



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

December 8, 2021

Specialist's Factual Report

METEOROLOGY

ERA22FA010

Table Of Contents

A.	ACCIDENT	3
B.	METEOROLOGY SPECIALIST	3
C.	DETAILS OF THE INVESTIGATION	3
D.	WEATHER INFORMATION	3
1.0	Synoptic Conditions.....	3
1.1	Surface Analysis Chart	4
1.2	National Composite Radar Mosaic	4
1.3	Low-Level Significant Weather Prognostic Chart.....	5
2.0	Observations	6
2.1	Stewart, New York.....	6
2.2	Poughkeepsie, New York.....	7
2.3	Danbury, Connecticut	8
2.4	White Plains, New York	8
2.5	Teterboro, New Jersey	9
2.6	Islip, New York.....	10
2.7	METAR Display	11
2.8	Remote Automated Weather Stations	13
3.0	Sounding	14
4.0	Satellite Imagery	15
5.0	Weather Surveillance Radar Imagery	17
6.0	Pilot Reports.....	20
7.0	NWS Forecasts.....	21
7.1	Terminal Aerodrome Forecasts.....	21
7.2	Area Forecast Discussion.....	22
7.3	Graphical Forecast for Aviation.....	23
8.0	NWS Inflight Weather Advisories.....	25
9.0	Preflight Weather Briefing.....	26
10.0	Astronomical Conditions	26

A. ACCIDENT

Location: Cornwall, New York
Date: October 10, 2021
Time: 1357 eastern daylight time (EDT)
1757 coordinated universal time (UTC)
Airplane: Robinson Helicopter R44 II; Registration: N637HP

B. METEOROLOGY SPECIALIST

Don Eick
Senior Meteorologist
Operational Factors Division (AS-30)
National Transportation Safety Board

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's Senior Meteorologist was not on scene for this investigation and conducted the meteorology phase of the investigation from the Washington D.C. office, collecting data from official National Weather Service (NWS) sources including the Weather Prediction Center (WPC) and the National Center for Environmental Information (NCEI). All times are reported as EDT based upon the 24-hour clock, local time is -4 hours from UTC, and UTC=Z. 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. Directions are referenced to true north and distances in nautical miles. Heights are in feet (ft) 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 41.427329° N and longitude 73.985540° W at an elevation of approximately 300 ft. The flight track data of N637HP noted the helicopter flying southward along the Hudson River at 1,875 ft immediately prior to the accident.

D. WEATHER INFORMATION

1.0 Synoptic Conditions

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 weather features and in the creation of forecasts and warnings. Reference to these charts can be found in the joint NWS and Federal Aviation Administration (FAA) Advisory Circular "Aviation Weather Services", AC 00-45H change 2.

1.1 Surface Analysis Chart

The northeast section of the NWS Surface Analysis Chart for 1400 EDT is included as figure 1 with the approximate accident site marked by a red star. The chart depicted a low-pressure system at 1008-hectopascals (hPa) located to the south of the accident site off the Maryland coast with a warm front extending eastward. To the east-northeast of the accident site a high-pressure system at 1028-hPa was located off Gander, Canada, with a ridge of high pressure extending westward into New England and into central New York. The station models surrounding the accident site depicted light easterly winds of 5 knots or less, overcast clouds, with temperatures near 63° Fahrenheit (F), and dew point temperatures of 57° F. Several stations across Long Island, Connecticut, and New Jersey indicated light to moderate rain.

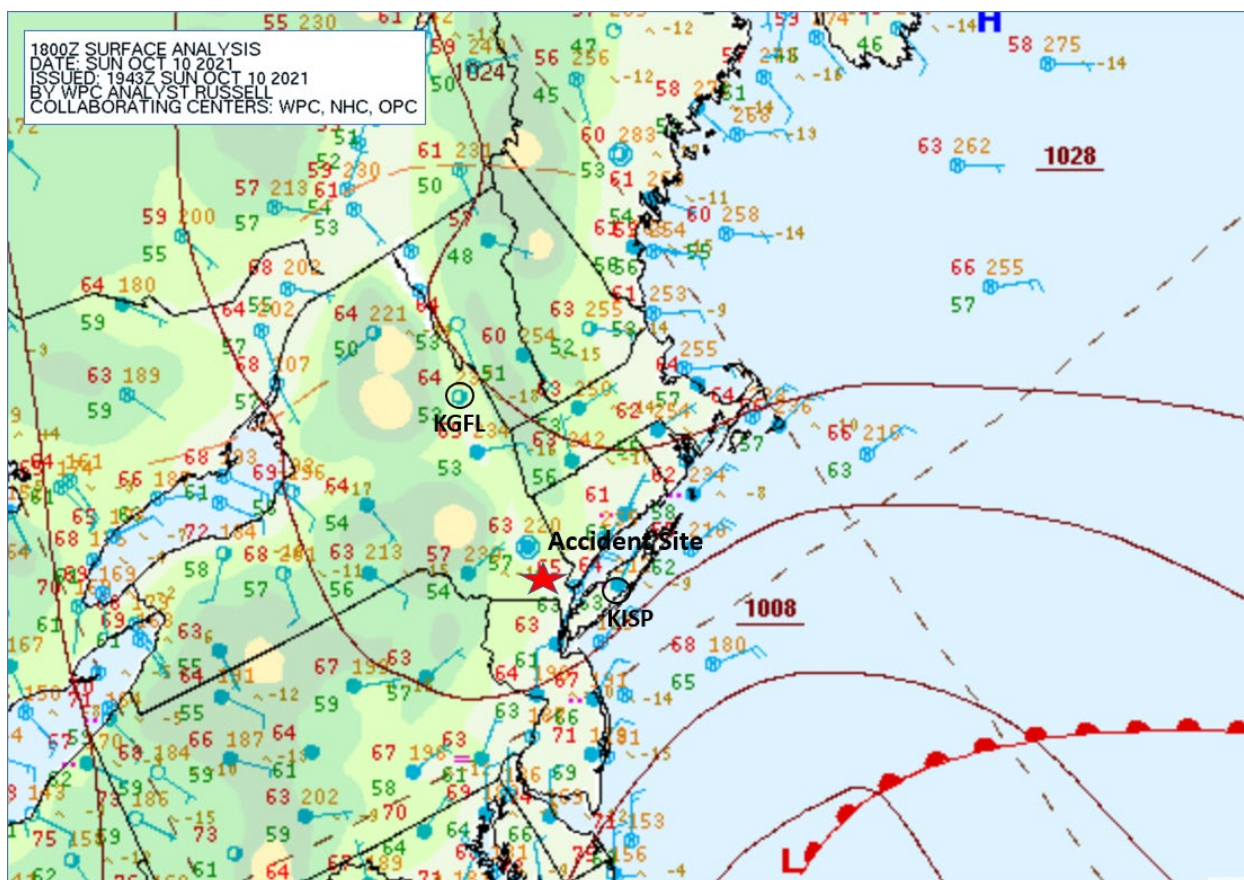


Figure 1 - Northeast section of the NWS Surface Analysis Chart for 1400 EDT with the approximate accident site marked by red star.

1.2 National Composite Radar Mosaic

The regional view of the National Composite Radar Mosaic for 1355 EDT is included as figure 2 with the approximate accident site marked by the red star. Several of the closest weather reporting sites have been added that will be documented in section 2.0 below. The image depicts a large band of precipitation extending across eastern Long Island into southern New Jersey, with another area of scattered light to moderate echoes associated with rain showers extending from

northeast New Jersey, southern New York, into Connecticut immediately south of the accident site. Based on the potential for echoes in the vicinity of the accident site the closest weather surveillance radar will be further documented in section 5.0 of this report.



Figure 2 - National Composite Radar Mosaic for 1355 EDT with the approximate accident site marked.

1.3 Low-Level Significant Weather Prognostic Chart

The NWS 12- and 24-hour Low-Level Significant Weather Prognostic Chart valid for 1400 EDT (left) and for 0200 EDT (right) is included as figure 3, and depicted the general flight categories¹, turbulence below 12,000 ft, and freezing levels. The areas of IFR conditions have been highlighted

¹ 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 the solid red line and the areas of MVFR conditions by the scalloped blue line, with VFR areas are not depicted.

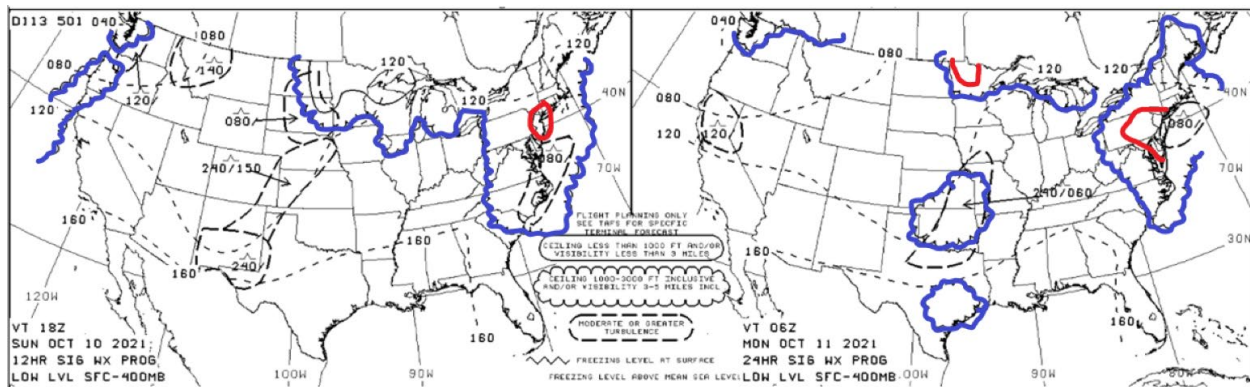


Figure 3 - 12-hour and 24-hour Low-Level Significant Weather Prognostic Chart valid for the period. The 12-hour forecast valid for 1400 EDT (left) and 24-hour forecast valid for 0200 EDT (right).

