NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

August 19, 2019

Weather Study

METEOROLOGY

ERA19FA191

Table Of Contents

A. ACCIDENT

Location: New York, New York
Date: June 10, 2019
Time: 1340 eastern daylight time
1740 Coordinated Universal Time (UTC)
Aircraft: Agusta A109E, Registration: N200BK

B. METEOROLOGIST

Paul Suffern
Senior Meteorologist
Operational Factors Division (AS-30)
National Transportation Safety Board

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) Meteorologist did not travel for this investigation and gathered the weather data for this investigation from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the National Centers for Environmental Information (NCEI). All times are eastern daylight time (EDT) on June 10, 2019, 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 miles. NWS airport and station identifiers use the standard International Civil Aviation Organization 4-letter station identifiers versus the International Air Transport Association 3-letter identifiers, which deletes the initial country code designator "K" for U.S. airports.

The accident site was located at latitude 40.7617° N, longitude 73.9819° W at an approximate elevation of 765 feet (ft).

D. FACTUAL INFORMATION

1.0 Synoptic Situation

The synoptic or large-scale migratory weather systems influencing the area were documented using standard NWS charts issued by the National Center for Environmental Prediction and the Weather Prediction Center, located in College Park, Maryland. These are the base products used in describing synoptic weather features and in the creation of forecasts and warnings for the NWS. Reference to these charts can be found in the joint NWS and Federal Aviation Administration (FAA) Advisory Circular "Aviation Weather Services", AC 00-45H.[1]

[1]

1.1 Surface Analysis Chart

The Mid-Atlantic United States section of the NWS Surface Analysis Chart for 1400 EDT is provided as figure 1 with the location of the accident site marked by the red circle. The chart indicated a low pressure system over central Maryland with a minimum pressure of 1013-hectopascals (hPa) and another low pressure system over Ohio with a minimum pressure of 1010-hPa. A warm front stretched from central Maryland in New Jersey then southeastward into the western Atlantic Ocean south of the accident site. The accident site was located north of the warm front on the cool side of the frontal boundary.

The station models around the accident site depicted air temperatures in the mid 60's to low 70's degrees Fahrenheit (°F), dew point temperatures in the mid 60's °F with a temperature-dew point spread of 6° or less, an east to southeast wind between 5 and 10 knots, overcast cloud cover, light rain, and mist.

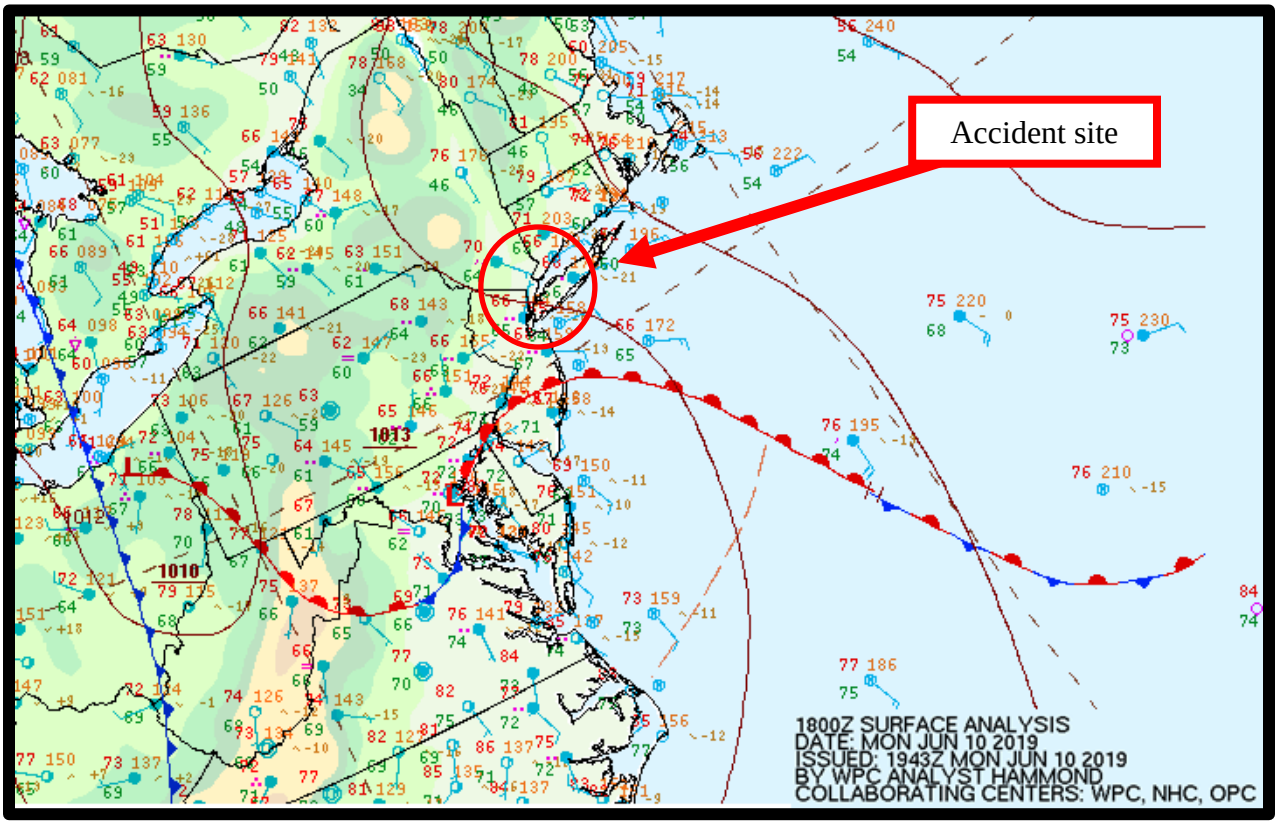

Figure 1 – NWS Surface Analysis Chart for 1400 EDT

https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1030235

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. There was a trough[2] at low- and mid-levels located south the accident site at 925- through 500-hPa. Troughs can act as lifting mechanisms to help produce clouds and precipitation if sufficient moisture is present. The wind was from the southeast at 15 knots at 925-hPa with the wind becoming southerly at 20 knots by 500-hPa (figure 5). At 300-hPa, the wind was from the southwest at 15 knots (figure 6).

