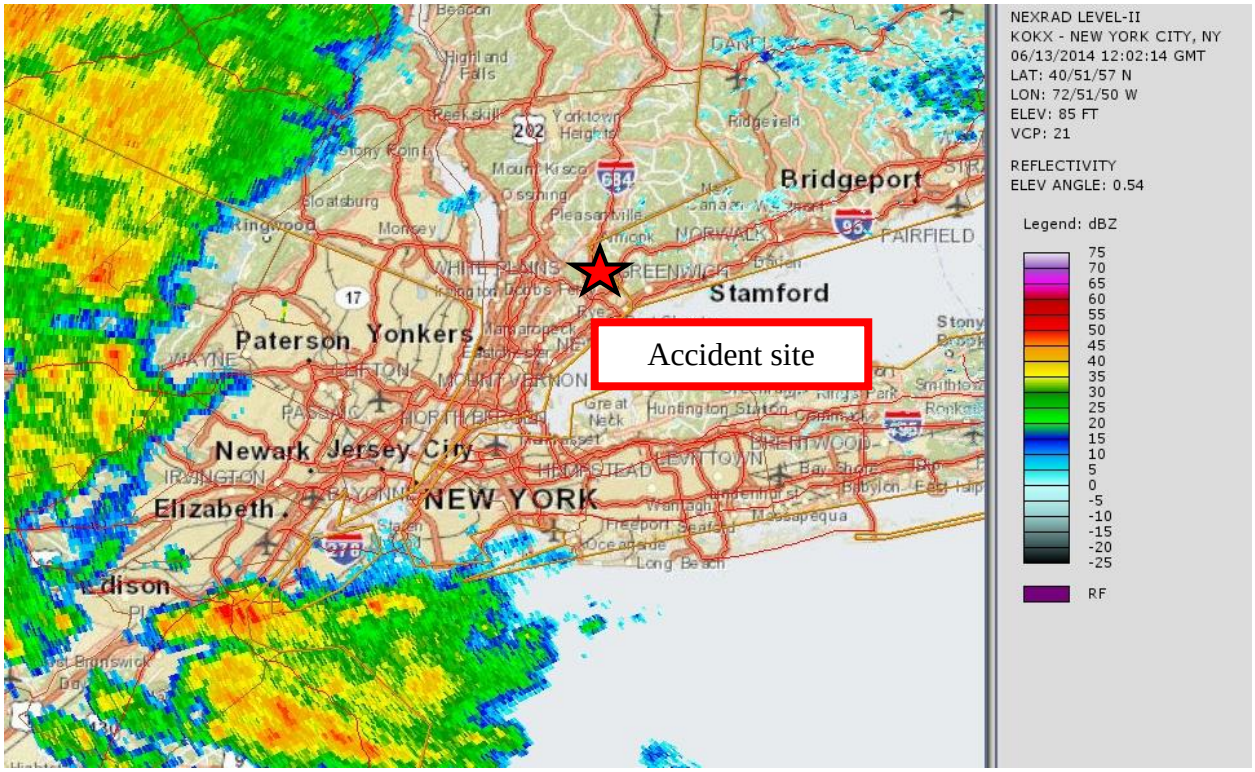


Figure 16 – KOKX WSR-88D reflectivity for the 0.5° elevation scan initiated at 0802 EDT

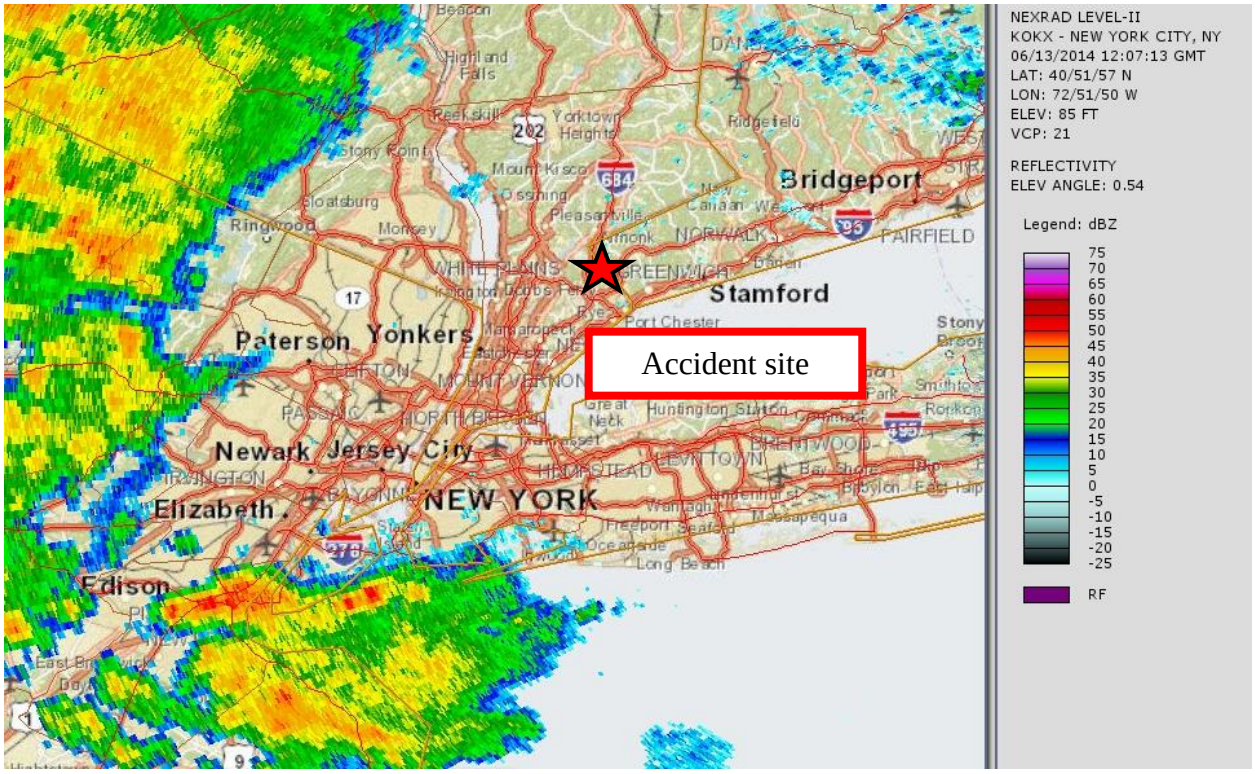


Figure 17 – KOKX WSR-88D reflectivity for the 0.5° elevation scan initiated at 0807 EDT