The 12-hour forecast valid for 1400 EDT (on the left) depicted a small area of IFR conditions expected over southeast New York, New Jersey, and western Connecticut, and included the accident site surrounded by a larger area of MVFR conditions over the mid-Atlantic through the northeast and Great Lakes region. The 24-hour forecast valid for 0200 EDT (on the right) depicted the area of IFR conditions increasing over the area and including eastern Pennsylvania, Maryland, and Delaware, with MVFR conditions surrounding the area.

2.0 Observations

The official observations issued surrounding the accident site were documented using Aviation Routine Weather Reports (METAR²) and Aviation Select Special Weather Reports (SPECI). Cloud heights are reported above ground level (agl) in the following section, and the magnetic variation was estimated at 13° west based on the latest sectional chart for the area.

2.1 Stewart, New York

The closest official weather reporting location to the accident site was New York Stewart International Airport (KSWF), Stewart, New York, located 7 miles northwest of the accident site at an elevation of 491 ft. The airport is attended continuously and is a joint military field, with human based observations. At the time of the accident the following conditions were reported.

KSWF weather observation at 1345 EDT, wind from 070° at 5 knots, visibility 5 miles in mist, ceiling overcast at 1,500 ft agl, temperature 16° Celsius (C), dew point temperature 14° C, altimeter setting 30.20 inches of mercury (inHg).

The general flight conditions and raw METARs in standard format issued surrounding the period from 1130 through 1800 EDT were as follows, with the observation decoded above and the time of the accident added in bold italic print.

² METAR is an abbreviation for meteorological aerodrome report.

MVFR METAR KSWF 101545Z 05005KT 10SM OVC015 15/12 A3022=

MVFR METAR KSWF 101645Z 06010KT 10SM OVC015 16/13 A3021=

MVFR METAR KSWF 101745Z 07005KT 5SM BR OVC015 16/14 A3020=

Accident 1757Z

METAR KSWF 101845 MISSING

MVFR METAR KSWF 101945Z 06006KT 5SM BR OVC012 16/16 A3018=

MVFR METAR KSWF 102045Z 08006KT 5SM BR OVC012 16/16 A3017=

MVFR METAR KSWF 102145Z 08005KT 6SM BR OVC010 16/16 A3016=

2.2 Poughkeepsie, New York

The next closest weather reporting location was Hudson Valley Regional Airport (KPOU), Poughkeepsie, New York, located approximately 12.5 miles north of the accident site at an elevation of 164 ft. The airport had a federally installed and maintained Automated Surface Observation System (ASOS), which was augmented by air traffic control tower personnel when in operation. At the time of the accident the following conditions were reported.

KPOU weather observation at 1353 EDT, wind calm, visibility 10 miles or more, ceiling overcast at 2,200 ft agl, temperature 17° C, dew point temperature 14° C, altimeter setting 30.19 inHg. Remarks; automated station with a precipitation discriminator, sea-level pressure 1022.0-hPa, temperature 17.2° C, dew point temperature 13.9° C, 6-hour maximum temperature 17.2° C, 6-hour minimum temperature 13.9° C, 3-hour pressure tendency fallen 1.2-hPa.

The general flight conditions and raw observations from 1130 through 1700 EDT reported surrounding the time of the accident were as follows.

MVFR METAR KPOU 101553Z 35006KT 10SM OVC022 17/13 A3021 RMK AO2 SLP228 T01670128=

MVFR METAR KPOU 101653Z 35005KT 10SM OVC022 17/13 A3020 RMK AO2 SLP224 T01720133=

MVFR METAR KPOU 101753Z 00000KT 10SM OVC022 17/14 A3019 RMK AO2 SLP220 T01720139 101720139 57012=

Accident 1757Z

MVFR METAR KPOU 101853Z 00000KT 10SM OVC020 17/14 A3018 RMK AO2 SLP217 T01720144=

MVFR METAR KPOU 101953Z 00000KT 10SM OVC020 17/15 A3016 RMK AO2 RAB28E39 SLP211 P0000 T01720150=

MVFR METAR KPOU 102053Z 34003KT 10SM OVC018 17/15 A3016 RMK AO2 SLP211 60000 T01670150 56009=

2.3 Danbury, Connecticut

Danbury Municipal Airport (KDXR), Danbury, Connecticut, was located about 23 miles east of the accident site and an elevation of 458 ft and had an ASOS which was augmented by air traffic control personnel during normal operating hours between 0600 through 2200 local. At the time of the accident the following conditions were being reported.

KDXR weather observation at 1353 EDT, wind from 070° at 8 knots, visibility 4 miles in light rain, ceiling overcast at 1,300 ft agl, temperature 17° C, dew point temperature 14° C, altimeter setting 30.21 inHg. Remarks: automated station with a precipitation discriminator, rain began at 1344 EDT, sea-level pressure 1022.8-hPa, hourly precipitation less than 0.01" (trace), 6-hour precipitation total trace, temperature 17.2° C, dew point temperature 13.9° C, 6-hour maximum temperature 17.2° C, 6-hour minimum temperature 14.4° C, 3-hour pressure tendency fallen 1.2-hPa.

The general flight conditions and raw observations reported surrounding the time of the accident from 1045 through 1700 EDT were as follows.

MVFR METAR KDXR 101453Z 05007KT 10SM BKN016 OVC022 16/12 A3024 RMK AO2 SLP239 T01610122 58004=

MVFR METAR KDXR 101553Z 07007KT 10SM OVC013 17/13 A3022 RMK AO2 SLP233 T01670128=

MVFR METAR KDXR 101653Z 05009KT 10SM OVC013 17/13 A3022 RMK AO2 SLP231 T01720133=

MVFR METAR KDXR 101753Z 07008KT 4SM -RA OVC013 17/14 A3021 RMK AO2 RAB44 SLP228 P0000 60000 T01720139 10172 20144 56012=

Accident 1757Z

MVFR METAR KDXR 101853Z 05008KT 10SM OVC011 17/14 A3019 RMK AO2 RAE14 SLP223 P0000 T01720144=

MVFR METAR KDXR 101953Z 07008KT 10SM OVC011 17/14 A3018 RMK AO2 SLP219 T01720144=

MVFR METAR KDXR 102053Z 04005KT 6SM HZ OVC010 17/14 A3018 RMK AO2 SLP218 60000 T01720144 56010

2.4 White Plains, New York

Westchester County airport (KHPN), White Plains, New York, was located approximately 25 miles south of the accident site at an elevation of 439 ft. The airport also had an ASOS which was augmented by air traffic control tower personnel when in operation. The following conditions were reported at the time of the accident.

KHPN weather observation at 1356 EDT, wind from 060° at 10 knots gusting to 16 knots, visibility 2 1/2 miles in light rain and mist, ceiling broken at 600 ft agl, overcast at 1,100 ft, temperature 16° C, dew point temperature 15° C, altimeter setting 30.17 inHg. Remarks: automated station with a precipitation discriminator, sea-level pressure 1021.4-hPa, hourly precipitation 0.12", 6-hour precipitation total 0.13", temperature 16.1° C,

dew point temperature 15.0° C, 6-hour maximum temperature 16.7° C, 6-hour minimum temperature 14.4° C, 3-hour pressure tendency fallen 1.2-hPa.

The general flight conditions and raw observations reported surrounding the time of the accident were as follows.

MVFR METAR KHPN 101456Z 08011G16KT 10SM OVC012 16/13 A3020 RMK AO2 SLP226 60001 T01610133 58006=

MVFR METAR KHPN 101556Z 07011G15KT 10SM OVC011 17/14 A3019 RMK AO2 SLP221 T01670139=

IFR METAR KHPN 101656Z 08010G18KT 2 1/2SM -RA BR OVC011 16/14 A3018 RMK AO2 RAB52 SLP219 P0000 T01610139=

IFR SPECI KHPN 101728Z 06008KT 1SM R16/P6000FT -RA BR BKN006 OVC011 16/15 A3018 RMK AO2 P0007 T01560150=

IFR METAR KHPN 101756Z 06010G16KT 2 1/2SM -RA BR BKN006 OVC011 16/15 A3017 RMK AO2 SLP214 P0012 60013 T01610150 10167 20144 56012=

Accident 1757Z

LIFR METAR KHPN 101856Z 07010KT 2 1/2SM -RA BR BKN004 OVC010 16/15 A3016 RMK AO2 SLP210 P0000 T01610150=

LIFR METAR KHPN 101956Z 06007KT 1 1/2SM -RA BR OVC004 16/15 A3015 RMK AO2 SLP207 P0000 T01610150=

IFR METAR KHPN 102056Z 07008KT 6SM BR OVC006 17/16 A3014 RMK AO2 RAE52 CIG 004V009 SLP205 P0000 60000 T01670156 56009=

2.5 Teterboro, New Jersey

Teterboro Airport, Teterboro, New Jersey, was located 34.5 miles south of the accident site at an elevation of 8 ft. The airport had an ASOS and was also augmented by air traffic control tower personnel when in operation. At the time of the accident the following conditions were reported.