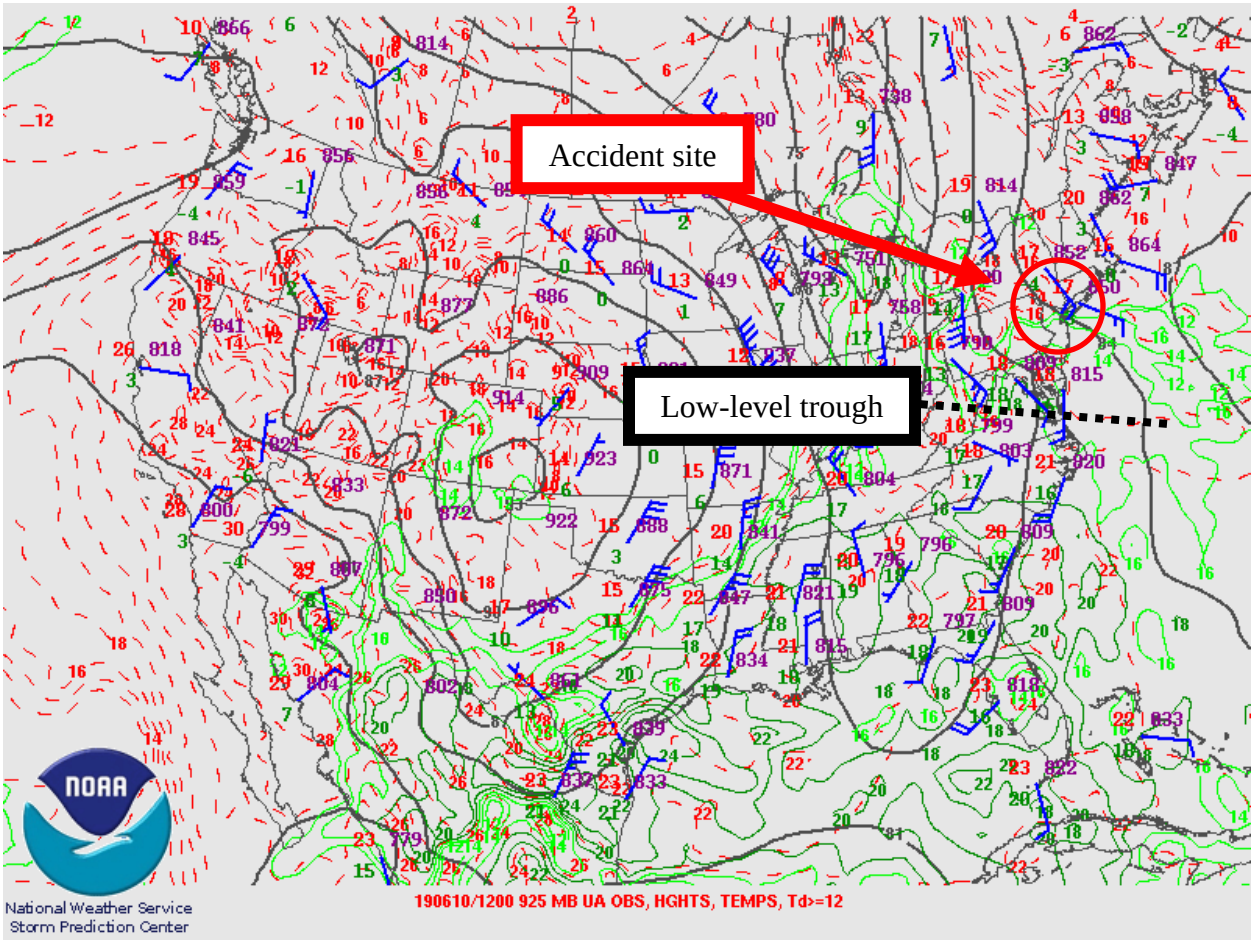

Figure 2 – 925-hPa Constant Pressure Chart for 0800 EDT

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

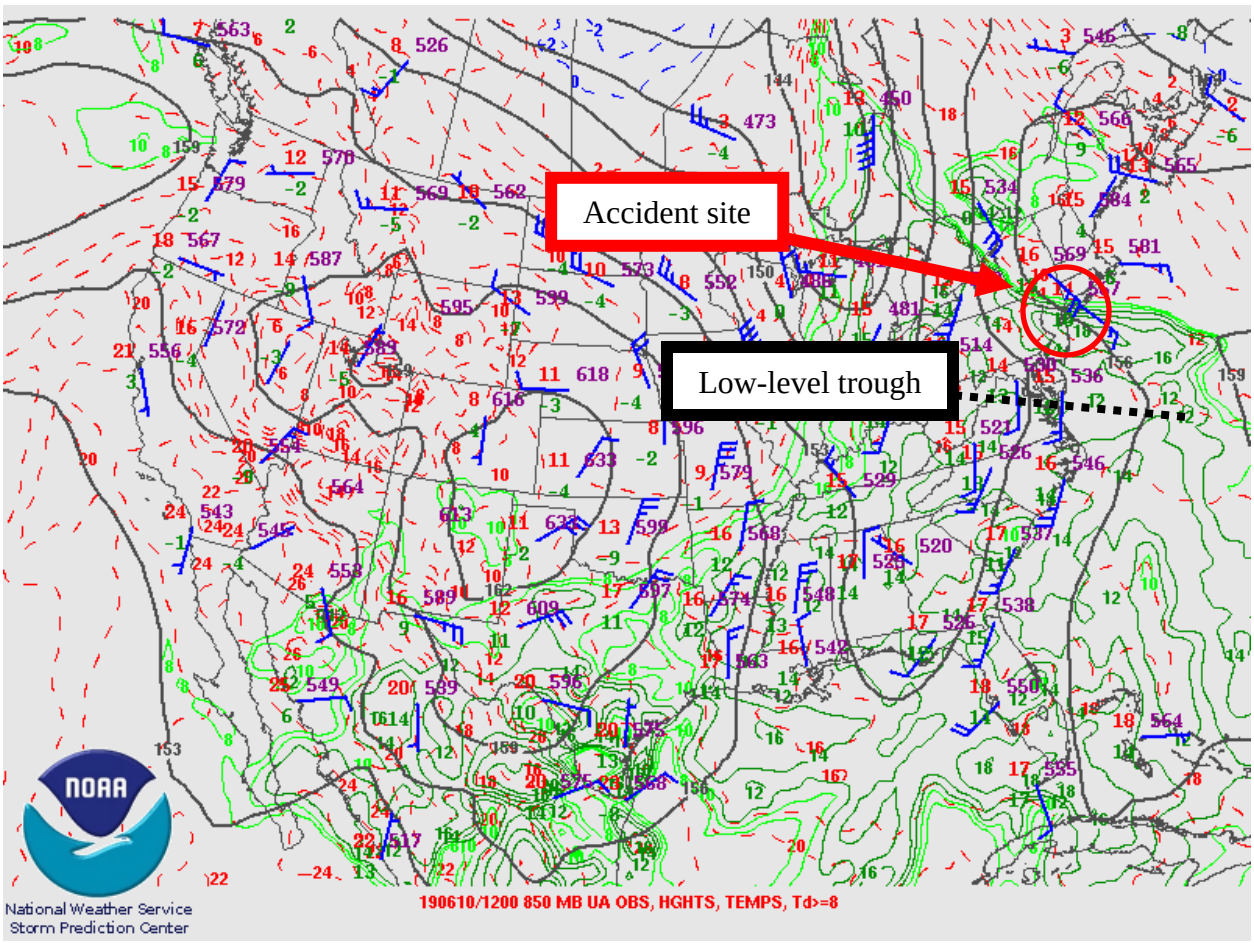

Figure 3 – 850-hPa Constant Pressure Chart for 0800 EDT

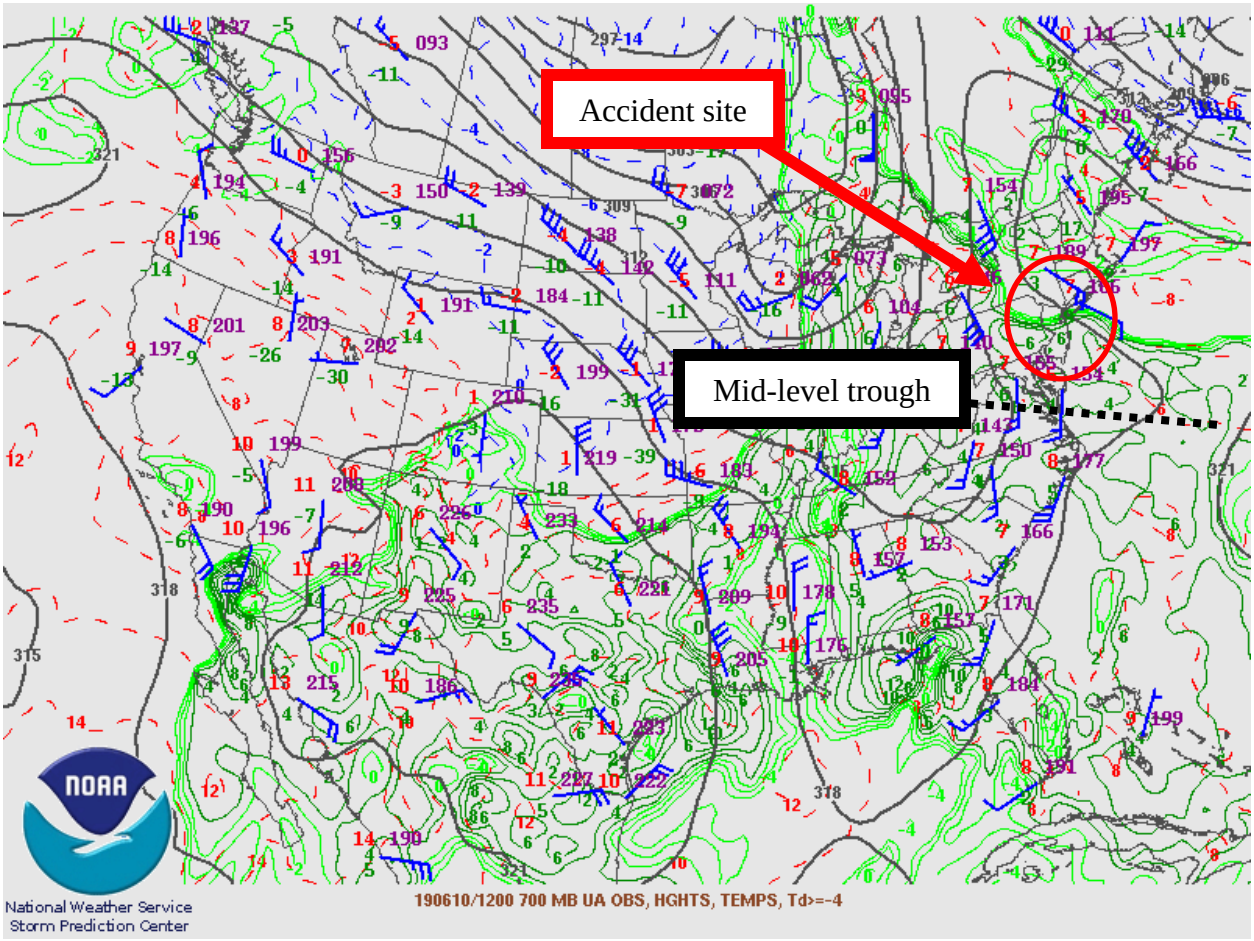

Figure 4 – 700-hPa Constant Pressure Chart for 0800 EDT

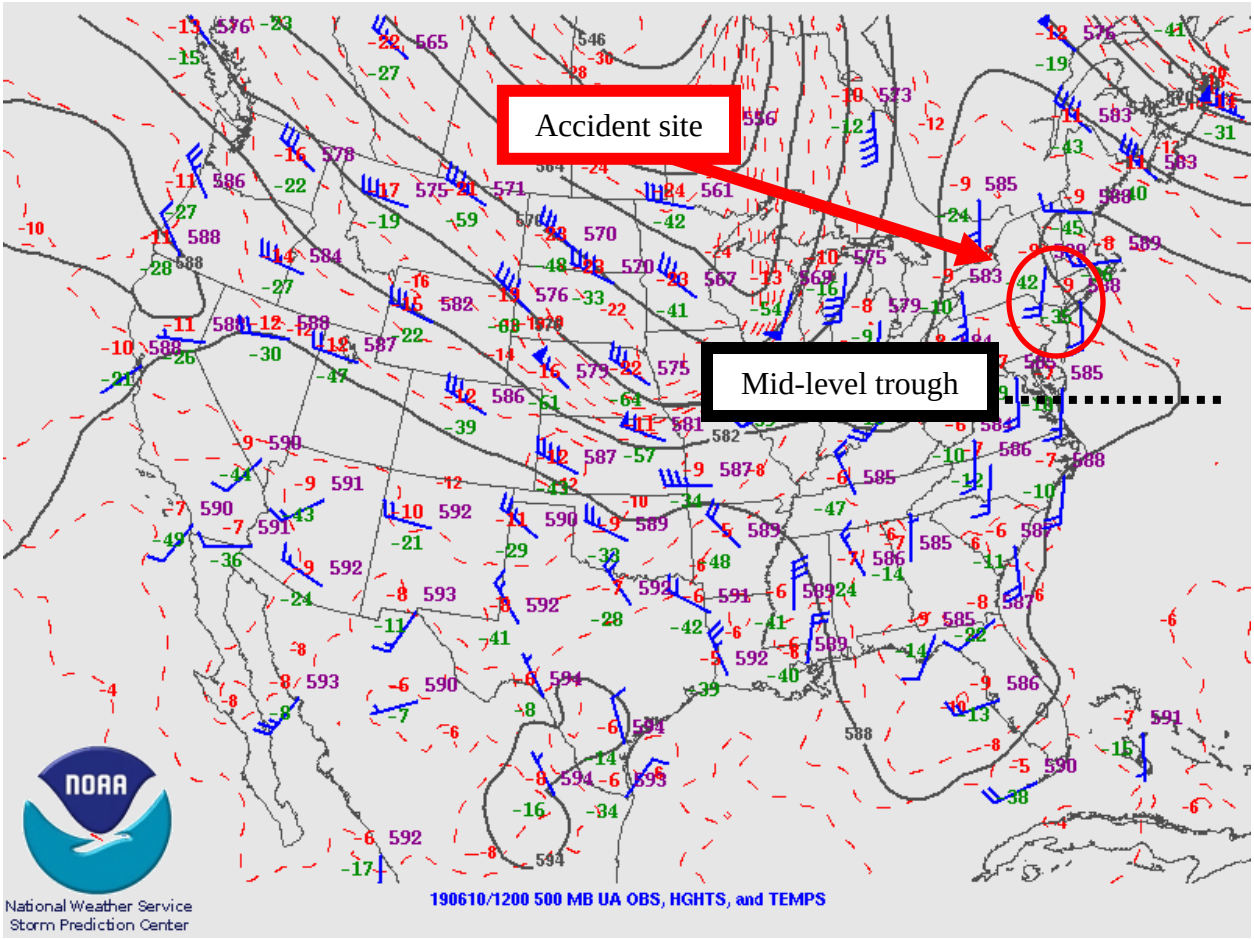

Figure 5 – 500-hPa Constant Pressure Chart for 0800 EDT

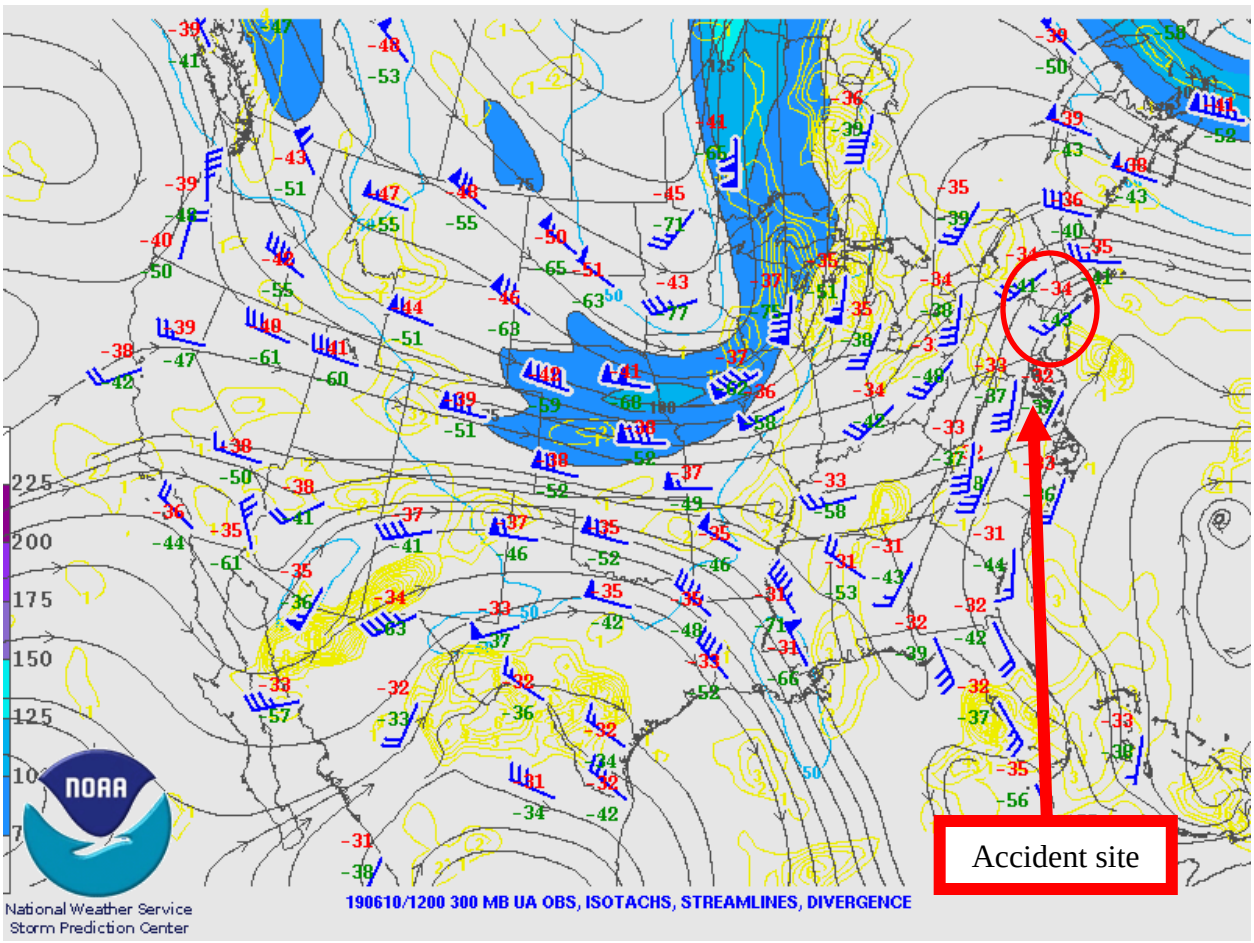

Figure 6 – 300-hPa Constant Pressure Chart for 0800 EDT

2.0 SPC Products

SPC issued the following Day 1 Convective Outlook at 1223 EDT (figure 7) with areas of general thunderstorms forecast for the accident site[3]. SPC defines the "TSTM" area as an area that encloses where a 10% or higher probability of thunderstorms is forecast during the valid period. The SPC Day 1 Convective Outlook text follows figure 7:

[3] The 0900 and 0800 EDT SPC Day 1 Convective Outlook forecast similar conditions and had similar graphics.