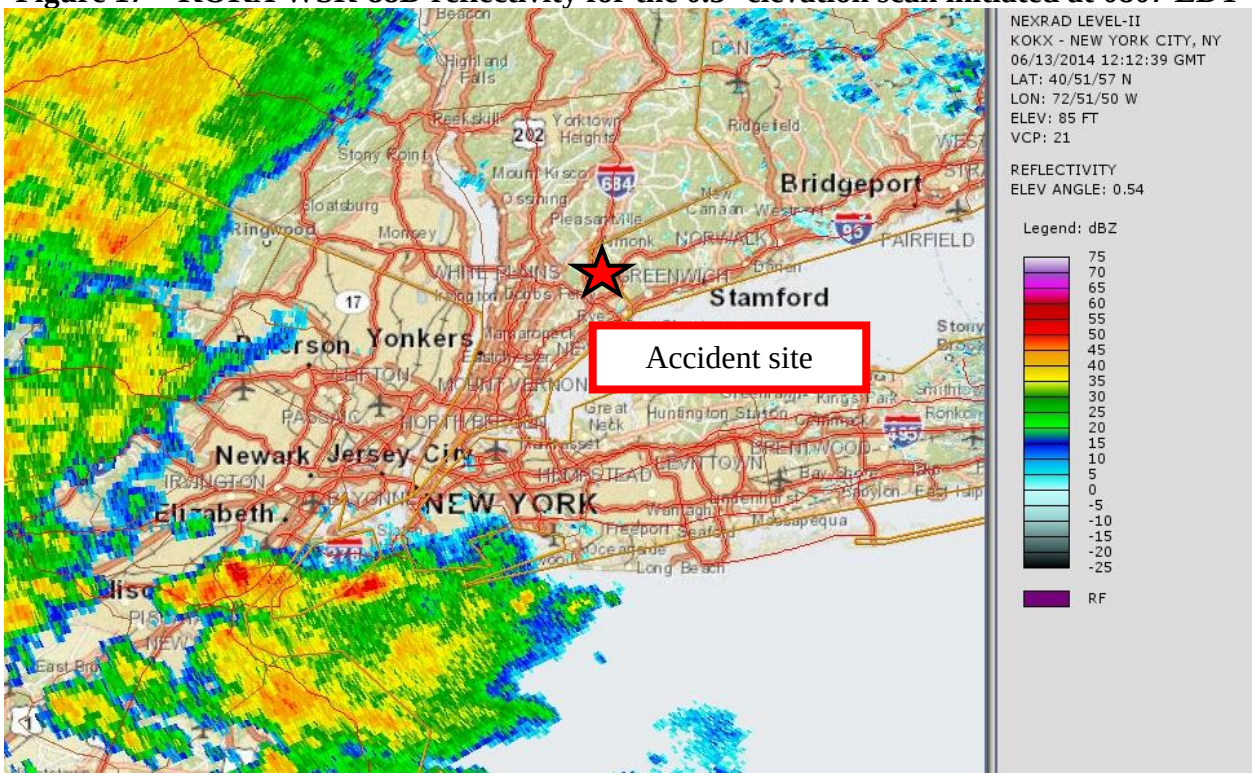


Figure 18 – KOKX WSR-88D reflectivity for the 0.5° elevation scan initiated at 0813 EDT

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 three hours after the accident time:

HVN UA /OV HVN/TM 1058/FL004/TP DH8A/SK OVC003=

JFK UA /OV CRI180010 /TM 1253 /FL090 /TP CRJ9 /SK OVC /WX +RA /TB LGT CHOP=

MGJ UA /OV SWF315010 /TM 1257 /FL040 /TP C421 /WX RA /TB LGT-OCNL MOD=

POU UA /OV POU225002 /TM 1318 /FL008 /TP C421 /SK BKN008=

BDR UA /OV BDR360004 /TM 1434 /FL060 /TP PC12 /RM /WX LGT-MOD RA /WESTBOUND=

HVN UA /OV FAP WRY 2/TM 1442/FL004/TP C56X/SK OVC004-TOP014=

POU UA /OV POU045002 /TM 1452 /FL013 /TP C421 /SK BKN013=

Routine pilot report (UA); Over New Haven, Connecticut; Time – 0658 EDT (1058Z); Altitude – 400 feet; Type aircraft – Bombardier Dash 8; Sky – Overcast 300 feet.

Routine pilot report (UA); 10 miles from Canarsie, New York, on the 180° radial; Time – 0853 EDT (1253Z); Altitude – 9,000 feet; Type aircraft – Canadair Regional Jet CRJ-900; Sky – Overcast; Weather – Heavy rain; Turbulence – Light chop.

Routine pilot report (UA); 10 miles from Newburgh, New York, on the 315° radial; Time – 0857 EDT (1257Z); Altitude – 4,000 feet; Type aircraft – Cessna 421; Weather – Moderate rain; Turbulence – Light with occasional moderate.