KTEB weather observation at 1351 EDT, wind from 040° at 6 knots, visibility 3 miles in light rain and mist, ceiling overcast at 700 ft agl, temperature 17° C, dew point temperature 16° C, altimeter setting 30.14 inHg. Remarks: automated station with a precipitation discriminator, sea-level pressure 1020.6-hPa, hourly precipitation 0.04", 6-hour precipitation total 0.06", temperature 16.7° C, dew point temperature 15.6° C, 6-hour maximum temperature 17.2° C, 6-hour minimum temperature 15.6° C, 3-hour pressure tendency fallen 1.5-hPa.

The general flight categories and raw observations reported surrounding the period of the accident were as follows.

MVFR METAR KTEB 101451Z 00000KT 10SM -RA BR OVC013 17/14 A3018 RMK AO2 SLP220 P0000 60002 T01670139 58005=

MVFR METAR KTEB 101551Z 06009G15KT 7SM BR OVC013 17/14 A3017 RMK AO2 RAE46 SLP215 P0000
T01720144=

MVFR METAR KTEB 101651Z 05008KT 4SM -RA BR OVC012 17/15 A3016 RMK AO2 RAB50 SLP212 P0000
T01720150=

IFR SPECI KTEB 101705Z 04008KT 3SM -RA BR OVC007 17/15 A3016 RMK AO2 P0001 T01720150=

IFR METAR KTEB 101751Z 04006KT 3SM -RA BR OVC007 17/16 A3014 RMK AO2 SLP206 P0004 60006
T01670156 10172 20156 58015=

Accident 1757Z

IFR SPECI KTEB 101810Z 05009KT 020V080 2SM R06/6000VP6000FT -RA BR OVC007 17/16 A3013 RMK
AO2 P0002 T01720156=

IFR SPECI KTEB 101826Z VRB06KT 5SM -RA BR OVC007 17/16 A3013 RMK AO2 P0003 T01720161=

IFR METAR KTEB 101851Z 05007KT 5SM -RA BR OVC007 17/16 A3013 RMK AO2 SLP202 P0004
T01720161=

IFR METAR KTEB 101951Z 05009KT 5SM -RA BR OVC007 18/17 A3012 RMK AO2 SLP200 P0000
T01780167=

MVFR SPECI KTEB 102022Z VRB06KT 10SM OVC011 18/17 A3012 RMK AO2 RAE16 P0000 T01830167=

MVFR METAR KTEB 102051Z 03009KT 10SM OVC011 18/17 A3012 RMK AO2 RAE16 SLP198 P0000 60004
T01830167 56008=

IFR SPECI KTEB 102130Z 04007KT 5SM -RA BR OVC008 18/16 A3012 RMK AO2 RAB25 P0000 T01780161=

IFR METAR KTEB 102151Z 06006KT 5SM -RA BR OVC008 17/16 A3011 RMK AO2 RAB25 SLP197 P0000
T01720161=

2.6 Islip, New York

The planned destination was Long Island Mac Arthur Airport (KISP), Islip, New York, located approximately 55 miles southeast of the accident site at an elevation of 99 ft. The airport also had an ASOS, which was augmented by air traffic control tower personnel when in operation. The following conditions were reported at the time of the accident.

KISP weather observation at 1356 EDT, wind from 060° at 12 knots, visibility 8 miles in light rain, a few clouds at 800 ft agl, ceiling broken at 1,200 ft, overcast at 4,700 ft, temperature 18° C, dew point temperature 17° C, altimeter setting 30.16 inHg. Remarks: automated station with a precipitation discriminator, rain began at 1315 EDT, sea-level pressure 1021.2-hPa, hourly precipitation less than 0.01", 6-hour precipitation total 0.11", temperature 17.8° C, dew point temperature 17.2° C, 6-hour maximum temperature 18.9° C, 6-hour minimum temperature 17.2° C, 3-hour pressure tendency fallen 0.9-hPa, maintenance indicator on.

The general flight categories and raw observations reported surrounding the period of the accident were as follows.

MVFR METAR KISP 101456Z 07010G18KT 10SM OVC016 19/16 A3018 RMK AO2 SLP221 T01890161 58004=

IFR SPECI KISP 101534Z 07008KT 2SM -RA BR FEW010 OVC015 18/17 A3018 RMK AO2 SFC VIS 3 RAB14 P0000 T01830167=

IFR METAR KISP 101556Z 06012KT 1 1/2SM R06/5000VP6000FT RA BR FEW007 BKN015 OVC029 18/17 A3018 RMK AO2 SFC VIS 2 RAB14 SLP218 P0008 T01780167 \$=

MVFR SPECI KISP 101613Z 06012KT 5SM -RA BR FEW008 BKN014 OVC036 18/17 A3017 RMK AO2 P0003 T01780167 \$=

MVFR METAR KISP 101656Z 06014KT 8SM FEW008 BKN011 OVC028 18/17 A3016 RMK AO2 RAE21 SLP213 P0003 T01830172 \$=

MVFR METAR KISP 101756Z 06012KT 8SM -RA FEW008 BKN012 OVC047 18/17 A3016 RMK AO2 RAB15 SLP212 P0000 60011 T01780172 10189 20172 56009 \$=

Accident 1757Z

MVFR METAR KISP 101856Z 06012KT 8SM BKN011 BKN028 OVC044 18/17 A3013 RMK AO2 RAE48 SLP203 P0000 T01830172 \$=

IFR METAR KISP 101956Z 05011KT 10SM OVC009 18/17 A3013 RMK AO2 RAB04E47 SLP203 P0000 T01830167 \$=

IFR METAR KISP 102056Z 05010KT 10SM OVC009 18/17 A3012 RMK AO2 RAB1958E06 SLP199 P0000 60000 T01830172 56013 \$=

MVFR METAR KISP 102156Z 05010KT 10SM BKN011 BKN024 OVC110 18/17 A3012 RMK AO2 SLP198 T01830167 \$=

2.7 METAR Display

A depiction of the conditions at 1400 EDT from the NWS Aviation Weather Center's METAR display³ is included as figure 4, with the approximate accident site marked by the red star. The image includes the radar overlay for the period and depicted moderate intensity echoes immediately south of the accident site.