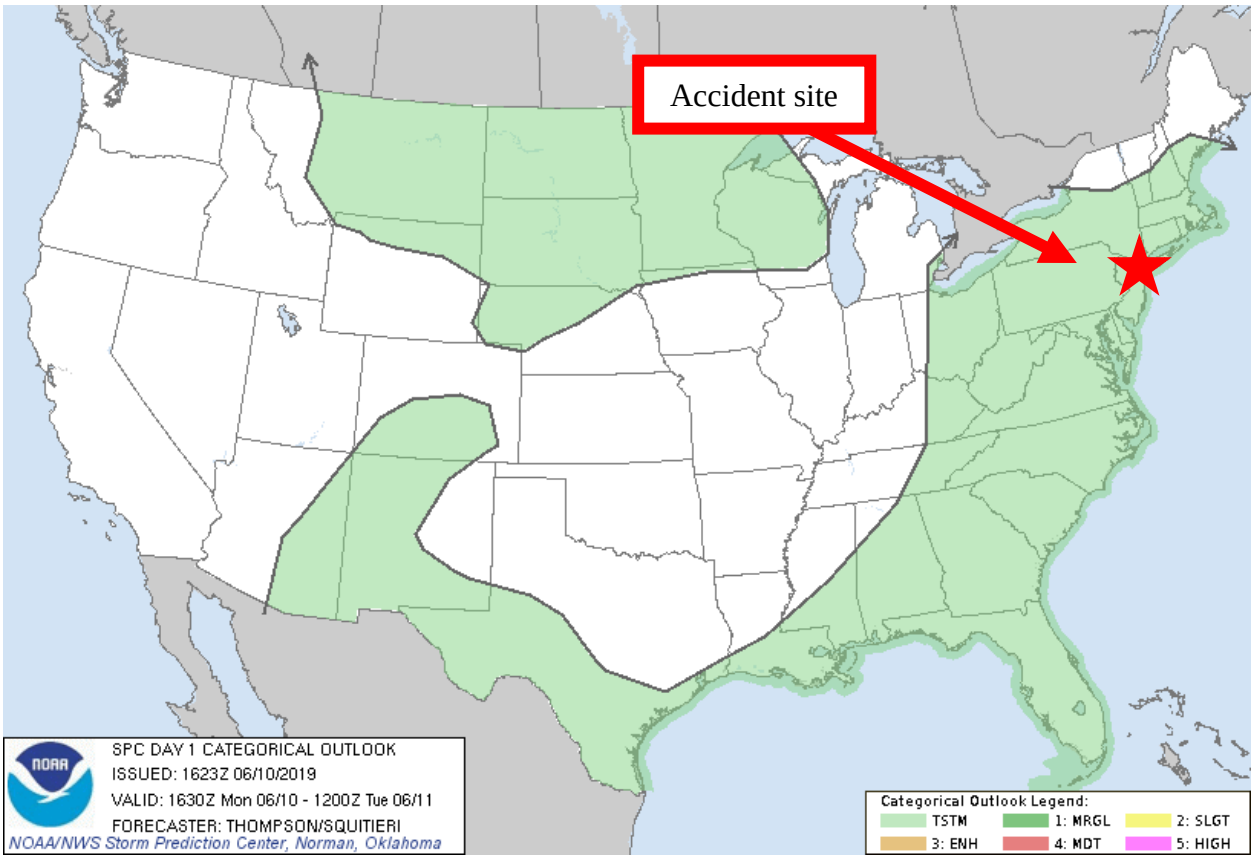

Figure 7 – SPC day 1 Convective Outlook valid at the time of the accident

SPC AC 101623

Day 1 Convective Outlook
NWS Storm Prediction Center Norman OK
1123 AM CDT Mon Jun 10 2019

Valid 101630Z - 111200Z

...NO SEVERE THUNDERSTORM AREAS FORECAST...

...SUMMARY...
Severe storms are unlikely this afternoon through tonight.

...eastern OH/PA this afternoon...
A northern stream shortwave trough will continue to progress eastward from the Lake Michigan vicinity, and this wave will be preceded by a weaker/lead shortwave trough and surface cold front now crossing OH. Widespread clouds will tend to slow surface heating, and lapse rate profiles aloft are poor. The poor lapse rates and at best modest deep-layer and low-level shear all suggest that severe storms are unlikely.

...Dakotas/MN this afternoon...
A steep lapse rate environment is expected with daytime heating/mixing beneath cold midlevel temperatures. However, boundary-layer dewpoints should mix into generally the low 40s this

afternoon, and only weak surface-based CAPE is expected. While isolated thunderstorms are expected in a rather broad zone, minimal forcing for ascent and relatively weak flow below 500 mb suggests that any threat for strong/damaging outflow gusts is too small to warrant any severe wind probabilities.

...FL this afternoon...
A slow-moving midlevel trough persists over the northeast Gulf of Mexico, though this trough has been weakening steadily the past few days. An isolated strong storm may occur across north FL and the eastern FL Panhandle where surface heating is strongest through early afternoon, though any threat for strong/damaging downburst winds should remain quite isolated.

...Southeast AZ this afternoon...
The west edge of the low-level moisture (low 50s dewpoints) has spread westward into southeast AZ. Once high clouds clear this area, surface heating over the higher terrain could support thunderstorm development this afternoon into this evening. Gusty outflow winds will be possible, but the threat for severe storms is expected to remain too marginal for an outlook area.

..Thompson/Squitieri.. 06/10/2019

CLICK TO GET WUUS01 PTSDY1 PRODUCT

NOTE: THE NEXT DAY 1 OUTLOOK IS SCHEDULED BY 2000Z

3.0 Surface Observations

The area surrounding the accident site was documented using official Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). Figure 8 is a sectional chart with the accident site and the closest weather reporting locations to the accident site marked.

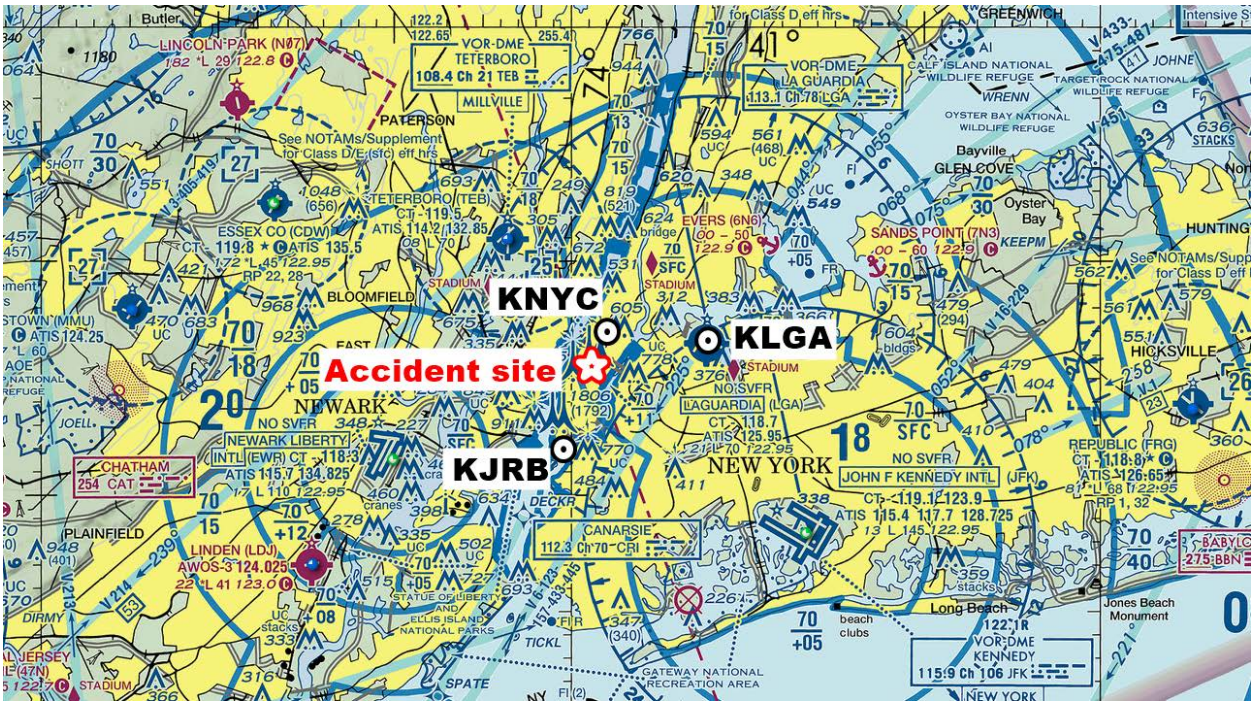

Figure 8 – Sectional chart of accident area with the location of the accident site and the closest surface observation sites

The closest official weather reporting facility to the accident site was from New York City Central Park equipment (KNYC) at an elevation of 154 ft, and was 1 mile northeast of the accident site. KNYC had an Automated Surface Observing System (ASOS[4]) whose reports were not supplemented and KNYC had a 13° westerly magnetic variation[5] (figure 8). The following observations were taken and disseminated during the times surrounding the accident:[6]

[1132 EDT] SPECI KNYC 101532Z AUTO 07007KT 2SM -RA BR FEW008 OVC013 17/15 A3012 RMK AO2 VIS 1 1/4V5 RAB06 P0001 T01670150 $=

[1151 EDT] METAR KNYC 101551Z AUTO 07007KT 1 1/4SM RA BR SCT008 OVC012 17/16 A3011 RMK AO2 RAB06 SLP187 P0004 T01670156 $=

[1158 EDT] SPECI KNYC 101558Z AUTO VRB06KT 1 1/4SM RA BR BKN008 OVC012 17/16 A3011 RMK AO2 P0001 T01670156 $=

[1243 EDT] SPECI KNYC 101643Z AUTO 04006KT 3SM -RA BR OVC005 17/16 A3009 RMK AO2 P0004 T01720161 $=

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

[5] Magnetic variation – The angle (at a particular location) between magnetic north and true north. Latest measurement taken from https://skyvector.com/

[6] Bolded sections in this report highlight information that directly reference the weather conditions that affected the accident location around the accident time.

[1251 EDT] METAR KNYC 101651Z AUTO 07007KT 2 1/2SM RA BR OVC005 17/16 A3009 RMK AO2 SLP180 P0005 T01720161 $=

[1327 EDT] SPECI KNYC 101727Z AUTO 07008KT 1 3/4SM -RA BR OVC006 17/17 A3007 RMK AO2 P0002 T01720167 $=

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[1351 EDT] METAR KNYC 101751Z AUTO 07008KT 1 1/4SM RA BR OVC005 18/17 A3005 RMK AO2 SLP168 P0006 60015 T01780167 10178 20161 58028 $=

[1407 EDT] SPECI KNYC 101807Z AUTO 05008KT 1/2SM +RA FG VV005 18/17 A3004 RMK AO2 P0008 T01780172 $=

[1418 EDT] SPECI KNYC 101818Z AUTO 05006KT 3/4SM +RA BR VV004 18/17 A3005 RMK AO2 P0016 T01780172 $=

KNYC weather at 1251 EDT, automated, wind from 070° at 7 knots, 2 and a half miles visibility, moderate rain, mist, an overcast ceiling at 500 ft above ground level (agl), temperature of 17° Celsius (C), dew point temperature of 16°C, and an altimeter setting of 30.09 inches of mercury (inHg). Remarks, station with a precipitation discriminator, sea level pressure 1018.0 hPa, 0.05 inches of precipitation since 1151 EDT, temperature 17.2°C, dew point temperature 16.1°C, maintenance is needed on the system.