Routine pilot report (UA); 2 miles from Poughkeepsie, New York, on the 225° radial; Time – 0918 EDT (1318Z); Altitude – 800 feet; Type aircraft – Cessna 421; Sky – Broken ceiling at 800 feet.

Routine pilot report (UA); 4 miles from Bridgeport, Connecticut, on the 360° radial; Time – 1034 EDT (1434Z); Altitude – 6,000 feet; Type aircraft – Pilatus PC-12; Remarks; Weather – Light to moderate rain; Westbound.

Routine pilot report (UA); Over New Haven, Connecticut; Time – 1042 EDT (1442); Altitude – 400 feet; Type aircraft – Cessna Citation Excel; Sky – Overcast ceiling at 400 feet with tops at 1,400 feet.

Routine pilot report (UA); 2 miles from Poughkeepsie, New York, on the 045° radial; Time – 1052 EDT (1452Z); Altitude – 1,300 feet; Type aircraft – Cessna 421; Sky – Broken ceiling at 1,300 feet.

8.0 SIGMET and CWSU Advisory

No SIGMET was valid for the accident site at the accident time nor would one be expected.

No CWSU Advisory (CWA) or meteorological impact statement (MIS) were valid for the accident site at the accident time.

9.0 AIRMETs

AIRMET Sierra issued at 0730 EDT, and valid at the accident time, forecasted IFR conditions for the accident site with ceilings below 1,000 feet and visibilities below 3 miles with precipitation and mist (figure 19). An AIRMET for mountain obscuration was valid for just west of the accident site and accident route and an AIRMET for moderate icing was valid above 12,000 feet:

WAUS41 KKCI 131130 AAA
WA1S
_BOSS WA 131130 AMD
AIRMET SIERRA UPDT 3 FOR IFR AND MTN OBSCN VALID UNTIL 131500
.
AIRMET IFR...WV VA NC SC GA...UPDT
FROM HNN TO 20S EKN TO 50W CSN TO GSO TO RDU TO 20NW FLO TO
50NNW LGC TO 20WNW GQO TO HMV TO 50WSW BKW TO HNN
CIG BLW 010/VIS BLW 3SM BR. CONDS ENDG 12-15Z.
.
AIRMET IFR...NY NJ PA OH WV MD DC DE VA NC AND CSTL WTRS...UPDT
FROM SYR TO 20SSE HNK TO 30SSE ECG TO 30NNE GSO TO 50W CSN TO
20S EKN TO 20SW ERI TO 20SSE BUF TO SYR
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 15Z ENDG 15-18Z.
.
AIRMET IFR...ME NH VT
FROM 70NW PQI TO 30NNE PQI TO 30NNW ENE TO 40SW YSC TO 40E YSC
TO 70NW PQI
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS ENDG 12-15Z.
.
AIRMET IFR...ME NH VT MA RI CT NY NJ PA MD DE VA AND CSTL
WTRS...UPDT
FROM 40WNW BGR TO 90SSW YSJ TO 200SE ACK TO 190S ACK TO 50S SBY
TO 20SSE HNK TO 30SSE SYR TO 60SW MPV TO 50SSW YSC TO 30NNW ENE
TO 40WNW BGR
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 15Z THRU 21Z.
.
AIRMET MTN OBSCN...ME NH VT MA NY PA WV MD VA
FROM 70NW PQI TO MLT TO CON TO 20NNW SAX TO HAR TO 40S PSK TO
HMV TO HNN TO 20N EWC TO JHW TO SYR TO 30SE YOW TO 30E YSC TO
70NW PQI
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 15Z THRU 21Z.
.
OTLK VALID 1500-2100Z...IFR ME NH VT MA RI CT NY LO NJ PA MD DE
VA AND CSTL WTRS
BOUNDED BY 60ENE YSC-60SW YSJ-200SE ACK-190S ACK-140SE SIE-50SE
SBY-20S SIE-40S ETX-30S HNK-40S SYR-60SSW YOW-30ESE YOW-50WSW
YSC-30ESE YSC-60ENE YSC
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG THRU 21Z.

....
WAUS41 KKCI 130845
WA1Z
_BOSZ WA 130845
AIRMET ZULU UPDT 1 FOR ICE AND FRZLVL VALID UNTIL 131500
.
AIRMET ICE...NH VT MA RI CT NY LO NJ PA DE AND CSTL WTRS
FROM 30N PQI TO 110SE BGR TO 20WNW ENE TO 20E PVD TO 100ESE ACK
TO 110SSE ACK TO 20E SIE TO 20NNW HAR TO 20SSE SLT TO 60NNW SYR
TO 30SE YOW TO 30ESE YSC TO 70ENE YQB TO 30N PQI
MOD ICE BTN 120 AND FL240. CONDS CONTG BYD 15Z THRU 21Z.
.
OTLK VALID 1500-2100Z...ICE ME NH VT MA RI CT NY AND CSTL WTRS
BOUNDED BY 30N PQI-60WSW YSJ-200SE ACK-40SSE HTO-40ESE HNK-20NNW
HNK-50ENE SYR-MSS-30ESE YSC-70WNW PQI-30N PQI
MOD ICE BTN 120 AND FL240. CONDS CONTG THRU 21Z.
.
FRZLVL...RANGING FROM 105-140 ACRS AREA
  120 ALG 50S HNN-30SE AIR-80NE YYZ
  120 ALG 70NW PQI-30NW PQI-20S HUL-60SW YSJ
....
WAUS41 KKCI 130845
WA1T
_BOST WA 130845
AIRMET TANGO UPDT 1 FOR TURB VALID UNTIL 131500
.
NO SGFNT TURB EXP OUTSIDE OF CNVTV ACT.
....