³ <https://www.aviationweather.gov/metar>

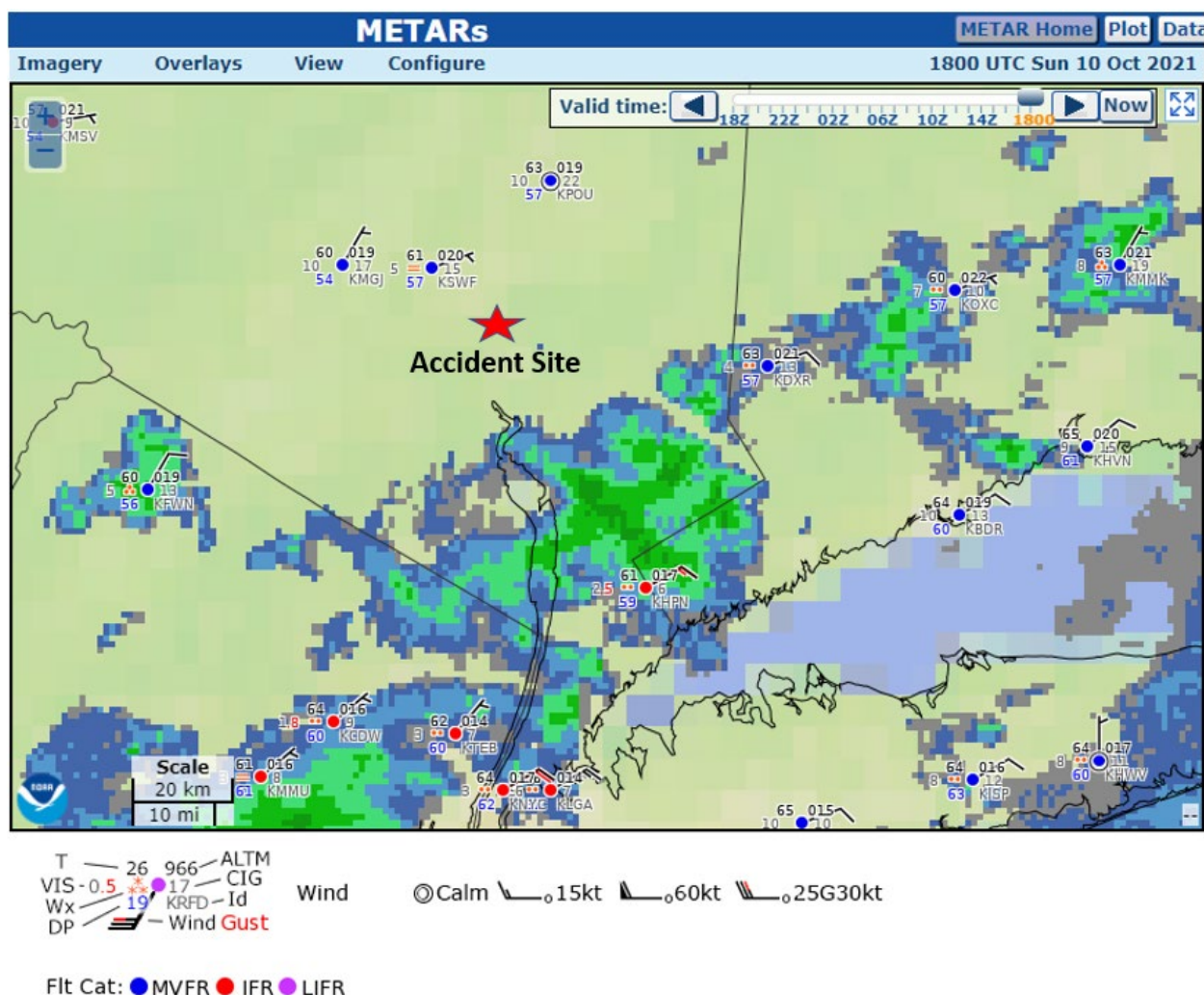
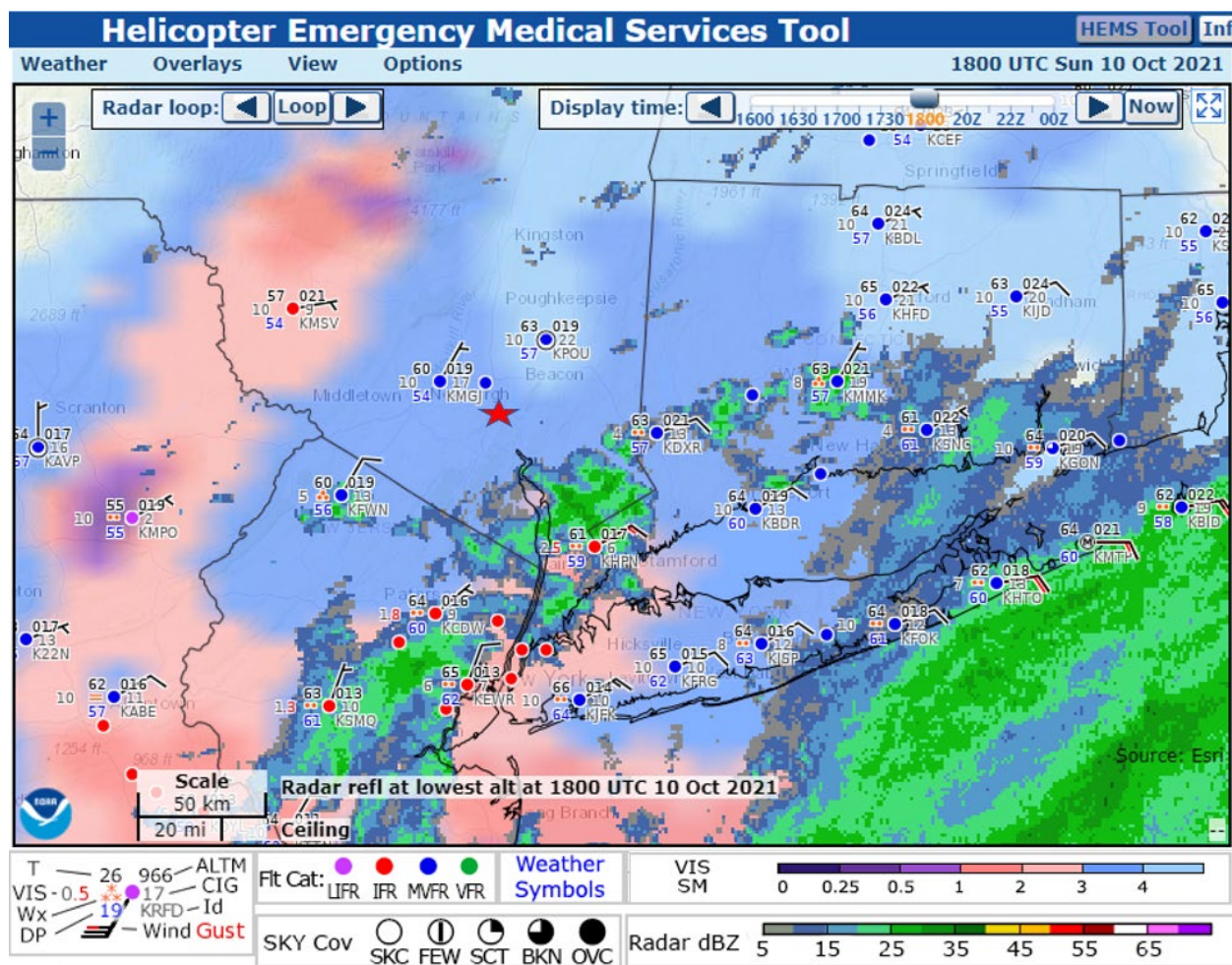


Figure 4 - NWS Aviation Weather Center's METAR display at 1400 EDT with accident site.

Figure 5 is the NWS AWC Helicopter Emergency Medical Services (HEMS) Weather Tool⁴ display of the METAR observations, radar image and the general flight visibility for 1400 EDT with the approximate accident site noted by the red star. The accident site was located in an area where visibilities were depicted from 3 to 4 miles, with visibilities less than 3 miles immediately south. Numerous stations immediately southeast, south, through southwest reported IFR conditions due to low ceilings and visibility at the time.

⁴ <https://www.aviationweather.gov/hemst>



2.8 Remote Automated Weather Stations

A review of Remote Automated Weather Stations (RAWS) sites in the vicinity of the accident site included the United States Military Academy (USMA) at latitude 41.3650 N and longitude 74.026667 W, approximately 4 miles southwest of the accident site at an elevation 922 ft. The station reported the following conditions at 1355 EDT, with the wind rounded to the nearest 5°, and wind speed converted from miles per hour (mph) to knots.

Temperature	59° F
Dew Point Temperature	57° F
Relative Humidity	94%
Wind	070° at 3 knots
Peak Wind	055° at 7 knots

3.0 Sounding

To determine the vertical structure of the atmosphere over the accident site a High-Resolution Rapid Refresh (HRRR) numerical model was obtained from the NOAA Air Resource Laboratory using the closest grid point⁵ to the accident site coordinates for 1400 EDT. The HRRR numerical model was then plotted on a standard skew T log P diagram⁶ using the RAOB software program⁷ from the surface through 20,000 ft and is included as figure 6.

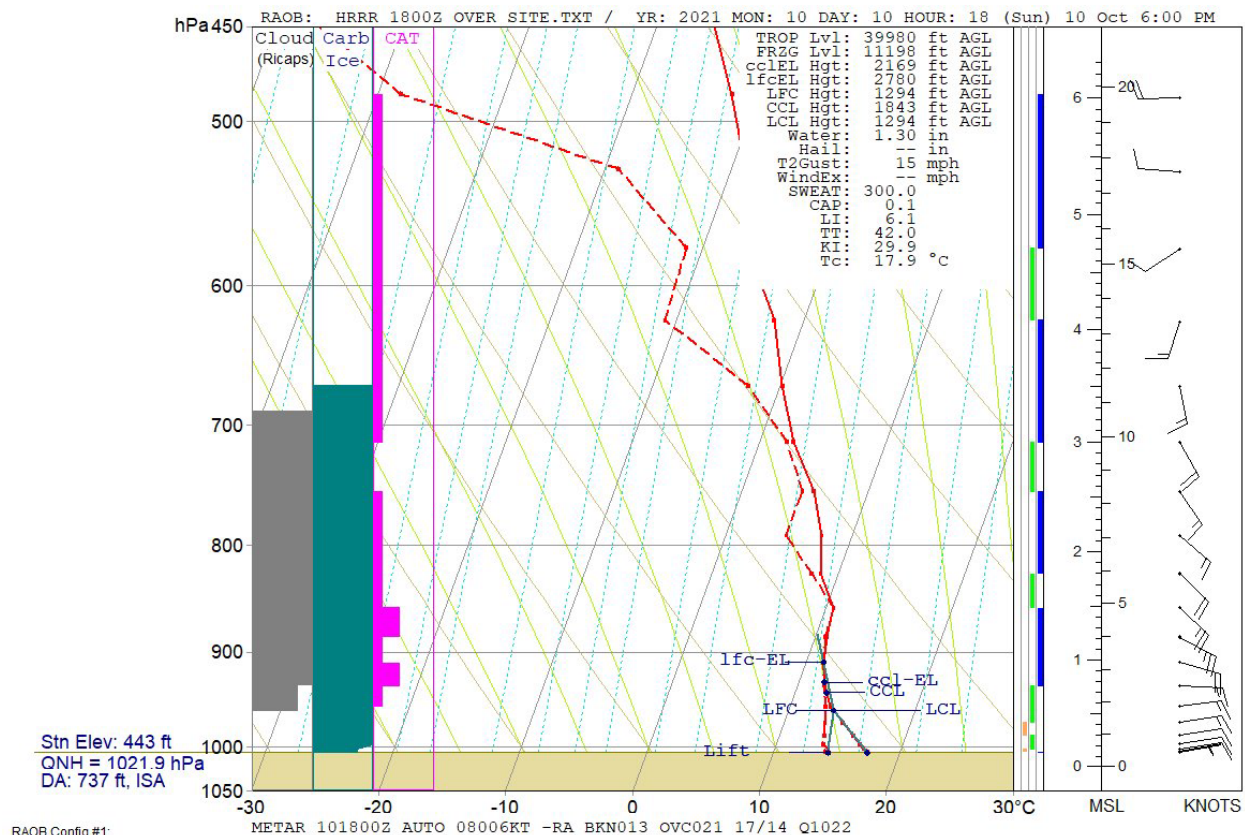


Figure 6 - High-Resolution Rapid Refresh model sounding for 1400 EDT over the area of the accident site.