KNYC weather at 1327 EDT, automated, wind from 070° at 8 knots, 1 and three-quarter miles visibility, light rain, mist, an overcast ceiling at 600 ft agl, temperature of 17°C, dew point temperature of 17°C, and an altimeter setting of 30.07 inHg. Remarks, station with a precipitation discriminator, 0.02 inches of precipitation since 1251 EDT, temperature 17.2°C, dew point temperature 16.7°C, maintenance is needed on the system.

KNYC weather at 1351 EDT, automated, wind from 070° at 8 knots, 1 and a quarter miles visibility, moderate rain, mist, an overcast ceiling at 500 ft agl, temperature of 18°C, dew point temperature of 17°C, and an altimeter setting of 30.05 inHg. Remarks, station with a precipitation discriminator, sea level pressure 1016.8 hPa, 0.06 inches of precipitation since 1251 EDT, 6-hourly precipitation of 0.15 inches, temperature 17.8°C, dew point temperature 16.7°C, 6-hourly maximum temperature of 17.8°C, 6-hourly minimum temperature of 16.1°C, 3-hourly pressure decrease of 2.8 hPa, maintenance is needed on the system.

KNYC weather at 1407 EDT, automated, wind from 050° at 8 knots, a half mile visibility, heavy rain, fog, vertical visibility of 500 ft agl, temperature of 18°C, dew point temperature of 17°C, and an altimeter setting of 30.04 inHg. Remarks, station with a precipitation discriminator, 0.08 inches of precipitation since 1351 EDT, temperature 17.8°C, dew point temperature 17.2°C, maintenance is needed on the system.

The next closest official weather reporting facility to the accident site was from New York Downtown Manhattan equipment (KJRB) at an elevation of 7 ft, and was 4 miles south-southwest of the accident site. KJRB had an Automated Weather Observing System (AWOS[7]) whose reports were not supplemented and KJRB had a 13° westerly magnetic variation (figure 8). The following observations were taken and disseminated during the times surrounding the accident:

[1230 EDT] SPECI KJRB 101630Z AUTO 04011KT 7SM OVC010 18/17 A3006 RMK AO2 CIG 006V012 P0002=

[1242 EDT] SPECI KJRB 101642Z AUTO 05011KT 2 1/2SM BR BKN008 OVC011 18/17 A3006 RMK AO2 VIS 1 3/4V5 CIG 006V009 P0003=

[1256 EDT] METAR KJRB 101656Z AUTO 04011KT 2 1/2SM BR OVC008 18/17 A3005 RMK AO2 VIS 2V4 CIG 006V012 SLP177 P0003 T01830172=

[1314 EDT] SPECI KJRB 101714Z AUTO 04013KT 4SM BR OVC010 18/17 A3004 RMK AO2 CIG 006V013=

[1324 EDT] SPECI KJRB 101724Z AUTO 05012KT 1 3/4SM BR OVC010 18/17 A3004 RMK AO2 CIG 005V013 P0001=

[1333 EDT] SPECI KJRB 101733Z AUTO 03012KT 1 1/4SM -RA BR BKN006 OVC010 18/17 A3003 RMK AO2 VIS 3/4V3 RAB33 CIG 004V009 P0005=

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[1343 EDT] SPECI KJRB 101743Z AUTO 05012KT 2 1/2SM -RA BR BKN006 BKN010 OVC015 18/18 A3003 RMK AO2 VIS 1 1/2V4 RAB33 CIG 004V009 P0007=

[1356 EDT] METAR KJRB 101756Z AUTO 05011KT 2SM -RA BR BKN006 OVC010 18/18 A3002 RMK AO2 RAB33 SLP167 P0009 60015 T01830178 10183 20172 58025=

[1426 EDT] SPECI KJRB 101826Z AUTO 03011KT 1 3/4SM -RA BR SCT006 OVC012 19/18 A3000 RMK AO2 P0009=

KJRB weather at 1333 EDT, automated, wind from 030° at 12 knots, 1 and a quarter miles visibility, light rain, mist, a broken ceiling at 600 ft agl, overcast skies at 1,000 ft agl, temperature of 18°C, dew point temperature of 17°C, and an altimeter setting of 30.03 inHg. Remarks, station with a precipitation discriminator, visibility varying between three quarters of a mile and 3 miles, rain began at 1333 EDT, ceiling varying between 400 and 900 ft agl, 0.05 inches of precipitation since 1251 EDT.

[7] 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.

KJRB weather at 1343 EDT, automated, wind from 050° at 12 knots, 2 and a half miles visibility, light rain, mist, a broken ceiling at 600 ft agl, broken skies at 1,000 ft agl, overcast skies at 1,500 ft agl, temperature of 18°C, dew point temperature of 18°C, and an altimeter setting of 30.03 inHg. Remarks, station with a precipitation discriminator, visibility varying between 1 and a half miles and 4 miles, rain began at 1333 EDT, ceiling varying between 400 and 900 ft agl, 0.07 inches of precipitation since 1251 EDT.

LaGuardia Airport equipment (KLGA) was located at an elevation of 21 ft and was 5 miles east-northeast of the accident site. KLGA had an Automated Surface Observing System (ASOS[8]) whose reports were supplemented by an official observer and KLGA had a 13° westerly magnetic variation (figure 8). The following observations were taken and disseminated during the times surrounding the accident:

[1551 EDT] METAR KLGA 101551Z 04015KT 1 1/4SM R04/4000VP6000FT -RA BR SCT005 OVC015 17/15 A3008 RMK AO2 SFC VIS 1 ¾ RAB1455 SLP187 P0001 T01670150=

[1211 EDT] SPECI KLGA 101611Z 05015KT 1 1/4SM R04/5000VP6000FT -RA BR SCT005 OVC013 17/15 A3007 RMK AO2 SFC VIS 1 3/4

[1249 EDT] SPECI KLGA 101649Z 04015G22KT 2 1/2SM -RA BR SCT007 OVC010 18/16 A3006 RMK AO2 SFC VIS 5 P0008=

[1251 EDT] METAR KLGA 101651Z 04014KT 2 1/2SM -RA BR SCT007 OVC010 18/16 A3006 RMK AO2 SFC VIS 5 SLP179 P0008 T01780156=

[1315 EDT] SPECI KLGA 101715Z 04012KT 2SM R04/4000VP6000FT -RA BR SCT007 OVC010 17/16 A3005 RMK AO2 P0003 T01720156=

[1338 EDT] SPECI KLGA 101738Z 04014KT 1 1/2SM R04/4500VP6000FT -RA BR OVC007 17/16 A3003 RMK AO2 SFC VIS 2 P0005 T01720156=

ACCIDENT TIME 1340 EDT

[1341 EDT] SPECI KLGA 101741Z 04012KT 1 1/2SM R04/4500VP6000FT -RA BR OVC008 17/16 A3003 RMK AO2 SFC VIS 2 P0005 T01720156=

[1351 EDT] METAR KLGA 101751Z 04014KT 1 1/2SM -RA BR OVC008 17/16 A3002 RMK AO2 SFC VIS 2 SLP167 P0005 60014 T01720156 10178 20161 58020=

[1411 EDT] SPECI KLGA 101811Z 04011KT 1/2SM R04/2800VP6000FT RA FG OVC005 17/16 A3002 RMK AO2 P0004 T01720161=

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

KLGA weather at 1338 EDT, wind from 040° at 14 knots, 1 and a half miles visibility, runway visual range varying between 4,500 ft and greater than 6,000 ft on runway 04, light rain, mist, an overcast ceiling at 700 ft agl, temperature of 17°C, dew point temperature of 16°C, and an altimeter setting of 30.03 inHg. Remarks, station with a precipitation discriminator, surface visibility 2 miles, 0.05 inches of precipitation since 1251 EDT, temperature 17.2°C, dew point temperature 15.6°C.

KLGA weather at 1341 EDT, wind from 040° at 12 knots, 1 and a half miles visibility, runway visual range varying between 4,500 ft and greater than 6,000 ft on runway 04, light rain, mist, an overcast ceiling at 800 ft agl, temperature of 17°C, dew point temperature of 16°C, and an altimeter setting of 30.03 inHg. Remarks, station with a precipitation discriminator, surface visibility 2 miles, 0.05 inches of precipitation since 1251 EDT, temperature 17.2°C, dew point temperature 15.6°C.

The observations from KNYC, KJRB, and KLGA surrounding the accident time indicated LIFR to IFR[9] conditions with the surface wind from the northeast at 8 to 14 knots.

[9] As defined by the NWS and the FAA Aeronautical Information Manual (AIM) section 7-1-7 defines the following general flight categories:

- Low Instrument Flight Rules (LIFR*) – ceiling below 500 ft above ground level (agl) and/or visibility less than 1 statute mile.
- Instrument Flight Rules (IFR) – ceiling between 500 to below 1,000 feet agl and/or visibility 1 to less than 3 miles.
- Marginal Visual Flight Rules (MVFR**) – ceiling from 1,000 to 3,000 ft agl and/or visibility 3 to 5 miles.
- Visual Flight Rules (VFR) – ceiling greater 3,000 ft agl and visibility greater than 5 miles.

* By definition, IFR is a ceiling less than 1,000 ft agl and/or visibility less than 3 miles while LIFR is a sub-category of IFR.

**By definition, VFR is a ceiling greater than or equal to 3,000 ft agl and visibility greater than 5 miles while MVFR is a sub-category of VFR.

4.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR)[10] model sounding was created for the accident site for 1400 EDT with a station elevation of 0 ft.[11] The 1400 EDT HRRR sounding was plotted on a standard Skew-T Log P diagram[12] with the derived stability parameters included in figure 9 with data from the surface to 600-hPa (or approximately 14,000 ft msl). This data was analyzed using the RAOB[13] software package. The sounding depicted the convective condensation level (CCL)[14] at 86 ft agl and the lifted condensation level (LCL)[15] at 168 ft. The sounding had a greater than 90% relative humidity from the surface through 32,000 ft msl. The freezing level was located at 14,671 ft msl. The precipitable water value was 2.16 inches.

[10] The HRRR is a NOAA real-time three-kilometer resolution, hourly-updated, cloud-resolving, convection-allowing atmospheric model, initialized by three-kilometer grids with three-kilometer radar assimilation. Radar data is assimilated in the HRRR every 15 minutes over a one hour period.
[11] HRRR sounding was created using NOAA Air Resource Laboratory: https://ready.arl.noaa.gov/READYamet.php
[12] Skew T log P diagram – is a standard meteorological plot using temperature and the logarithmic of pressure as coordinates, used to display winds, temperature, dew point, and various indices used to define the vertical structure of the atmosphere.
[13] RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania.
[14] 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.
[15] LCL - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