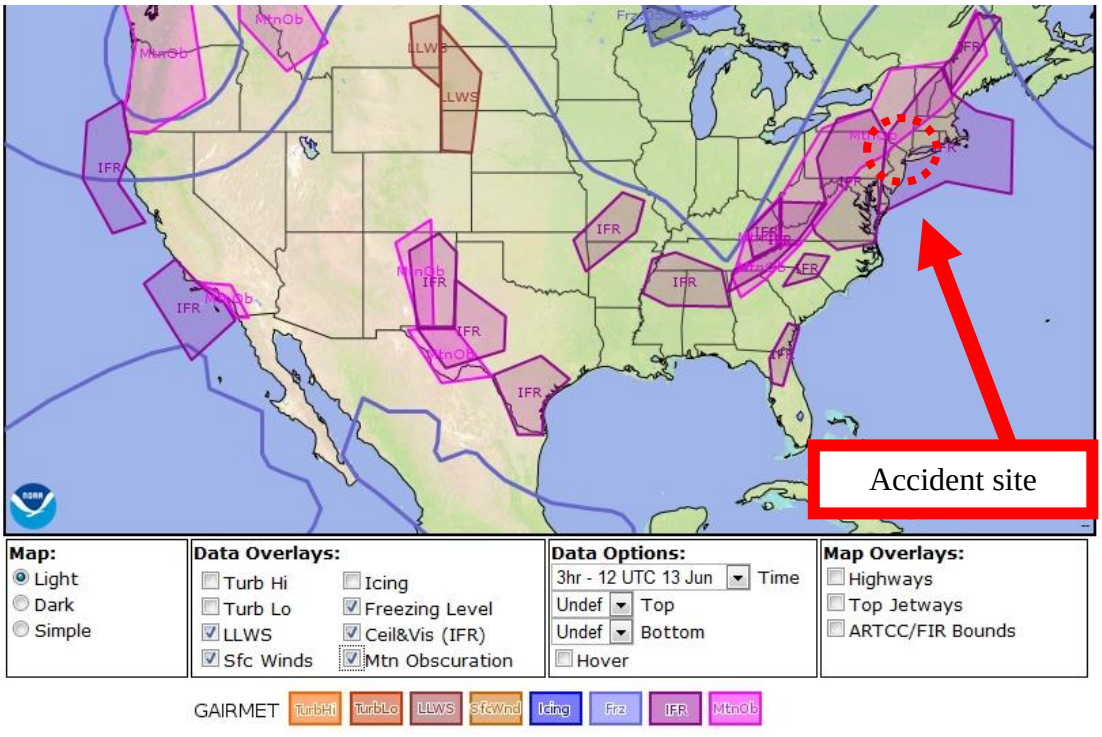


Figure 19 – Image of IFR and mountain obscuration AIRMETs valid at the accident time

10.0 Area Forecast

The Area Forecast issued at 0445 EDT, valid at the accident time, forecasted an overcast ceiling at 1,000 feet msl with tops to FL250[20]. The visibility was forecast to be 3 miles with mist and till 1300 scattered light rain showers were forecast:

FAUS41 KKCI 130845
FA1W
_BOSC FA 130845
SYNOPSIS AND VFR CLDS/WX
SYNOPSIS VALID UNTIL 140300
CLDS/WX VALID UNTIL 132100...OTLK VALID 132100-140300
ME NH VT MA RI CT NY LO NJ PA OH LE WV MD DC DE VA AND CSTL WTRS
.
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...09Z CDFNT CNTRL LE-SW OH-LOW PRES NR MEM. TROF NCNTRL
PA-LOW PRES NERN MD-SCNTRL VA-NERN GA. WRMFNT ERN LO-NERN PA-NRN
NJ-NJ CSTL WTRS. 03Z CDFNT NCNTRL NY-NW VA-NRN GA-LOW PRES NERN
AL. TROF SRN DE-SE VA-ERN SC. WRMFNT NERN NY-WRN MA-BOS-MA CSTL
WTRS.
.
ME NH VT
NERN ME...OVC015-025 TOP FL250. TIL 11Z VIS 3-5SM -RA. 16Z BKN025
OVC050 TOP FL200. OTLK...MVFR CIG RA.
SE ME...BKN070 TOP FL200. OCNL -RA. BECMG 1113 BKN015-025 OVC090
TOP FL220. 19Z OCNL -RA. OTLK...MVFR CIG RA 02Z IFR CIG RA BR.
NW ME/NRN NH/VT...BKN025-030 OVC080 TOP FL250. OCNL -RA. 12Z
OVC025-035. VIS 5SM BR. SCT -SHRA. OTLK...MVFR CIG SHRA BR.
SW ME/SRN NH...BKN025 BKN120 TOP FL250. 11Z OVC010-015. VIS 3-5SM
BR. OCNL -RA. 17Z VIS 3SM RA BR. OTLK...IFR CIG RA BR.
.
MA RI CT
NERN MA...OVC015-025 TOP 060. 12Z OVC010. VIS 3-5SM BR. SCT
-SHRA. 18Z OVC010. VIS 3-5SM BR. OTLK...IFR CIG BR.
RMNDR...OVC010-015 TOP FL250. VIS 3-5SM BR. TIL 18Z SCT -SHRA.
OTLK...IFR CIG BR.
.
NY LO NJ
WRN NY
NRN...BKN080 OVC110 TOP FL250. SCT -SHRA. 12Z OVC045. 18Z BKN060.
WDLY SCT -SHRA. OTLK...VFR.
SRN...OVC025-030 TOP FL250. VIS 3-5SM BR. OCNL -RA. 15Z BKN060.
SCT -SHRA. 20Z BKN060 TOP 120. OTLK...VFR.
NCNTRL-NERN NY/LO...BKN045 OVC080 TOP FL250. SCT -SHRA. 11Z
OVC025. VIS 3-5SM IN SCT -SHRA. OTLK...VFR SHRA.
SCNTRL NY...OVC025-030 TOP FL250. VIS 3-5SM BR. OCNL -RA. 15Z
BKN045. VIS 5SM IN SCT -SHRA. 20Z BKN060 TOP 150. OTLK...VFR.