The HRRR 1400 EDT sounding depicted an elevation of 443 ft, with a near surface temperature of 17.4° C (63.3° F), a dew point temperature of 14.3° C (57.7° F), with a relative humidity of 82%. The sounding depicted a lifted condensation level (LCL)⁸ and level of free convection

⁵ Nearest grid point was at latitude 41.43° N and longitude 73.99° W.

⁶ Skew T log P diagram – is a standard meteorological plot or thermodynamic diagram using temperature and the logarithmic of pressure as coordinates, used to display winds, temperature, dew point, and various indices used to define the vertical structure of the atmosphere.

⁷ RAOB – (The Universal RAWinsonde OBservation program) is an interactive sounding analysis program developed by Eosonde Research Services (ERS) previously known as Environmental Research Services, The Villages, Florida.

⁸ Lifted Condensation Level - the level at which a lifted parcel becomes saturated. The LCL height corresponds to cloud base height for forced ascent.

(LFC)⁹ at 1,294 ft agl, with a convective condensation level (CCL)¹⁰ at 1,843 ft agl, with RAOB depicting broken clouds at about 1,300 ft agl, and an overcast layer of clouds at 2,100 ft with the sounding saturated from the LCL through 11,000 ft (depicted as gray bar on left axis). The precipitable water content was 1.30 inches, with the freezing level was at approximately 11,200 ft. The RAOB analysis program also indicated a greater than 80% probability of moderate to severe risk of carburetor type icing (green bar on left axis) from the surface through 12,000 ft, based on the thermal and relative humidity structure of the atmosphere. The Lifted Index (LI)¹¹ of 6.1 indicated a stable atmosphere, and the RAOB analysis program indicated conditions favoring nimbostratus type clouds with light rain at the time.

The HRRR 1400 EDT wind profile indicated a near surface wind from 080° at 6 knots with winds veering or turning clockwise to the southeast with a low-level wind maximum at approximately 4,800 ft agl from 137° at 25 knots. The wind continuing to veer to the south and then west at 15,000 ft. The mean 0 to 6 km (18,000 ft) wind was from 167° at 8 knots. The estimated wind at 1,875 ft or the last known altitude of the helicopter was from 085° at 14 knots.

A table of the HRRR parameters of height, pressure, temperature (T), dew point temperature (Td), relative humidity (RH), wind direction and speed, clear air turbulence (CAT), and low-level wind shear (LLWS) potential were as follows from the surface through 5,000 ft.

Height (ft-msl)	Pres hPa	T (°C)	Td (°C)	RH (%)	Wind (deg/kts)	CAT (FAA)	LLWS (FAA)
443	1006	17.4	14.3	82	079/ 6		
471	1005	17.4	14.1	81	078/ 6		LIGHT
555	1002	17.0	14.2	84	080/ 8		LIGHT
695	997	16.6	13.7	83	080/ 10		
977	987	15.8	13.5	86	080/ 12		
1375	973	14.6	13.2	91	080/ 13		
1864	956	13.2	12.8	97	083/ 14	LGT	
2507	934	12.1	12.1	100	093/ 17	MDT	
3193	911	11.4	11.4	100	108/ 21	LGT	
3988	885	10.9	10.8	99	121/ 23	MDT	
4870	857	10.6	10.6	100	137/ 25	LGT	
5909	825	8.6	7.9	95	137/ 19	LGT	

4.0 Satellite Imagery

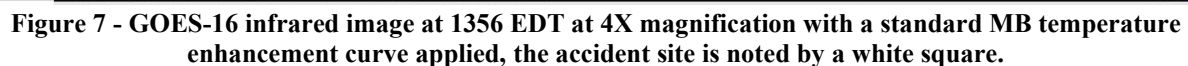
The Geostationary Operational Environmental Satellite number 16 (GOES-16) data were obtained from an archive at the Space Science Engineering Center (SSEC) at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man-computer Interactive

⁹ Level of Free Convection (LFC) - the last level where a parcel becomes buoyant, or "warmer" than the environmental temperature at the same level. The LFC represents the bottom of the layer containing CAPE.

¹⁰ Convective Condensation Level - 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 Lifted Index (LI) - A common measure of atmospheric instability. Its value is obtained by computing the temperature that air near the ground would have if it were lifted to 500-hPa or approximately 18,000 feet and comparing that temperature to the actual temperature at that level.

The GOES-16 infrared and visible images at 1356 EDT are included as figures 7 and 8 respectively. The images depict a thick layer of clouds that obscured the accident site with a radiative cloud top temperature of 243 Kelvin or -30° C, which corresponded to cloud tops near 27,000 ft.



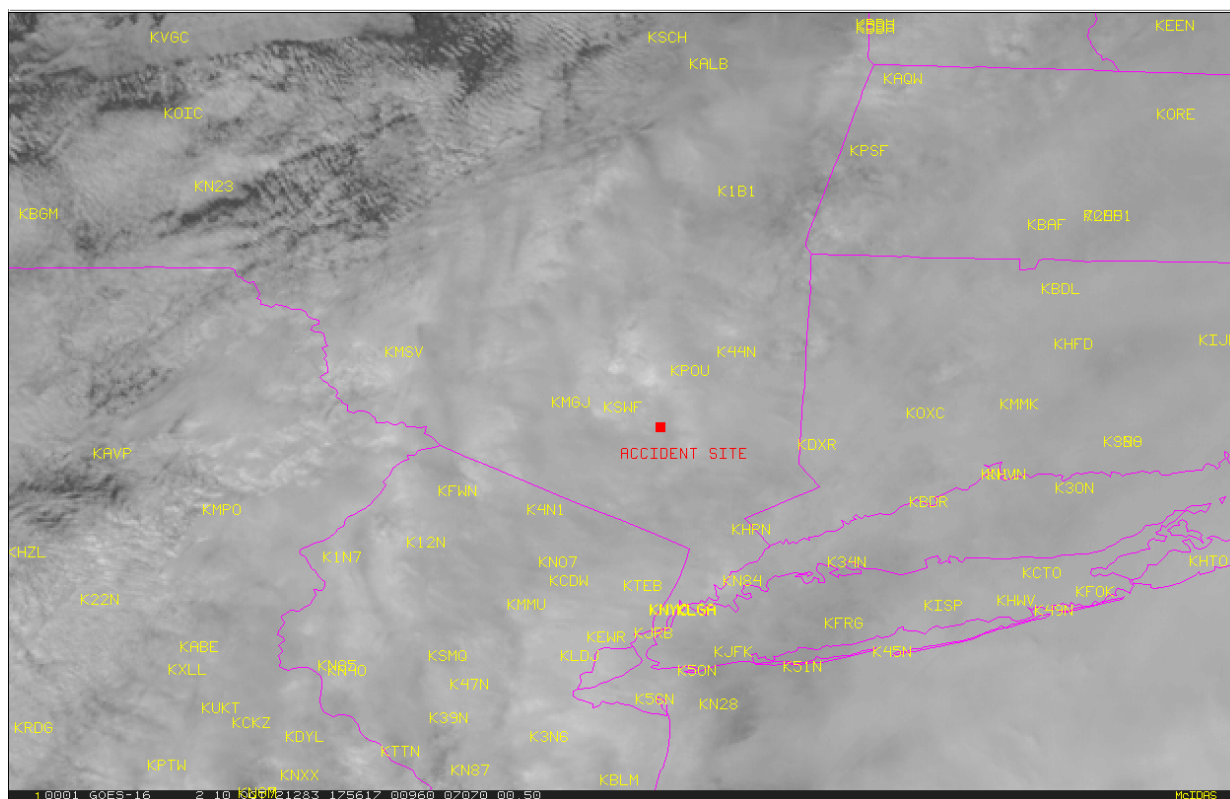


Figure 8 - GOES-16 visible image at 1356 EDT at 2X magnification, accident site marked by red square.

5.0 Weather Surveillance Radar Imagery

The closest NWS Weather Surveillance Weather Radar 1988 Doppler (WSR-88D)¹² was from the New York City (KOKX) WSR-88D located in Upton, NY, approximately 60 miles southeast of the accident site. The level II and III data were obtained from the NCEI archive and displayed using the NWS NEXRAD Interactive Viewer and Data Exporter software. During the period the KOKX WSR-88D was operating in the standard precipitation mode volume scanning pattern 215 (VCP-215) where the radar makes 15 different elevation scans during the 7 minute scan. Figure 9 is a depiction of the VCP-215 elevation scanning strategies.

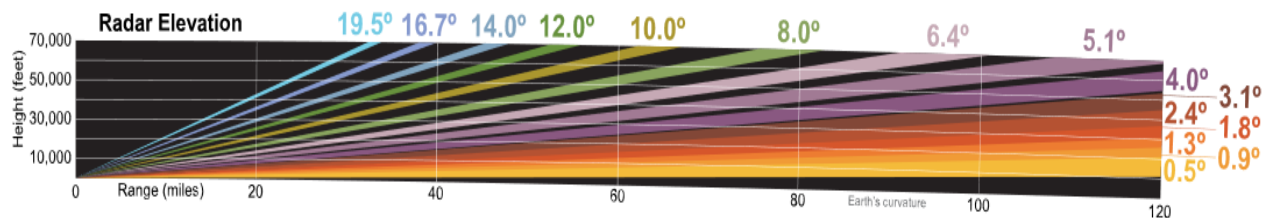


Figure 9 - WSR-88D VCP-215 elevation scanning strategies.