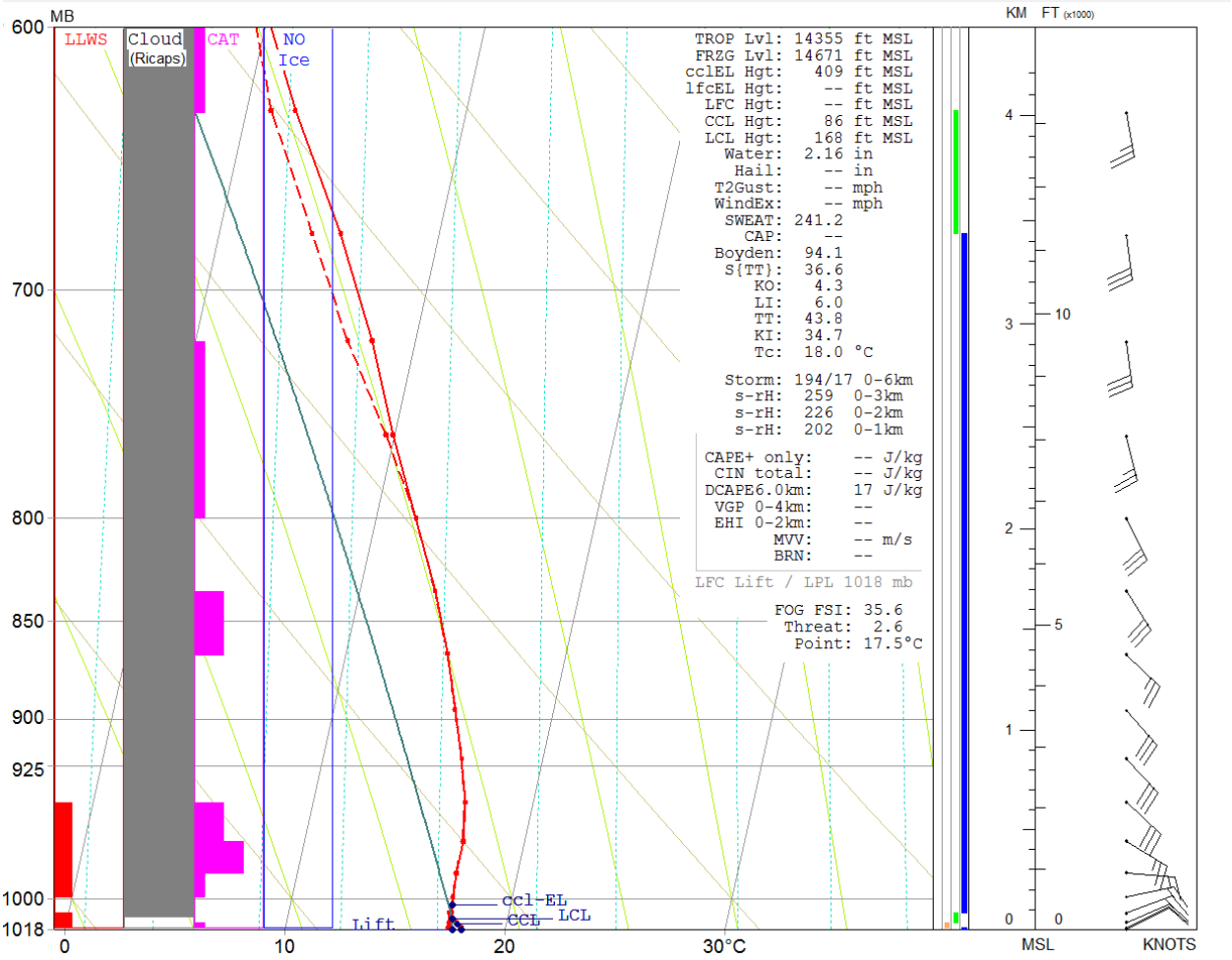


Figure 9 – 1400 EDT HRRR sounding for the accident site

The 1400 EDT HRRR sounding for the accident site indicated a stable environment from 200 ft agl through 11,000 ft. RAOB identified the possibility of clouds from ~200 ft agl through 14,000 ft msl. RAOB did not indicate the possibility of icing conditions below 14,000 ft msl.

The 1400 EDT HRRR sounding wind profile indicated a surface wind from 062° at 8 knots with the wind veering[16] to the south by 10,000 ft msl. The wind speed increased to 30 knots by 2,000 ft. RAOB indicated light low-level wind shear (LLWS) between the surface and ~2,000 ft agl. RAOB indicated light to severe clear-air turbulence (CAT) existed in several layers between the surface and 2,000 ft with the possibility of moderate CAT between 5,000 and 14,000 ft msl.

[16] A clockwise turning of the wind with height in the northern hemisphere.

5.0 Satellite Data

Data from the Geostationary Operational Environmental Satellite number 16 (GOES-16) data was obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man-computer Interactive Data Access System software. Visible (band 2) and infrared (bands 13) imagery at wavelengths of 0.64 microns (µm) and 10.3 µm, respectively, were retrieved for the period. Satellite imagery surrounding the time of the accident, from 1100 EDT through 1600 EDT at approximately 5-minute intervals were reviewed, and the closest images to the time of the accident are documented here.

Figures 10 and 11 present the GOES-16 visible imagery from 1340 and 1350 EDT at 2X magnification with the accident site highlighted with a red square. The GOES-16 imagery indicated overcast cloud cover above the accident site at the accident time. The cloud cover was moving from southwest to northeast (attachment 1).

Figure 12 presents the GOES-16 infrared imagery from 1340 EDT at 5X magnification and with a temperature enhancement curve applied with the accident site highlighted with a red square. Inspection of the infrared imagery indicated abundant cloud cover over the accident site at the accident time with the lowest brightness temperatures (green and yellow colors, higher clouds) located above and to the west, north, and southeast of the accident site (attachment 2). Based on the brightness temperatures above the accident site (246 Kelvin) and the vertical temperature profile provided by the 1400 EDT HRRR sounding, the approximate cloud-top heights over the accident site were 29,000 ft at 1340 EDT. It should be noted these figures have not been corrected for any parallax error.

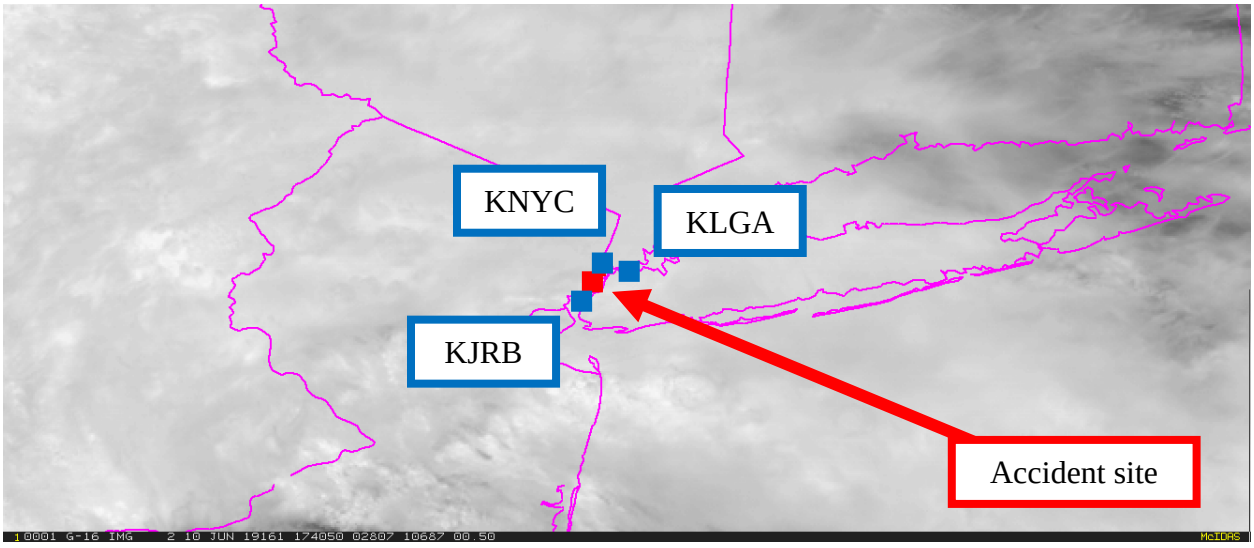


Figure 10 – GOES-16 visible image at 1340 EDT

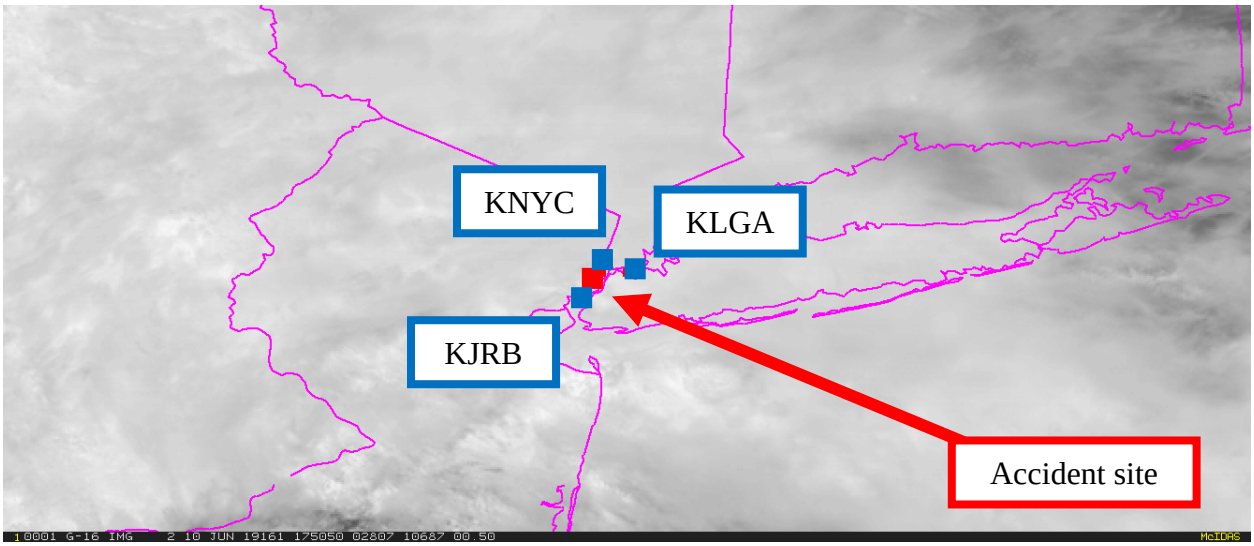


Figure 11 – GOES-16 visible image at 1350 EDT

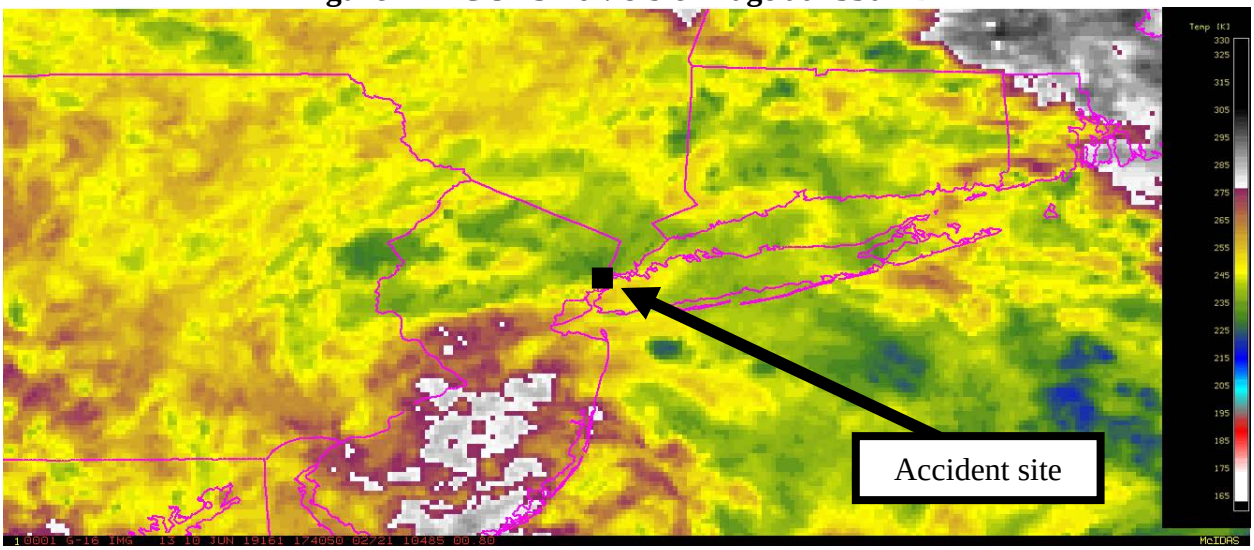


Figure 12 – GOES-16 infrared image at 1340 EDT

6.0 Regional Radar Imagery Information

A regional view of the NWS National Composite Radar Mosaic is included as figure 13 for 1340 EDT. The image depicted echoes from 20 to 40 decibels (dBZ[17]) echoes in the immediate vicinity of the accident site.

[17] 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.