[20] Flight Level – A Flight Level (FL) is a standard nominal altitude of an aircraft, in hundreds of feet. This altitude is calculated from the International standard pressure datum of 1013.25 hPa (29.92 inHg), the average 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.

SE NY-LONG ISLAND/NJ...OVC010 TOP FL250. VIS 3SM BR. TIL 17Z SCT -SHRA. OTLK...IFR CIG BR 00Z VFR SHRA.

.
PA
NW...OVC025 TOP 150. VIS 3-5SM BR. 15Z BKN045. WDLY SCT -SHRA/-TSRA. CB TOP FL350. OTLK...MVFR CIG TIL 23Z SHRA TSRA.
SW...BKN070 TOP 150. OCNL VIS 3-5SM BR. 14Z OVC035 TOP FL250. SCT -SHRA/-TSRA. CB TOP FL400. OTLK...VFR 01Z MVFR CIG.
CNTRL...OVC035-040 TOP FL250. VIS 3-5SM BR. SCT -SHRA/ISOL EMBD -TSRA. CB TOP FL320. 16Z OVC050. SCT -SHRA/-TSRA. CB TOP FL380. OTLK...MVFR CIG SHRA TSRA 00Z VFR.
NERN...OVC015-025 TOP FL250. VIS 3-5SM BR. OCNL -RA. 15Z BKN030. VIS 5SM BR. SCT -SHRA. OTLK...MVFR SHRA BR 22Z VFR.
SE...OVC010 TOP FL250. VIS 3SM BR. SCT -SHRA. 16Z BKN025. OTLK...VFR TSRA.
.
OH LE
WRN OH/WRN LE...BKN045 OVC120 TOP FL200. ISOL -SHRA/-TSRA. CB TOP FL330. 12Z BKN060 TOP 150. 15Z SCT060. WND NW G25KT. OTLK...VFR TIL 00Z WND.
NERN OH/ERN LE...SCT070. 10Z SCT035 BKN060 TOP FL200. WDLY SCT -SHRA/ISOL -TSRA. CB TOP FL350. 15Z BKN060. OTLK...VFR.
SE OH...BKN050 OVC090 TOP 120. 12Z BKN050 TOP FL220. WDLY SCT -SHRA/ISOL -TSRA. CB TOP FL350. 20Z BKN050 TOP 150. OTLK...VFR.
.
WV MD DC DE VA
WRN WV...BKN020 OVC060 TOP 100. VIS 3-5SM BR. 13Z BKN050 LYRD FL250. WDLY SCT -SHRA/-TSRA. CB TOP FL350. 20Z BKN050 TOP 150. OTLK...VFR.
ERN WV/MD PNHDL/WRN VA...BKN030-040 OVC070 TOP FL180. OCNL VIS 3-5SM BR. WDLY SCT -SHRA/ISOL EMBD -TSRA. CB TOP FL300. 15Z BKN070 TOP 150. WDLY SCT -TSRA. CB TOP FL400. OTLK...VFR TIL 23Z TSRA.
NERN MD/DC/DE/NERN VA...BKN010-020 OVC050 LYRD FL250. OCNL VIS 3-5SM BR. TIL 11Z WDLY SCT -SHRA. 13Z BKN025. 18Z BKN050. WDLY SCT -SHRA/ISOL -TSRA. CB TOP FL380. OTLK...VFR TIL 23Z SHRA TSRA.
SE VA...OVC010 TOP 035. VIS 3-5SM BR. 14Z SCT035. 19Z BKN050 LYRD FL200. ISOL -SHRA/-TSRA. CB TOP FL450. OTLK...VFR SHRA TSRA.
.
CSTL WTRS
N OF BOS...BKN020 OVC070 TOP FL250. ISOL -SHRA. BECMG 1821 OVC010-020. VIS 3SM BR. SCT -SHRA. OTLK...IFR CIG SHRA BR.
BOS-SBY...OVC010 TOP FL250. VIS 3-5SM BR. SCT -SHRA. OTLK...IFR CIG SHRA BR.
S OF SBY...SCT010 BKN050 TOP FL200. ISOL -SHRA/-TSRA. CB TOP FL400. OTLK...VFR SHRA TSRA.
....

11.0 Terminal Aerodrome Forecast

KHPN was the closest site with a NWS TAF. The TAF valid at the time of the accident was issued at 0728 EDT and was valid for a 24-hour period beginning at 0800 EDT. The TAF forecast for KHPN was as follows:

TAF KHPN 131128Z 1312/1412 **11005KT 1/4SM -DZ FG VV002**
TEMPO 1312/1315 1SM SHRA OVC002
FM131600 14005KT 1SM BRBKN004
FM131800 16005KT 6SM BR SCT006 OVC010
FM132100 17006KT P6SM SHRA SCT015 BKN025
FM132300 18005KT 4SM BR VCSH SCT008 BKN015
FM140600 23007KT P6SM VCSH SCT015 SCT035 BKN050
AMD NOT=

The forecast expected wind from 110° at 5 knots, a quarter mile visibility, light drizzle, fog, and vertical visible 200 feet agl. Temporary conditions between 0800 to 1100 EDT expected 1 mile visibility, moderate rain showers, and an overcast ceiling at 200 feet agl.