¹² The WSR-88D is a S-band 10-centimeter wavelength radar with a power output of 750,000 watts, with a 28-foot parabolic antenna concentrating the energy into a 0.95° beam width. The radar produces three basic types of products: reflectivity, radial velocity, and spectral width.

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors¹³, 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)¹⁴ and is a general measure of echo intensity.

The FAA Advisory Circular AC 00-24C - “Thunderstorm” defines echoes less than 30 dBZ as “light” in intensity, “moderate” echoes 30-40 dBZ, “heavy” with echoes of >40-50 dBZ, and “extreme” intensity with echoes above >50 dBZ. These are the new standard radio phraseology terms used by air traffic controllers to describe weather conditions to pilots as shown in figure 10.

Reflectivity (dBZ) Ranges	Weather Radar Echo Intensity Terminology
< 30 dBZ	Light
30-40 dBZ	Moderate
>40-50 dBZ	Heavy
>50 dBZ	Extreme

Figure 10 - Reflectivity and weather echo intensity terminology.

The center of the KOKX lowest 0.53° elevation scan was centered near 5,800 ft over the accident site. Figure 11 is the KOKX WSR-88D 0.53° base reflectivity image at 1457 EDT with the flight track overlaid in pink, with figure 12 a closeup of the radar image over the accident site. The image depicted a small area of echoes less than 15 dBZ over the Cornwall area and the accident site, with another defined area of light-to-moderate echoes near 34.5 dBZ about 3 miles south of the accident site through the KHPN and KLGA area. An animation of the radar imagery indicated that the echoes were moving to the north-northwest with time consistent with the HRRR mean winds.

The flight track indicated that N637HP was operating at 1,875 ft msl and as it approached the area of light intensity echoes the helicopter slowed from around 110 knots to 54 knots ground speed at 1356 EDT and climbed to 2,475 ft, with the last target of the track turning northwest at 2,400 ft and 97 knots.

¹³ Hydrometeors are any product of condensation or sublimation of atmospheric water vapor, whether formed in the free atmosphere or at 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.

¹⁴ dBZ - 10 log Z_e

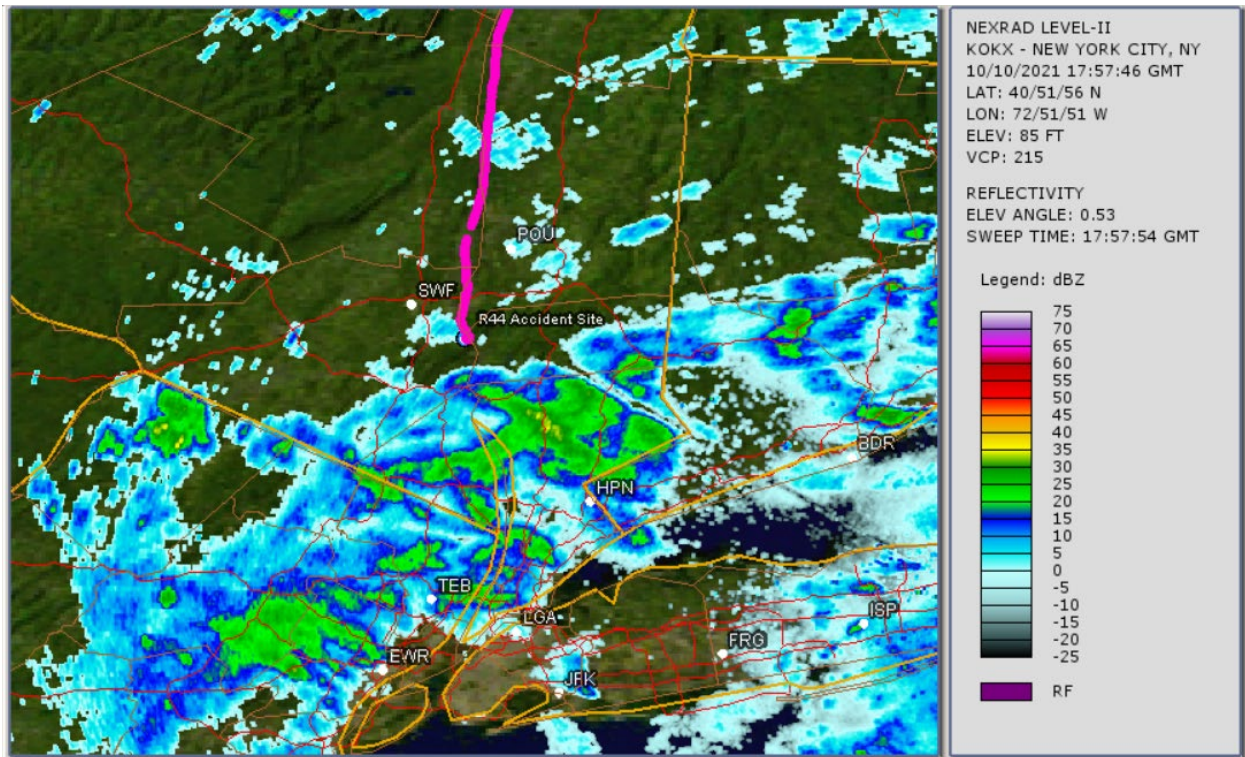


Figure 11 – KOKX WSR-88D 0.53° base reflectivity image at 1357 EDT.

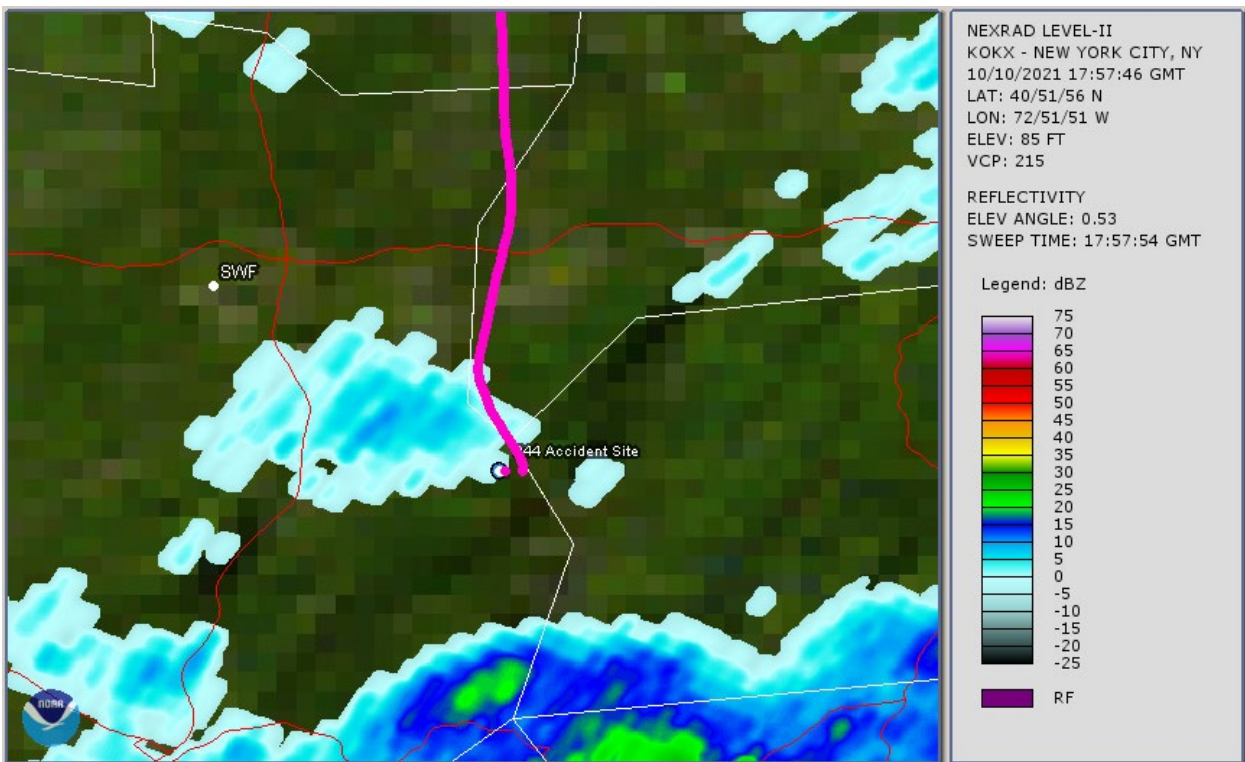


Figure 12 - KOKX WSR-88D 0.53° base reflectivity image with flight track for 1357 EDT.

6.0 Pilot Reports

The following pilot reports (PIREPs)¹⁵ were distributed into the national airspace between 1000 and 1600 EDT below 10,000 ft and within 80 miles of the accident site. The reports are provided in standard code and abbreviations with time referenced to UTC, with altitudes and cloud heights reported in msl heights. Reports of ceilings less than 1,000 ft are provided in bold black type.