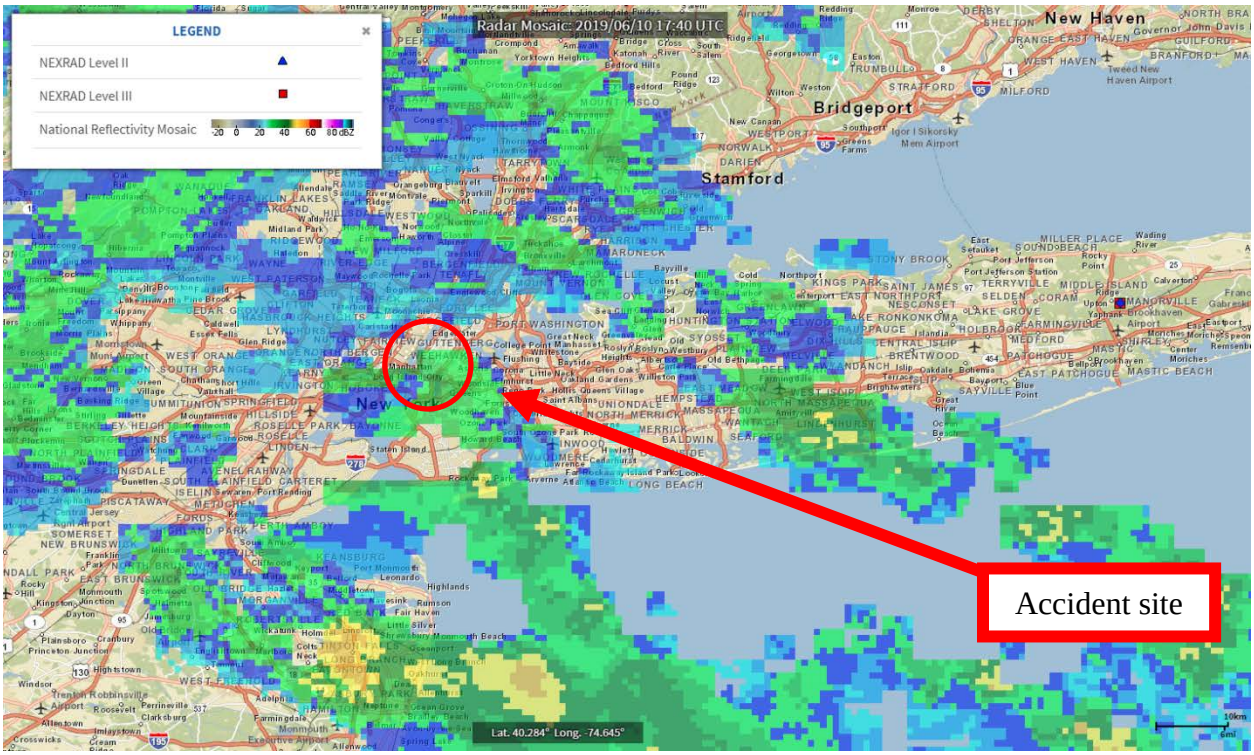


Figure 13 – Regional Composite Reflectivity image for 1340 EDT

7.0 Radar Imagery Information

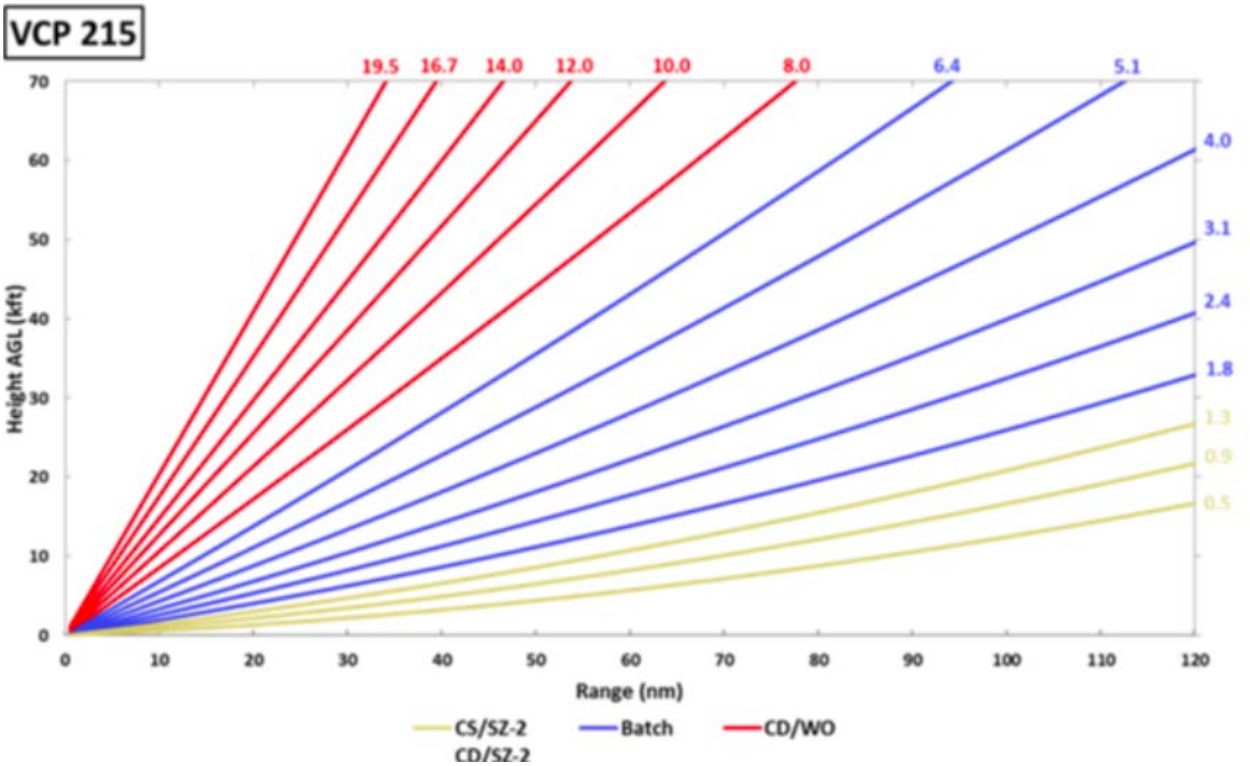
The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)[18] to the accident site was Brookhaven, New York, (KOKX), with antenna elevation of 198 ft, located 51 miles east of the accident site. Level II archive radar data was obtained from the NCEI utilizing the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software.

7.1 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. Products that require data from multiple elevation scans are not available until the end of the five to ten-minute volume scan.

[18] 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.

The WSR-88D operates in several different scanning modes, identified as Mode A and Mode B. Mode A is the precipitation scan and has three common scanning strategies. The most common is where the radar makes 15 elevation scans from 0.5° to 19.5° every six minutes. This particular scanning strategy is documented as volume coverage pattern 215 (VCP-215). 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 VCP-215. 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-215 Precipitation Mode Scan Strategy[19]

[19] Contiguous Surveillance (CS)--The low Pulse Repetition Frequency (PRF) scan of the split cut. Gives a high R_{max} value to determine proper target location and intensity, but a low V_{max} value limits the velocities that can be measured. Contiguous Doppler (CD)--The high PRF scan of the split cut. Gives a low R_{max} value causing more range folded (multiple trip) echoes, but a high V_{max} value to get higher, more accurate velocity values.
Batch Mode – Uses alternating low and high PRFs on each radial for one full rotation at each elevation angle. The two resulting data sets (low PRF and high PRF) are combined to resolve range ambiguity. Used in the middle elevation angles.
W – With range unfolding (W)
WO – Without range unfolding (WO)

7.2 Beam Height Calculation

Assuming standard refraction[20] of the WSR-88D radar beam with the antenna elevation at 198 ft (KOKX), and considering a beamwidth[21] of 0.95°, the following table shows the approximate heights for the radar beam center, top and base for antenna elevations over the accident site. These heights have been rounded to the nearest 10 ft.

ANTENNA ELEVATION	BEAM CENTER	BEAM BASE	BEAM TOP
KOKX 0.5°	4,790 ft	2,280 ft	7,300 ft

Based on the radar height calculations, the elevation scan from KOKX listed in the above table depicted the conditions between 2,280 ft and 7,300 ft over the accident site and "saw" the closest altitudes to the ground and the accident aircraft's flight level before the accident.[22]

7.3 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors[23] 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 dBZ, and is a general measure of echo intensity. FAA Advisory Circular AC 00-24C[24], "Thunderstorms," dated February 19, 2013, also defines the echo intensity levels and weather radar echo intensity terminology associated with those levels. For dBZ values less than 30 the weather radar echo intensity terminology should be "light." For dBZ values between 30 and 40, the terminology should be "moderate." "Heavy" terminology is used for dBZ values greater than 40 dBZ but less than 50 dBZ, inclusive. Finally, any dBZ values above 50 dBZ shall be described as "extreme." From the NWS, precipitation conditions at the surface can be inferred from VIP Levels described in the chart below:

[20] Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

[21] Beamwidth - the angular separation between the half power points on the antenna radiation pattern, where the gain is one half the maximum value.

[22] Flight Level – A Flight Level (FL) is a standard nominal altitude of an aircraft, in hundreds of ft. This altitude is calculated from the International standard pressure datum of 1013.25 hPa (29.92 inHg), the standard sea-level pressure, and therefore is not necessarily the same as the aircraft's true altitude either above mean sea level or above ground level.

[23] 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.

[24] https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1020774

- VIP 1 (Level 1, 18-30 dBZ) - Light precipitation
- VIP 2 (Level 2, 30-38 dBZ) - Light to moderate rain
- VIP 3 (Level 3, 38-44 dBZ) - Moderate to heavy rain
- VIP 4 (Level 4, 44-50 dBZ) - Heavy rain
- VIP 5 (Level 5, 50-57 dBZ) - Very heavy rain; hail possible
- VIP 6 (Level 6, >57 dBZ) - Very heavy rain and hail; large hail possible

7.4 Base Reflectivity and Lightning Data

Figures 14 and 15 present the KOKX WSR-88D base reflectivity images for the 0.5° elevation scans initiated at 1334:59 and 1341:09 EDT, respectively, with a resolution of 0.5° X 250 m. Reflectivity values between 20 and 30 dBZ were located above the accident site at the accident time. The reflectivity bands were moving from south to north (attachment 3).

There were no lightning flashes[25] recorded around the accident site at the accident time.[26]

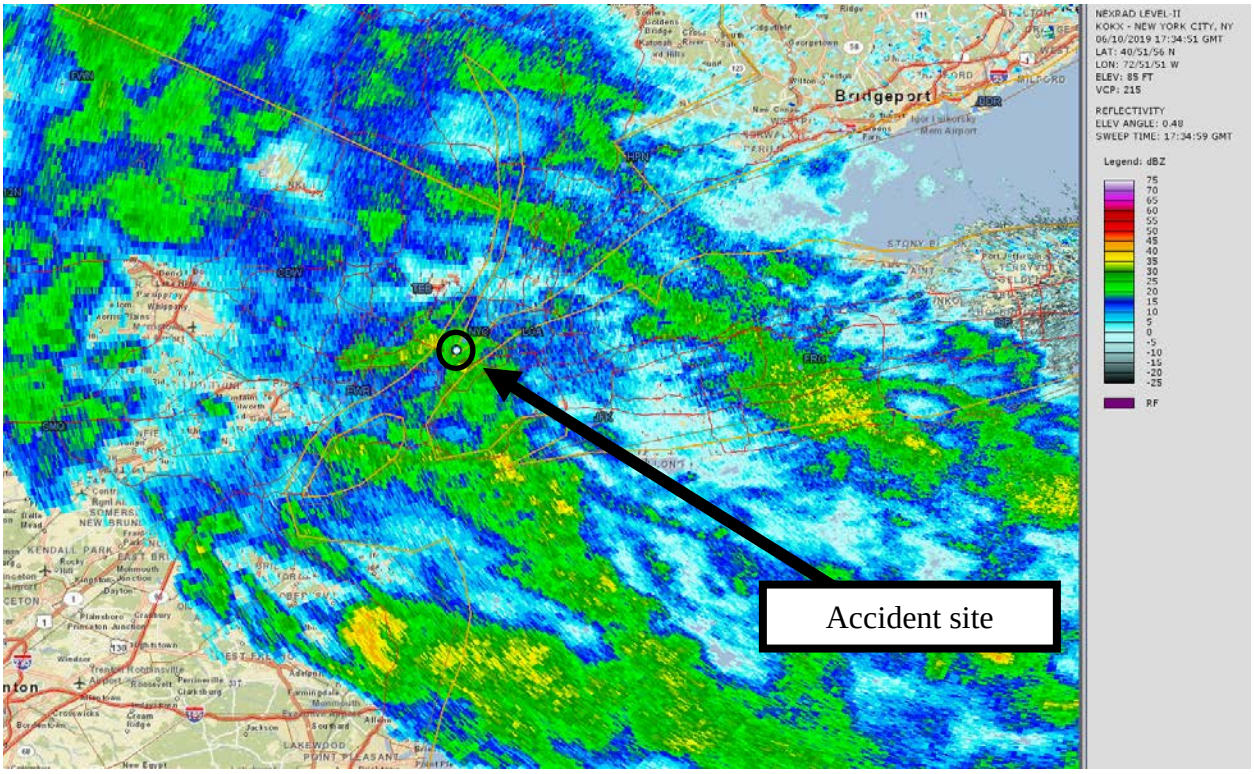


Figure 14 – KOKX WSR-88D reflectivity for the 0.5° elevation scan initiated at 1334:59 EDT with the accident site marked with a black circle

[25] Lightning Flash – This is one contiguous conducting channel and all the current strokes/pulses that flow through it. There are two types of flashes: ground flashes and cloud flashes.
[26] A review of Earth Networks Total Lightning network was done.