KPWM also had a NWS TAF. The TAF valid at the time of the accident was issued at 0720 EDT and was valid for a 24-hour period beginning at 0800 EDT. The TAF forecast for KPWM was as follows:

TAF KPWM 131120Z 1312/**1412 09009KT 6SM -RA BR OVC030**
FM131400 10009KT 5SM -RA BR OVC012
FM131800 09009KT 1SM +RA BR OVC003
FM140000 09007KT 1 1/2SM -RA BR OVC003=

The forecast expected wind from 090° at 9 knots, visibility of 6 miles, light rain and mist, and an overcast ceiling at 3,000 feet agl around the time of the accident.

The previous TAF forecast for KPWM was issued at 0131 EDT and valid for a 24-hour period beginning at 0200 EDT:

TAF KPWM 130531Z 1306/1406 09006KT P6SM -RA OVC025
FM131000 09009KT 6SM -RA BR OVC007
FM131400 10009KT 3SM -RA BR OVC007
FM131800 09009KT 1SM +RA BR OVC003
FM140000 09007KT 1 1/2SM -RA BR OVC003=

The forecast expected wind from 090° at 9 knots, visibility of 6 miles, light rain and mist, and an overcast ceiling at 700 feet agl around the time of the accident.

12.0 National Weather Service Area Forecast Discussion

The National Weather Service Office in New York, New York, issued the following Area Forecast Discussion at 0759 EDT which discussed low IFR conditions at most of the TAF airports around the New York City area including the closest airport to the accident site. The IFR were expected to improve later on in the day once the warm front moved north of the area:

FXUS61 KOKX 131159
AFDOKX
AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE NEW YORK NY
759 AM EDT FRI JUN 13 2014
.SYNOPSIS...
WARM FRONT LIFTS NORTH THROUGH THE REGION TODAY...FOLLOWED BY

A COLD FRONT PASSING THROUGH TONIGHT. HIGH PRESSURE WILL THEN BUILD INTO THE AREA THROUGH SUNDAY...AND SLIDE OFF THE MID-ATLANTIC COAST SUNDAY NIGHT. A SERIES OF WEAK COLD FRONTS WILL IMPACT THE AREA NEXT WEEK.
&&
.NEAR TERM /UNTIL 6 PM THIS EVENING/...
UPDATED FOR DENSE FOG ACROSS LI AS HIGHER DEW POINT AIR TRAVERSES THE COOLER NEAR SHORE WATERS. THIS MAY NEED TO BE EXPANDED TO CT.
A WARM FRONT GRADUALLY LIFTS NORTH THROUGH THE FORECAST AREA TODAY. ISENTROPIC LIFT AND MID LEVEL SHORTWAVE ENERGY AHEAD FOR THE FRONT WILL PROVIDE LIFT FOR SHOWERS. ANOTHER SHORTWAVE IN THE 700-800MB LAYER IS PROGGED TO SHIFT IN FROM THE SOUTH THIS AFTN WITH A CHANCE OF MORE SHOWERS. MODELS ARE FAVORING EASTERN PARTS THE CWA WITH ITS PASSAGE. EVEN WESTERN AREAS STAND A DECENT CHANCE OF SHOWERS...IF NOT DIRECTLY ASSOCIATED WITH THE SHORTWAVE...THEN WITH HIGHER CAPE AND A PRE-FRONTAL SURFACE TROUGH. THUNDERSTORMS WILL BE POSSIBLE AT ANY GIVEN TIME...BUT ARE MORE LIKELY TO OCCUR DURING THE AFTERNOON WITH GREATER INSTABILITY.
RAINFALL...EVEN OUTSIDE OF THUNDERSTORMS...COULD BE HEAVY AT TIMES WITH PWAT VALUES APPROACHING 2 INCHES. AND WITH A RELATIVELY SLOW STORM MOTION...THERE ARE FLOODING CONCERNS...BUT NOT ENOUGH CONFIDENCE TO GO WITH A FLASH FLOOD WATCH FOR ANY PARTICULAR AREA. PLEASE REFER TO THE HYDROLOGY SECTION BELOW FOR MORE DETAILS.
MUGGY CONDITIONS WILL CONTINUE WITH DEWPOINTS IN THE 60S. A MAV/NAM MOS BLEND LOOKED GOOD FOR TEMPERATURES.
THERE IS A MODERATE RISK OF RIP CURRENTS ALONG OCEAN BEACHES TODAY.
&&
.SHORT TERM /6 PM THIS EVENING THROUGH 6 PM SATURDAY/...
A COLD FRONT MOVES THROUGH TONIGHT WITH SHOWERS LIKELY AND A CHANCE OF THUNDERSTORMS. SHEAR AND LIFT BOTH INCREASE...WITH 500-1000 J/KG SURFACE-BASED CAPE STILL AVAILABLE...SO SOME STORMS COULD BE STRONG WITH HEAVY RAINFALL. SEVERE STORMS ARE NOT IMPOSSIBLE...BUT WITH RELATIVELY LIGHT AND UNIDIRECTIONAL WINDS ALOFT PLUS HIGH WET-BULB ZERO/FREEZING LEVEL HEIGHTS...DAMAGING WIND AND LARGE HAIL THREATS LOOK TO BE MINIMAL. THE COLD FRONT WILL BE EXITING EASTERN LONG ISLAND NEAR DAYBREAK...WITH SHOWERS COMING TO AN END.
ANY LINGERING SHOWERS OVER EASTERN LI AND SE CT END EARLY IN THE MORNING SATURDAY. GENERALLY PARTLY CLOUDY/MOSTLY SUNNY CONDITIONS FOR MUCH OF THE DAY. THE FLOW ALOFT WILL BE CYCLONIC WITH A SHORTWAVE PASSING THROUGH DURING THE AFTERNOON. MOISTURE LOOKS TO BE TOO LIMITED FOR A THREAT OF SHOWERS...SO WILL KEEP WITH A DRY FORECAST. WENT A COUPLE OF DEGREES ABOVE A MAV/NAM MOS BLEND FOR HIGHS.
&&
.LONG TERM /SATURDAY NIGHT THROUGH THURSDAY/...
BOTH THE 00Z GFS AND ECWMF ARE IN VERY GOOD AGREEMENT WITH THE UPPER AIR PATTERN THROUGH MUCH OF NEXT WEEK...WITH SMALL DIFFERENCES AT THE SFC...IN PARTICULAR WITH THE TIMING AND LOCATION OF A SERIES OF FRONTAL SYSTEMS. AT THE ONSET...STRONG RIDGING EAST OF THE MS RIVER GRADUALLY TRANSLATES EAST. SHORT WAVE ENERGY EMERGING FROM THE NORTHERN PLAINS WILL INTERACT WITH AN UPPER LOW OVER EASTERN CANADA TO SUPPRESS THE RIDGE SOUTH. THIS WILL ALLOW FOR A COUPLE OF WEAK COLD FRONTS TO APPROACH THE AREA...THE FIRST MON NIGHT INTO TUE...AND THE SECOND...WED NIGHT INTO THU. PRIOR RUNS DID NOT PROVIDE ENOUGH OF A SOUTHWARD PUSH WITH THE AREA REMAINING IN THE