BDL UA /OV 6 SW 3B0/TM 1402/FL030/TP SR22/SK BKN020
ABE UA /OV FJC/TM 1408/FL040/TP BE33/WV 13031
OXC UA /OV OXC/TM 1419/FLDURC/TP P28A/SK BKN016
HPN UA /OV HPN/TM 1420/FL014/TP P46T/SK CIG 014 BKN/RM ILS RWY 16 CLOUD BASES 1400MSL
EWR UA /OV 3 S EWR/TM 1432/FL010/TP A320/SK 010 OVC
ISP UA /OV ISP066005/TM 1445/FLDURD/TP LJ60/SK BKN015
EWR UA /OV 2 S EWR/TM 1456/FL007/TP DH8D/SK 007 OVC
BDL UA /OV BDL270015/TM 1501/FL030/TP E755/SK B033 T044 BKN/RM DURD
MMU UA /OV MMU/TM 1510/FL007/TP GALX/SK OVC007
OXC UA /OV OXC/TM 1513/FLDURC/TP FA20/SK OVC020
HFD UA /OV HFD/TM 1517/FL019/TP PA32/SK OVC020/RM REPORTED BASES OVC019 LANDING RY2
BAF UA /OV BAF /TM 1529 /FL090 /TP PAY2 /SK OVC-TOP065-OVC120
ISP UA /OV ISPT/TM 1554/FLDURD/TP C182/SK OVC005-TOPUNKN/TB LGT CHOP
FOK UA /OV FOK060003/TM 1600/FLDURC/TP PC12/SK OVC010
MMU UA /OV MMU/TM 1600/FL009/TP C56X/SK OVC009
BDR UA /OV BDR/TM 1600/FLDURC/TP PC12/SK BKN017
EWR UA /OV 3 S EWR/TM 1601/FL008/TP B738/SK 008 OVC
OXC UA /OV OXC/TM 1605/FLDURD/TP C510/SK BKN017/WV 082020
HPN UA /OV HPN/TM 1608/FLDURD/TP E190/RM BASES REPORTED AT 015
DXR UA /OV DXR/TM 1615/FL015/TP PC12/SK OVC010
EWR UA /OV SAX VOR/TM 1644/FL060/TP B752/SK TOPS 055/WX VMC
EWR UA /OV 2 S EWR/TM 1647/FL005/TP B738/SK 005 OVC
BLM UA /OV COL163008 /TM 1648 /FL060 /TP SR22 /WX FV99SM RA /TB CONS MOD /RM STRATUS INSIGHT
HPN UA /OV HPN/TM 1650/FLDURD/TP F2TH/RM REPORTED BASES AT 014.
BDL UA /OV BDL/TM 1702/FL017/TP E170/SK BKN018
EWR UA /OV 2 NM SOUTH EWR/TM 1703/FL006/TP CRJ7/SK 006 OVC
DXR UA /OV DXR/TM 1706/FL016/TP C25A/SK OVC012
BDR UA /OV 2 MILE FINAL RWY 6/TM 1710/FL009/TP PC12/SK OVC014/WX 8SM/RM BASE 009
OXC UA /OV OXC/TM 1718/FLDURC/TP PC12/SK OVC017
EWR UA /OV 1 NM SOUTH EWR/TM 1737/FL004/TP E170/SK 004 OVC
ISP UA /OV ILS RWY 06/TM 1740/FLDURD/TP H25B/TB LIGHT CHOP/RM GAIN/LOSS 5 KTS
ABE UA /OV 2 MI FINAL RWY 6/TM 1743/FL012/TP SR22/SK OVC012
HTO UA /OV HTO100005/TM 1748/FL030/TP E55P/SK OVC010
HPN UA /OV HPN/TM 1749/FLDURD/TP GLF6/RM REPORTED BASES AT 006.
BDL UA /OV BDL/TM 1753/FL020/TP J328/SK OVC018
Accident 1757Z
OXC UA /OV OXC/TM 1801/FLDURC/TP PC12/SK OVC015
OXC UA /OV OXC/TM 1805/FLDURD/TP B350/SK OVC015
BDL UA /OV BDL/TM 1815/FL020/TP CRJ7/SK OVC018
EWR UA /OV RY4R FINAL/TM 1835/FL010/TP CRJ7/SK 010 OVC
JFK UA /OV JFK090004/TM 1904/FL030/TP CRJ9/SK OVC016-TOP025
EWR UA /OV BWZ/TM 1907/FL60/TP B739/SK IMC/WX RAIN/WV 130025
POU UA /OV POU/TM 1910/FL012/TP C172/SK OVC020/WX VIS 4 LT RAIN
EWR UA /OV RY4R FINAL/TM 1918/FL011/TP B737/SK 011 OVC
BDL UA /OV BDL/TM 1924/FL012/TP A320/SK OVC012/RM DURD RY6

¹⁵ Only includes PIREPs which were disseminated through normal weather circuits and do not include reports only broadcast to air traffic controllers via radio and not transcribed into the database.

DXR UA /OV DXR/TM 1929/FL013/TP C525/SK OVC010
MMU UA /OV KMMU/TM 1932/FL006/TP CL60/SK OVC006/RM DURCRY5
BDR UA /OV 2NM FNL/TM 1947/FL008/TP C172/SK OVC013
HPN UA /OV HPN/TM 1951/FLDURD/TP GLF4/RM REPORTED BASES AT 005
LGA UA /OV LGA/TM 1955/FL012/TP E170/RM BASES REPORTED AT 1200FT

A review of the PIREPs indicated no urgent reports were reported during the period, with all the reports providing information on sky cover with bases and tops of clouds, with only a few reports of turbulence during the period. Cloud bases were reported as low as 500 to 600 ft msl from an hour prior to 2 hours after the accident predominately south of the accident site. Several of the reports were from corporate aircraft on approach to KHPN approximately 25 miles south of the accident site.

7.0 NWS Forecasts

The NWS New York Weather Forecast Office (WFO) located in Upton, NY, was responsible for issuing forecasts and warnings over the accident site, while the NWS AWC and the Center Weather Service Unit (CWSU) located in the New York (KZNY) Air Route Traffic Control Center (ARTCC) were jointly responsible for the aviation advisories. The forecasts issued surrounding the period were as follows.

7.1 Terminal Aerodrome Forecasts

A Terminal Aerodrome Forecast (TAF) is a concise statement of the expected meteorological conditions significant to aviation for a specified time within 5 statute miles of the center of the airport's runway complex (terminal). The closest TAF to the accident site was issued for KSWF located 7 miles northwest of the accident site. The following forecasts were issued pertinent to the accident, the initial TAF issued at 0723 and the amended TAFs issued at the same time for both stations at 1041 EDT.

TAF KSWF 101123Z 1012/1118 06008KT P6SM OVC012

FM102000 05008KT P6SM VCSH OVC010

FM110300 03005KT P6SM OVC012

AMD NOT SKED=

AMD TAF KSWF 101441Z 1015/1118 06008KT P6SM OVC012

FM102000 05008KT P6SM VCSH OVC010

FM110300 03005KT P6SM OVC012

FM111300 03006KT P6SM OVC030

FM111500 04006KT P6SM OVC045=

The KSWF TAF issued at 0723 EDT and available prior to departure expected MVFR conditions to prevail with winds from 060° at 8 knots, visibility 6 miles or more, with a ceiling overcast at 1,200 ft agl. The TAF was updated or amended at 1041 EDT without any changes to the forecast for the period of the accident.

The next closest forecast along the route of flight was for KHPN approximately 25 miles south of the accident site.

*TAF KHPN 101123Z 1012/1112 06010KT P6SM -SHRA OVC010
FM101600 06011KT 5SM -SHRA OVC008
FM110000 05008KT P6SM VCSH BKN010
FM110600 04009KT P6SM BKN012
AMD NOT SKED=*

*AMD TAF KHPN 101441Z 1015/1112 06009KT P6SM -RA OVC010
FM101600 06011KT 5SM -SHRA OVC008
FM102200 06009KT P6SM VCSH OVC015
FM110000 05009KT P6SM OVC015
FM110600 03008KT 6SM BR BKN012=*

The KHPN forecast issued at 0723 EDT expected IFR conditions to prevail from 1100 through 1800 EDT, with wind from 060° at 11 knots, visibility 5 statute miles in light rain showers, and ceiling overcast at 800 ft agl. The amended TAF issued at 1041 EDT continued the forecast conditions, with MVFR conditions after 1800 EDT.

7.2 Area Forecast Discussion

The NWS Area Forecast Discussions (AFD) are issued by each WFO to describe the short term weather conditions within their region with an aviation section that includes the general conditions as it relates to the creation of the TAF. These are useful for additional aviation-related issues that cannot be encoded into the TAF and provide some reasoning behind the forecast. These are generated roughly every 6 hours and corresponds to the release of the latest TAFs for that office. The AFD synopsis and aviation section issued by KOKX at 1052 EDT was as follows.

*FXUS61 KOKX 101453
AFDOKX*

*Area Forecast Discussion
National Weather Service New York NY
1053 AM EDT Sun Oct 10 2021*

.SYNOPSIS...

Low pressure will remain south of the region through Tuesday. A weak trough will pass through during Wednesday, followed by high pressure through Friday.

.AVIATION /15Z SUNDAY THROUGH THURSDAY/...

Low pressure will meander south of the area off the Mid Atlantic coast through the TAF period.

MVFR conds should prevail today and tonight with a chance of tempo IFR at any given time. Showers will likely be more widespread/likely in the afternoon and focused more for southern and coastal terminals.

Winds will be ENE 10-15 kt. Gusts to around 20 kt.