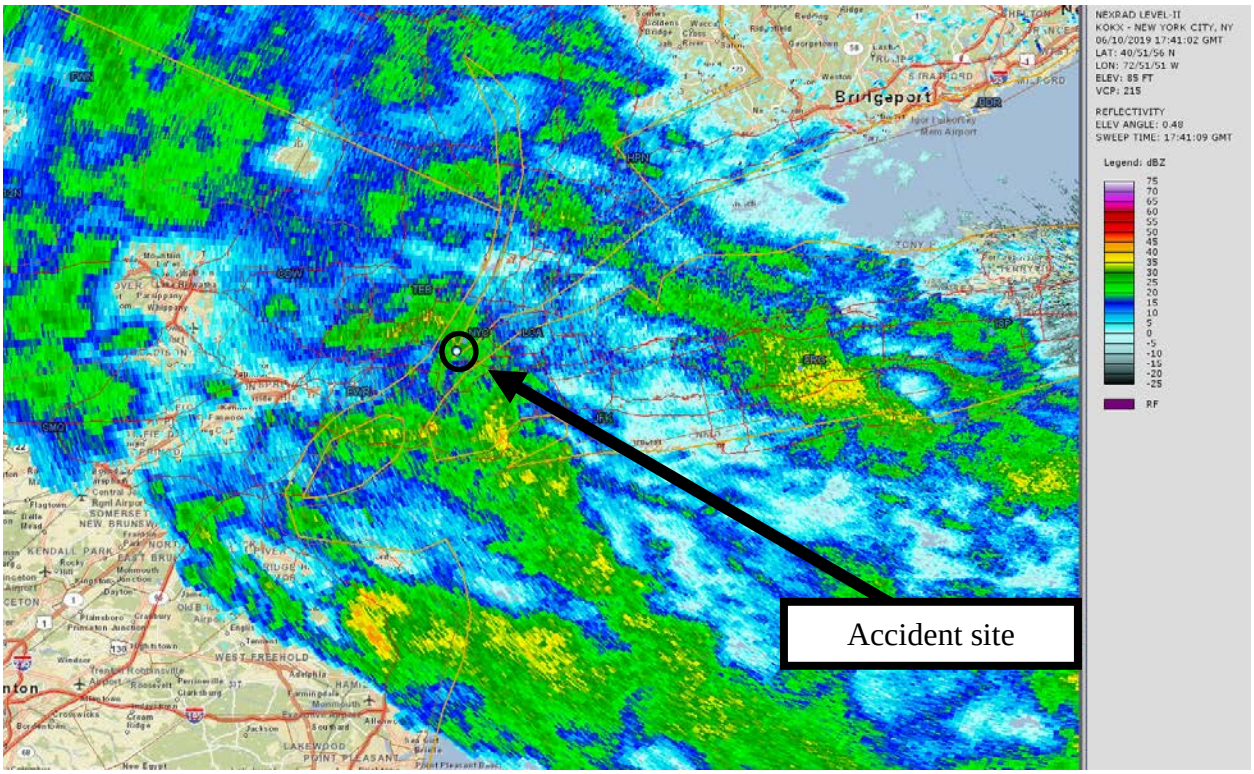


Figure 15 – KOKX WSR-88D reflectivity for the 0.5° elevation scan initiated at 1341:09 EDT with the accident site marked with a black circle

8.0 Pilot Reports[27]

All pilot reports (PIREPs) within 50 miles of the accident site from about three hours prior to the accident time to about one hour after the accident time for below FL180[28] are provided below:

TEB UA /OV TEB/TM 1522/FLDURGD/TP F900/SK OVC011/RM BASES 1100FT ON FINAL RWY 6

EWR UA /OV RY4R/TM 1528/FL006/TP E45X/SK 006OVC/RM ILS RY4R

TEB UA /OV TEB/TM 1534/FL005/TP SK76/SK BKN002/RM TOWER VIS 3.5SM AND DECREASING

TEB UA /OV TEB/TM 1536/FL005/TP C680/SK BKN008

MMU UA /OV KMMU/TM 1555/FL008/TP GLF4/SK OVC006/RM FIN23

EWR UA /OV 3NM FINAL RY4R/TM 1608/FL010/TP A320/TB LT/RM LT TURB BELOW 010

FRG UA /OV FRG/TM 1613/FLDURGD/TP BE76/RM RWY 14 BE76 BROKE OUT AT 013/ ON FINAL

[27] Only pilot reports with the World Meteorological Organization (WMO) header UBPA**, UBNY**,UBNJ**, and UBCT** identifier were considered.

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

FRG UA /OV KFRG/TM 1619/FL013/TP GLF5/SK BKN013/RM GLF5 LANDING RWY 14 REPORTED CEILINGS OF BKN013

FRG UA /OV KFRG/TM 1626/FL011/TP SR22/SK BKN011/TB LGT

EWR UA /OV EWR180001/TM 1627/FL003/TP B763/SK 003 BKN

EWR UA /OV RY4R FINAL/TM 1712/FL020/TP B777/TB NEG/RM NO TURBULANCE, SMOOTH RIDE ON FINAL

EWR UA /OV 1NM FINAL RY4R/TM 1735/FL003/TP B738/SK 003OVC/WV VRB/RM ILS RY4R

JFK UA /OV JFK/TM 1741/FLDURGC/TP A321/SK BKN011-UNKN

JFK UA /OV JFK/TM 1821/FLDURC/TP E190/SK BKN002

The reports in plain language taken from standard code and abbreviations, with cloud heights in msl were as follows:

Teterboro Airport, New Jersey, (TEB) routine pilot report (UA); Over – TEB; Time – 1122 EDT (1522Z); Altitude – During descent; Type aircraft – Dassault Falcon 900; Sky – Overcast clouds at 1,100 ft; Remarks – Bases at 1,100 ft on final into runway 6.

Newark Liberty International Airport, New Jersey, (EWR) routine pilot report (UA); Over – Runway 4R; Time – 1128 EDT (1528Z); Altitude – 600 ft; Type aircraft – Embraer EMB-145XR; Sky – Overcast clouds at 600 ft; Remarks – ILS into runway 4R.

TEB, routine pilot report (UA); Over – TEB; Time – 1134 EDT (1534Z); Altitude – 500 ft; Type aircraft – Sikorsky S-76; Sky – Broken clouds at 200 ft; Remarks – Tower visibility 3.5 miles and decreasing.

TEB, routine pilot report (UA); Over – TEB; Time – 1136 EDT (1536Z); Altitude – 500 ft; Type aircraft – Cessna Citation Sovereign; Sky – Broken clouds at 800 ft.

Morristown Municipal Airport, New Jersey, (MMU) Routine pilot report (UA); Over – MMU; Time – 1155 EDT (1555Z); Altitude – 800 ft; Type aircraft – Gulfstream IV; Sky – Overcast clouds at 600 ft; Remarks – Final into runway 23.

EWR, routine pilot report (UA); Over – 3 mile final into runway 4R; Time – 1208 EDT (1608Z); Altitude – 1,000 ft; Type aircraft – Airbus A320; Turbulence – Light; Remarks – Light turbulence below 1,000 ft.

Republic Airport, New York, (FRG) routine pilot report (UA); Over – FRG; Time – 1213 EDT (1613Z); Altitude – During descent; Type aircraft – Beechcraft Duchess; Remarks – On final into runway 14 Beechcraft Duchess broke out at 1,300 ft.

FRG, routine pilot report (UA); Over – FRG; Time – 1219 EDT (1619Z); Altitude – 1,300 ft; Type aircraft – Gulfstream V; Sky – Broken clouds at 1,300 ft; Remarks – Gulfstream V landing on runway 14 reported ceilings of broken clouds at 1,300 ft.

FRG, routine pilot report (UA); Over – FRG; Time – 1226 EDT (1626Z); Altitude – 1,100 ft; Type aircraft – Cirrus SR22; Sky – Broken clouds at 1,100 ft; Turbulence – Light.

EWR, routine pilot report (UA); Over – 1 mile from EWR on the 180° radial; Time – 1227 EDT (1627Z); Altitude – 300 ft; Type aircraft – Boeing B767-300; Sky – 300 ft broken.

EWR, routine pilot report (UA); Over – Runway 4R on final; Time – 1312 EDT (1712Z); Altitude – 2,000 ft; Type aircraft – Boeing B777; Turbulence – Negative; Remarks – No turbulence, smooth ride on final.

EWR, routine pilot report (UA); Over – 1 mile final to runway 4R; Time – 1335 EDT (1735Z); Altitude – 300 ft; Type aircraft – Boeing B737-800; Sky – Overcast clouds at 300 ft; Wind - Variable; Remarks – ILS into runway 4R.

John F Kennedy International Airport, New York (JFK), routine pilot report (UA); Over – JFK; Time – 1341 EDT (1741Z); Altitude – During climb; Type aircraft – Airbus A321; Sky – Broken clouds at 1,100 ft with unknown tops.

JFK, routine pilot report (UA); Over – JFK; Time – 1421 EDT (1821Z); Altitude – During climb; Type aircraft – Embraer E-190; Sky – Broken clouds at 200 ft.

9.0 SIGMETs

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

10.0 CWSU Advisories

There were no Center Weather Service Unit (CWSU) Center Weather Advisories (CWA) or Meteorological Impact Statement (MIS) valid for the accident site at the accident time.

11.0 AIRMETs

There were Airmen's Meteorological Information (AIRMET) advisories Sierra and Tango valid for the accident site at the accident time for below 10,000 ft. AIRMET Sierra warned of IFR and mountain obscuration conditions due to clouds and mist, while AIRMET Tango warned of moderate turbulence below 8,000 and LLWS conditions expected:

WAUS41 KKCI 101445
WA1S
-BOSS WA 101445
AIRMET SIERRA UPDT 2 FOR IFR AND MTN OBSCN VALID UNTIL 102100
.
AIRMET IFR...PA OH LE WV
FROM 50W YYZ TO 30N ERI TO HNN TO CVG TO FWA TO 30SE ECK TO 50W
YYZ
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 21Z ENDG 21-00Z.
.

AIRMET IFR...MA RI CT NY LO NJ PA OH LE WV MD DC DE VA AND CSTL WTRS
FROM 60SSW YOW TO 40E SYR TO PVD TO 70SSE ACK TO 180ESE SIE TO 20SSE SBY TO 20S ORF TO HMV TO HNN TO 30N ERI TO 60SSW YOW
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.
.
AIRMET MTN OBSCN...NH VT MA NY PA WV MD VA NC SC GA
FROM 40SSW MSS TO 40SW CON TO HAR TO 40SSE PSK TO CLT TO 20SW ATL TO GQO TO HMV TO HNN TO 20SW EWC TO JHW TO 20NNE SYR TO 40SSW MSS
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.
.
OTLK VALID 2100-0300Z
AREA 1...IFR ME NH VT MA RI CT NY LO NJ PA OH LE WV MD DC DE VA AND CSTL WTRS
BOUNDED BY 30ESE YOW-60WSW YSC-30NNE ENE-100SE ACK-170SSE ACK-200S ACK-160SE SIE-60E ORF-40SSE PSK-20SE HMV-60WSW BKW-30WNW AIR-20NW ERI-40NW JHW-30ESE YOW
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG THRU 03Z.
.
AREA 2...MTN OBSCN ME NH VT MA NY PA WV MD VA NC SC GA
BOUNDED BY 60WSW YSC-20E MPV-50WSW BGR-CON-20W LYH-20NNE SPA-30ENE ATL-50WSW VXV-HMV-HNN-20SW JHW-20N SYR-MSS-60WSW YSC
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG THRU 03Z.
....