WARM SECTOR FOR THE PERIOD. WHILE THERE IS AGREEMENT WITH THE ECWMF AND GFS FOR TH THE SECOND FRONT TO DROP SOUTH OF THE AREA...THERE IS STILL DISAGREEMENT WITH THE FIRST...DUE TO A MORE WESTERLY FLOW ALOFT. IN BOTH CASES...THIS FRONT WASHES OUT...WITH NOT MUCH CHANGE IN AIRMASS. PREFERENCE AT THIS TIME WILL BE TO MAINTAIN CONTINUITY WITH THE PREVIOUS FORECAST UNTIL THERE IS MORE RUN TO RUN CONTINUITY AMONGST THE GLOBAL MODELS.
THIS WILL MEAN A WARM...INCREASINGLY MUGGY PERIOD AS WE PROGRESS THROUGH THE WEEK. DAYTIME HIGHS WILL GENERALLY BE IN THE 80S...WITH LOWS IN THE 60S. HOWEVER...SUN INTO MON WILL FEATURE DRIER...COOLER CONDITIONS BY SEVERAL DEGREES AS HIGH PRESSURE BUILDS ACROSS THE AREA SUN AND THEN OFFSHORE SUN NIGHT. SCT CONVECTION WILL BE POSSIBLE WITH EACH OF THE FRONTAL SYSTEMS...WITH THE POTENTIAL FOR MORE ORGANIZATION WITH SECOND DUE STRONGER WIND SHEAR.
&&
.AVIATION /12Z FRIDAY THROUGH TUESDAY/...
A WARM FRONT OVER THE MID-ATLANTIC APPROACHES THE REGION THIS MORNING...THEN A COLD FRONT APPROACHES THIS EVENING AND CROSSES THE REGION OVERNIGHT.
EXPECT CIGS TO GENERALLY REMAIN LIFR/VLIFR THROUGH 15Z. SOME SHOWER ACTIVITY MOVING THROUGH THE REGION MAY BRIEFLY IMPROVE CONDITIONS FOR A SHORT PERIOD.
EXPECT SLOW IMPROVEMENT AFTER 15Z WITH DAYTIME HEATING...BUT MORESO IN WAKE OF WARM FRONT THIS AFTERNOON...ESPECIALLY ACROSS THE NYC/NJ/LONG ISLAND TERMINALS.
ADDITIONAL SHOWERS WITH SCATTERED TSTMS ARE EXPECTED ACROSS WESTERN TERMINALS AFTER 21Z AHEAD OF SLOW MOVING COLD FRONTAL PASSAGE...TRANSLATING THROUGH EASTERN TERMINALS THROUGH TONIGHT.
CONDITIONS ARE FORECAST TO FALL BACK TO IFR OR LESS AFTER 00Z...AND REMAIN DOWN UNTIL THE PASSAGE OF THE COLD FRONT. FOR NOW...EXPECTING THE FRONT TO MOVE THROUGH BETWEEN 05Z-07Z FOR THE NYC TERMINALS. EARLIER TO THE WEST...AND LATER TO THE EAST.
WINDS WILL ALSO VEER TOWARDS THE WEST-NORTHWEST LATE.
...NY METRO ENHANCED AVIATION WEATHER SUPPORT...
DETAILED INFORMATION...INCLUDING HOURLY TAF WIND COMPONENT FCSTS CAN BE FOUND AT: HTTP://WWW.ERH.NOAA.GOV/ZNY/N90 (LOWER CASE)
KJFK FCSTER COMMENTS: AMENDMENTS LIKELY TODAY FOR CHANGING FLIGHT CATEGORIES AS A WARM FRONT MOVES ACROSS THE AREA. THE TIMING OF FOG IMPROVEMENT COULD BE OFF BY +/- 1 HOUR. THE WARM FRONT IS FORECAST TO LIFT NORTH OF THE TERMINAL AROUND 20Z. CHANCE OF THUNDER AFTER 20Z TODAY.
KLGA FCSTER COMMENTS: AMENDMENTS LIKELY TODAY FOR CHANGING FLIGHT CATEGORIES AS A WARM FRONT MOVES ACROSS THE AREA. THE TIMING OF FOG IMPROVEMENT COULD BE OFF BY +/- 1 HOUR. THE WARM FRONT IS FORECAST TO LIFT NORTH OF THE TERMINAL AROUND 21Z.
KEWR FCSTER COMMENTS: AMENDMENTS LIKELY TODAY FOR CHANGING FLIGHT CATEGORIES AS A WARM FRONT MOVES ACROSS THE AREA. THE TIMING OF FOG IMPROVEMENT COULD BE OFF BY +/- 1 HOUR. THE WARM FRONT IS FORECAST TO LIFT NORTH OF THE TERMINAL AROUND 20Z.
THE AFTERNOON KEWR HAZE POTENTIAL FORECAST IS YELLOW...WHICH IMPLIES SLANT RANGE VISIBILITY 4-6SM OR GREATER OUTSIDE OF CLOUD.
KTEB FCSTER COMMENTS: AMENDMENTS LIKELY TODAY FOR CHANGING FLIGHT CATEGORIES AS A WARM FRONT MOVES ACROSS THE AREA. THE TIMING OF FOG IMPROVEMENT COULD BE OFF BY +/- 1 HOUR. THE WARM FRONT IS FORECAST TO LIFT NORTH OF THE TERMINAL AROUND 21Z.
KHPN FCSTER COMMENTS: AMENDMENTS LIKELY TODAY FOR CHANGING FLIGHT