WAUS41 KKCI 101445
WA1T
-BOST WA 101445
AIRMET TANGO UPDT 2 FOR TURB AND LLWS VALID UNTIL 102100
.
AIRMET TURB...OH LE
FROM 40SSE ECK TO 40SW CLE TO 50E CVG TO CVG TO FWA TO 40SSE ECK
MOD TURB BLW 100. CONDS DVLPG AFT 18Z. CONDS CONTG BYD 21Z THRU 03Z.
.
AIRMET TURB...ME NH VT MA RI CT NY LO NJ PA LE AND CSTL WTRS
FROM 20SSW YSC TO 40N ENE TO 30SSW BOS TO CYN TO 40SSW JHW TO 40ESE YYZ TO 30SE YOW TO 20SSW YSC
MOD TURB BLW 080. CONDS CONTG BYD 21Z THRU 03Z.
.
LLWS POTENTIAL...VT MA CT NY LO NJ PA LE AND CSTL WTRS
BOUNDED BY 20WSW MSS-50SW CON-HTO-CYN-40NNE ERI-40E YYZ-40NW SYR-20WSW MSS
LLWS EXP. CONDS CONTG BYD 21Z THRU 03Z.
.
OTLK VALID 2100-0300Z
AREA 1...TURB OH LE
BOUNDED BY 40ENE ECK-30SE DXO-30SSW CLE-50W HNN-CVG-FWA-40ENE ECK
MOD TURB BTN FL180 AND FL390. CONDS DVLPG AFT 21Z. CONDS CONTG THRU 03Z.
.
AREA 2...TURB NY LO PA OH LE WV MD VA NC SC GA
BOUNDED BY 30SE ECK-40WNW ERI-40SSE BUF-20NW HAR-20ESE LYH-20ESE CLT-40SSW SPA-30WSW ODF-40SSW VXV-HMV-HNN-CVG-FWA-30SE ECK
MOD TURB BLW 100. CONDS CONTG THRU 03Z.

.
AREA 3...TURB ME NH VT MA RI CT NY LO NJ PA AND CSTL WTRS
BOUNDED BY 40ESE YSC-60SW BGR-20WNW ACK-JFK-70SSW SYR-70SSW YOW-
30SE YOW-40ESE YSC
MOD TURB BLW 080. CONDS CONTG THRU 03Z.
....

12.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) products made available before the accident flight are shown in attachment 4. The GFA surface forecast products indicated IFR conditions would prevail with likely rain shower activity (greater than 60 percent chance) for 1400 EDT with a surface wind from the east at 5 to 10 knots. The GFA cloud forecast products indicated an overcast cloud ceiling at 300 to 1,000 ft msl with cloud tops at FL450 and cirrus above. For more information please see attachment 4.

13.0 Terminal Aerodrome Forecast

KLGA was the closest site with an NWS Terminal Aerodrome Forecast (TAF) and the KLGA TAF valid at the accident time was issued at 1120 EDT and was valid for a 27-hour period beginning at 1100 EDT. The 1120 EDT TAF for KLGA was as follows:

KLGA 101520Z 1015/1118 **06013KT 5SM -SHRA BR SCT007 OVC012**
TEMPO 1018/1020 3SM BR BKN008
FM102000 11008KT 3SM BR OVC007
FM110100 13009KT 3SM SHRA BR OVC009
FM111000 30012KT P6SM BKN030 OVC040
FM111300 32014G23KT P6SM SCT040 BKN150=

The TAF expected a wind from 060° at 13 knots, 5 miles visibility, light rain showers, mist, scattered clouds at 700 ft agl, and an overcast ceiling at 1,200 ft agl.

14.0 NWS Area Forecast Discussion

The NWS Office in Upton, New York, issued the following Area Forecast Discussion (AFD) at 1338 EDT (closest AFD to the accident time with an aviation section). The aviation section of the AFD discussed widespread IFR to MVFR conditions with occasional strong gusty winds:

FXUS61 KOKX 101738
AFDOKX

Area Forecast Discussion
National Weather Service New York NY
138 PM EDT Mon Jun 10 2019

.SYNOPSIS...
A warm front will gradually lift northward towards the region
today. A cold front will then approach from the Ohio Valley and
move through early Tuesday. High pressure then returns into
Wednesday, followed by another low pressure system on Thursday.
Weak high pressure will return on Friday, with a cold frontal

passage over the weekend.

&&

.NEAR TERM /UNTIL 6 PM THIS EVENING/...
Warm advection showers along and ahead of the warm front are continuing to develop this afternoon. The activity is mainly light with some pockets of moderate rain. The warm front is currently located across central NJ and then south of Long Island. Moisture advection will continue to increase this afternoon and as the warm front nears showers should expand in coverage. The close proximity of the ridging aloft to the east and battle with dry air from lingering surface ridging may play a role in the coverage and intensity of the showers.

The latest 12z 3-km NAM and HRRR appear to be handling the current set up well and have been followed for the distribution of PoPs through the early evening. Any heavy rain should be localized this afternoon. There is a better chance at some heavier showers if portions of the region become warm sectored by this evening. The high res models hint that this is most likely to our south in NJ with the warm front likely stalling over the local area. Any of this activity would then move north and weaken a bit this evening as it encounters less instability.

Temperatures will continue to be tricky today due to clouds and showers, but should be able to reach the upper 60s to lower 70s.

There is a moderate risk of rip current development at the ocean beaches into this evening.

&&

.SHORT TERM /6 PM THIS EVENING THROUGH 6 PM TUESDAY/...
The warm front may reside over the region and not fully push north tonight. This will be followed by a cold front early Tuesday morning. The front brings showers and embedded thunderstorms with potential for locally heavy rainfall. The trend for the front has been faster with it shift to the east of the region during the morning hours.

Showers end from west to east after 12z with clearing behind it as NW flow develops.

Lows tonight will be in the mid 60s, with highs on Tuesday in the mid 70s to around 80.

&&

.LONG TERM /TUESDAY NIGHT THROUGH MONDAY/...
The period starts off with dry weather as high pressure builds into the area Tuesday night behind a departing cold front. The high builds over the area Wednesday and moves east Wednesday evening.

As a trough amplifies over the Plains, a SW flow develops

aloft allowing shortwave energy over the SE states to track up the east coast. The degree of amplification of the trough will determine the exact track of the surface low, thus details on the exact track of the surface low, as well as the axis for any heavy rain remains uncertain at this time. It does appear that the low will pass nearby if not directly through the local area Thursday and Thursday evening.

Weak high pressure builds south of the region on Friday and moves off shore Friday night. A frontal boundary is expected to approach from the west this weekend, however the timing of the front still remains uncertain at this time.

Temperatures are expected to start off slightly below normal levels moderating to near normal by the weekend.

&&

.AVIATION /18Z MONDAY THROUGH SATURDAY/...
A warm front will gradually move northward into the airspace today, followed by a cold frontal passage tonight.

Conditions in the meantime have been fluctuating between MVFR and IFR, but in general will begin to trend more towards IFR or lower into the evening, as several periods of showers are expected. Showers will then become more widespread into tonight, with isolated thunderstorms possible, particularly with the frontal passage that is expected to occur roughly between 09 and 14Z from west to east. A rapid improvement to VFR is expected thereafter.

Winds will be E-ESE 10 to 15 kt, with isolated gusts in the evening to near 20 kt possible. Winds will briefly shift to the S tonight, and then WNW overnight as the cold front moves through, becoming increasingly gusty by the morning push.

...NY Metro Enhanced Aviation Weather Support...

Detailed information, including hourly TAF wind component fcsts, can be found at: http:/www.weather.gov/zny/n90

KJFK TAF Comments: Ceilings may fluctuate between IFR-MVFR. Winds may occasionally be stronger than forecast.

The afternoon KJFK haze potential forecast is RED, which implies slant range visibility less than 4SM outside of cloud.

KLGA TAF Comments: Ceilings may fluctuate between IFR-MVFR. Winds may occasionally be stronger than forecast.

The afternoon KLGA haze potential forecast is RED, which implies slant range visibility less than 4SM outside of cloud.

KEWR TAF Comments: Ceilings may fluctuate between IFR-MVFR. Winds may occasionally be stronger than forecast.

The afternoon KEWR haze potential forecast is RED, which implies slant range visibility less than 4SM outside of cloud.

KTEB TAF Comments: Ceilings may fluctuate between IFR-MVFR. Winds may occasionally be stronger than forecast.

KHPN TAF Comments: Ceilings may fluctuate between IFR-MVFR. Winds may occasionally be stronger than forecast.

KISP TAF Comments: Ceilings may fluctuate between IFR-MVFR. Winds may occasionally be stronger than forecast.

.OUTLOOK FOR 18Z TUESDAY THROUGH FRIDAY...
.Tue...VFR. NW wind 15-20 kt gusting 25-30kt.
.Wed...VFR.
.Wed night-Thu night...Showers likely with MVFR or lower conditions.
.Fri...VFR. WNW winds G20kt.
.Saturday...VFR, becoming MVFR or lower in showers and thunderstorms late. SW winds G20 during the afternoon.

&&

.MARINE...
SCA conditions continue on the ocean through early Tuesday afternoon due to a persistent SE-S swell and moderate S flow, with post- frontal NW flow also briefly gusting to 25-30 kt throughout as well and possibly near shore into Tuesday afternoon.

Seas will then gradually subside on the ocean waters Tuesday night with sub-advisory conditions returning Wednesday morning.

An increasing easterly flow ahead of low pressure tracking up the east coast Wednesday night and Thursday should bring seas back to SCA levels Thursday afternoon. Other than a few occasional gusts to 25 kt early Thursday from an increasing low level, winds are expected to remain below SCA levels. Seas will be slow to subside, possibly not falling below SCA levels until Fri night.

&&

.HYDROLOGY...
Rainfall today could be moderate to locally heavy with amounts averaging around 0.50 inch.

Another round of heavy rainfall is possible with a cold frontal passage late tonight into early Tuesday morning. Another 0.50 to 1 inch of rain expected on average, bringing the event total up to 1 to 1.5 inches. Locally higher amounts possible in any thunderstorms. This second round may also slow down the Tuesday morning commute.

Minor nuisance flooding is most likely, with only a low chance for isolated flash flooding.

&&

.EQUIPMENT...
NYC NOAA Weather Radio Station KWO35 (162.55 MHz) remains off
the air.

&&

.OKX WATCHES/WARNINGS/ADVISORIES...
CT...None.
NY...None.
NJ...None.
MARINE...Small Craft Advisory for hazardous seas until 6 AM EDT Tuesday
for ANZ350-353-355.

&&

$$

15.0 Winds and Temperature Aloft Forecast

The NWS 0959 EDT Winds and Temperature Aloft forecast valid for 1400 EDT for the closest point to the accident site is included below:

```
FBUS31 KWNO 101359
FD1US1
DATA BASED ON 101200Z
VALID 101800Z   FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT  3000    6000    9000   12000   18000   24000  30000  34000  39000
JFK 1533 1425+14 1524+10 1521+04 2019-07 2322-17 252432 242344 242656
```

The accident site was closest to the JFK forecast point. The JFK forecast for use between 1000 EDT and 1700 EDT indicated a wind at 3,000 ft from 150° at 33 knots and at 6,000 ft a wind from 140° at 25 knots with a temperature of 14°C.

16.0 Pilot Weather Briefing

The accident pilot did not request nor receive a weather briefing through Leidos.

A check of ForeFlight was done and revealed that the accident pilot did not request a weather briefing through ForeFlight. The accident pilot did access airport information via ForeFlight before the accident flight and could have viewed information such as METAR/TAF/MOS guidance (attachments 5 and 6). It is unknown if the accident pilot checked or received any additional weather information before or during the accident flight.

17.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for the accident site on June 10, 2019, indicated the following:

SUN	
Begin civil twilight	0451 EDT
Sunrise	0524 EDT
Sun transit	1255 EDT
Accident	**1340 EDT**[29]
Sunset	2027 EDT
End civil twilight	2100 EDT

E. LIST OF ATTACHMENTS

Attachment 1 – GOES-16 visible animation from 1201 to 1501 EDT

Attachment 2 – GOES-16 infrared animation from 1201 to 1501 EDT

Attachment 3 – KOKX WSR-88D base reflectivity images for the 0.5° elevation scans animation from 1304 to 1359 EDT

Attachment 4 – GFA products available before the accident flight for around the accident time

Attachment 5 – Accident flight information via ForeFlight

Attachment 6 – METAR information from airports at times accident pilot checked that airport information

Submitted by:

_____

Paul Suffern
Senior Meteorologist

[29] Inserted accident time for reference and context.

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