CATEGORIES AS A WARM FRONT MOVES ACROSS THE AREA. THE WARM FRONT IS FORECAST TO LIFT NORTH OF THE TERMINAL AROUND 22Z.
KISP FCSTER COMMENTS: AMENDMENTS LIKELY TODAY FOR CHANGING FLIGHT CATEGORIES AS A WARM FRONT MOVES ACROSS THE AREA. THE TIMING OF FOG IMPROVEMENT COULD BE OFF BY +/- 1 HOUR. THE WARM FRONT IS FORECAST TO LIFT NORTH OF THE TERMINAL AROUND 20Z.
.OUTLOOK FOR 12Z SATURDAY THROUGH TUESDAY...
.SAT MORNING...IMPROVING TO VFR.
.SAT AFTERNOON-MON...VFR.
.TUE...SCT AFTN TSTMS.
&&
.MARINE...
UPDATED TO AID A DENSE FOG ADVISORY TO ALL MARINE ZONES.
NO CHANGES TO THE SCA..EXPECTING 4-7FT OCEAN SEAS EAST OF FIRE ISLAND INLET TODAY THROUGH TONIGHT. SCA COULD NEED TO BE EXTENDED INTO THE WATERS FARTHER WEST AT SOME POINT. THEY COULD ALSO EVENTUALLY NEED TO BE EXTENDED IN TIME TO COVER PART OF SATURDAY MORNING. FOG ALSO A CONCERN FOR THE FIRST HALF OF THIS MORNING AS A WARM FRONT APPROACHES AND BEGINS TO MOVE THROUGH. MIGHT HAVE TO EVENTUALLY ISSUE A DENSE FOG ADVISORY...BUT FOR NOW WILL GO WITH A MARINE WEATHER STATEMENT FOR NEW YORK HARBOR AND ADJACENT AREAS OF THE OCEAN WATERS AND SOME OF THE LONG ISLAND SOUTH SHORE BAYS. OTHERWISE...SUSTAINED WINDS AT 15 KT OR LESS THROUGH SATURDAY ACROSS ALL WATERS.
SUB-SCA CONDITIONS FORECAST SUN-TUE AS HIGH PRESSURE PASSES TO THE EAST SUN NIGHT WITH A GRADUALLY STRENGTHENING SLY FLOW EARLY NEXT WEEK.
&&
.HYDROLOGY...
ADDITIONAL RAINFALL THROUGH TONIGHT WILL AVERAGE FROM 3/4 INCH TO 1 INCH. LOCALLY HEAVY RAIN COULD PRODUCE 1 TO 2 INCHES. MINOR URBAN/POOR DRAINAGE/SMALL STREAM FLOODING REMAIN THE MAIN THREATS. DRY WEATHER IS THEN FORECAST THROUGH MONDAY.
&&
.TIDES/COASTAL FLOODING...
HIGH ASTRONOMICAL TIDES PEAK FRI INTO SAT. BETWEEN HALF A FOOT AND 1.5 FT IS NEEDED FOR WATERS TO REACH MINOR FLOOD LEVELS. WITH THE SE/S FLOW...SURGE VALUES BETWEEN A HALF A FOOT AND A FOOT ARE LIKELY...WHICH MAY RESULT IN ISOLATED AREAS TOUCHING MINOR FLOOD LEVELS DURING FRIDAY EVENING AND EVEN SAT EVENING HIGH TIDES.
&&
.OKX WATCHES/WARNINGS/ADVISORIES...
CT...NONE.
NY...DENSE FOG ADVISORY UNTIL 11 AM EDT THIS MORNING FOR NYZ078>081-177-179.
NJ...NONE.
MARINE...DENSE FOG ADVISORY UNTIL 2 PM EDT THIS AFTERNOON FOR ANZ330-335-338-340-345-350-353-355.
SMALL CRAFT ADVISORY UNTIL 6 AM EDT SATURDAY FOR ANZ350-353.
&&
$$

13.0 Pilot Weather Briefing

There is no record of the accident pilot receiving or looking at weather information before the flight. The accident pilot did not get a weather briefing from an official source.

14.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for the accident site on June 13, 2014, indicated the following:

SUN	
Begin civil twilight	0448 EDT
Sunrise	0522 EDT
Sun transit	1255 EDT
Sunset	2028 EDT
End civil twilight	2102 EDT

F. LIST OF ATTACHMENTS

None.

Paul Suffern
NTSB, AS-30