...NY Metro (KEWR/KLGA/KJFK/KTEB) TAF Uncertainty... Gusts may be more occasional today than prevailing. Tempo IFR conds possible at any given time, and there is a low chance of IFR prevailing for more than an hour or two.

.OUTLOOK FOR 12Z MONDAY THROUGH THURSDAY...

.Monday...MVFR/IFR with chc -shra AM, MVFR/VFR PM. NE winds 10-15kt with gusts up to near 20kt.

.Tuesday-Thursday...Mainly VFR.

Detailed information, including hourly TAF wind component forecasts, can be found at:

<https://www.weather.gov/zny/n90>

7.3 Graphical Forecast for Aviation

The NWS Graphical Forecast for Aviation (GFA) are graphical depictions of surface wind, predominant precipitation and weather, color coded general flight categories of visibility, and cloud cover bases and tops, with the Graphical-Airmen's Meteorological Information (G-AIRMET)¹⁶ for IFR conditions, mountain obscuration, icing conditions, and strong surface wind overlaid for the enroute phase of flight. The GFA is available at the NWS AWC website and through other weather briefing services and is provided every 3-hours out to 18-hours. The GFA charts issued at approximately 1100 EDT and available to the pilot prior to flight, and valid for 1400 through 1700 EDT are included as figures 13 and 14. The GFA Surface forecast indicated general unrestricted visibility with rain showers closer to New York City area, with light easterly winds, and included a Graphic-AIRMET for IFR conditions was depicted over southeast New York and included the accident site. The GFA Cloud Forecast indicated broken clouds at 1,900 ft msl with layered clouds with tops to 18,000 ft with cirriform clouds above. The chart also included a Graphic-AIRMET for mountain obscuration over New York and for icing conditions over the region.

¹⁶ AIRman's METeorological Information (AIRMET) is a concise description of weather phenomena that are occurring or may occur (forecast) along an air route that may affect aircraft safety. Compared to SIGMETs, AIRMETs cover less severe weather: moderate turbulence and icing, sustained surface winds of 30 knots or more, low-level wind shear, widespread instrument flight rule conditions due to low ceilings or restricted visibility, or mountain obscuration conditions.

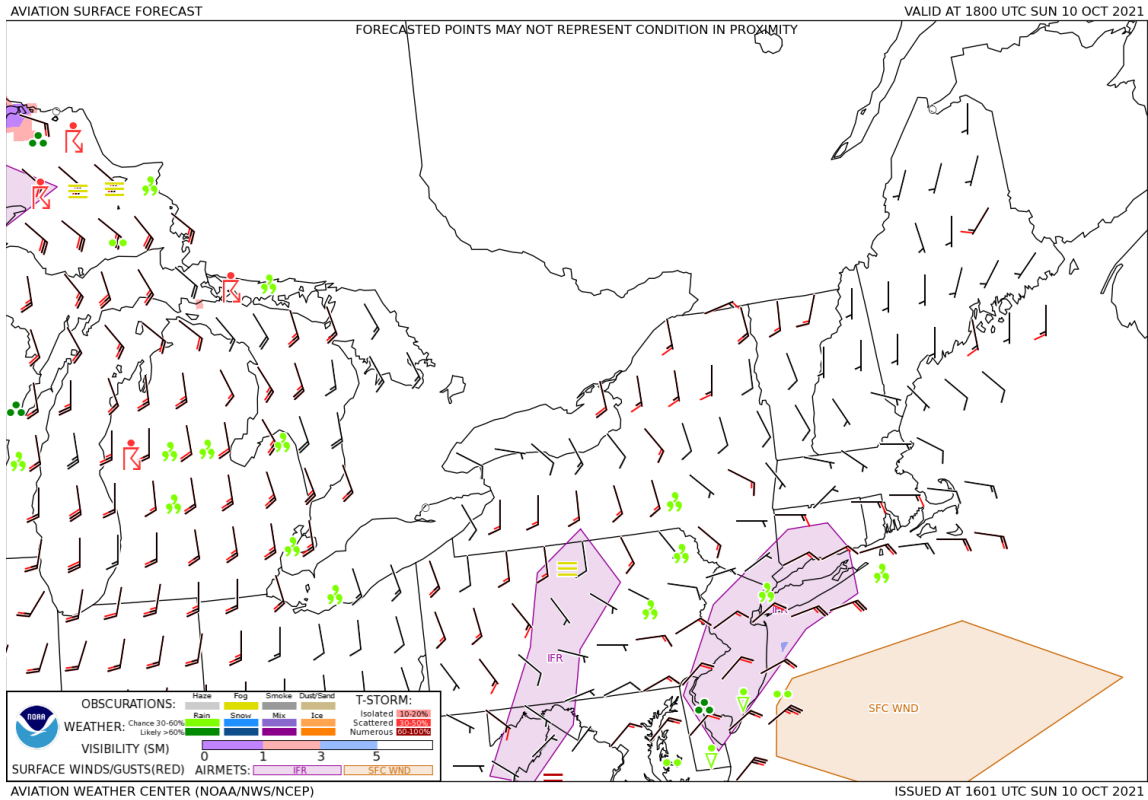


Figure 13 - Graphic Forecast for Aviation Surface Weather forecast valid from 1400 through 1700 EDT.

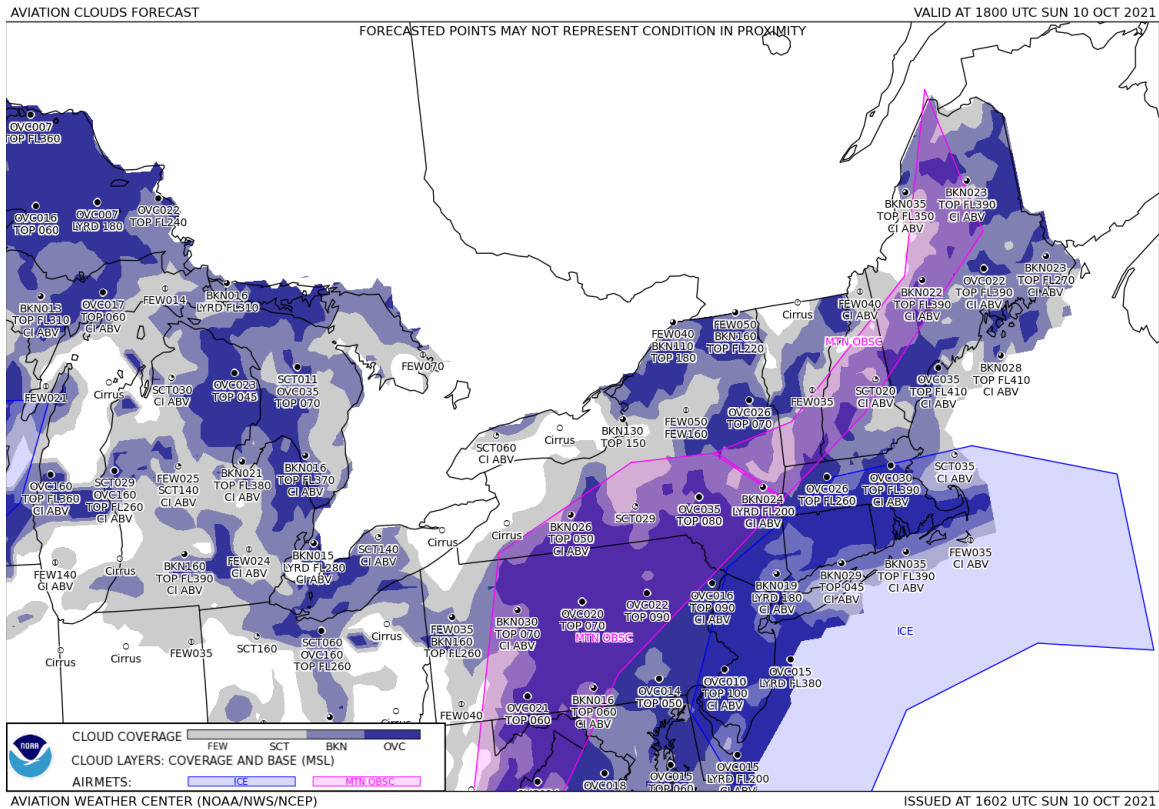


Figure 14 - Graphic Forecast for Aviation Cloud forecast valid from 1400 through 1700 EDT.

8.0 NWS Inflight Weather Advisories

Inflight Aviation Weather Advisories are forecasts to advise en route aircraft of development of potentially hazardous weather. Inflight aviation weather advisories in the conterminous U.S. are issued by the NWS AWC, as well as from the Center Weather Service Units (CWSU) associated with FAA air route traffic control centers (ARTCCs). There are four basic types of inflight aviation weather advisories: the Significant Meteorological Information (SIGMET), the Convective SIGMET, the Airmen's Meteorological Information (AIRMET), and the Center Weather Advisory (CWA). Inflight advisories serve to notify en route pilots of the possibility of encountering hazardous flying conditions which may not have been forecast at the time of the preflight briefing. Whether or not the condition described is potentially hazardous to a particular flight is for the pilot to evaluate on the basis of experience and the operational limits of the aircraft.

Figure 15 is a depiction of the NWS AWC's Graphic-AIRMET Sierra current at the time of the accident for IFR conditions due to ceilings below 1,000 ft agl and/or and visibility below 3 miles in precipitation and mist. The AIRMET extended over the accident site and the planned destination. There were no other SIGMETs, Convective SIGMETs, or CWA's current for the area during the period surrounding the flight.

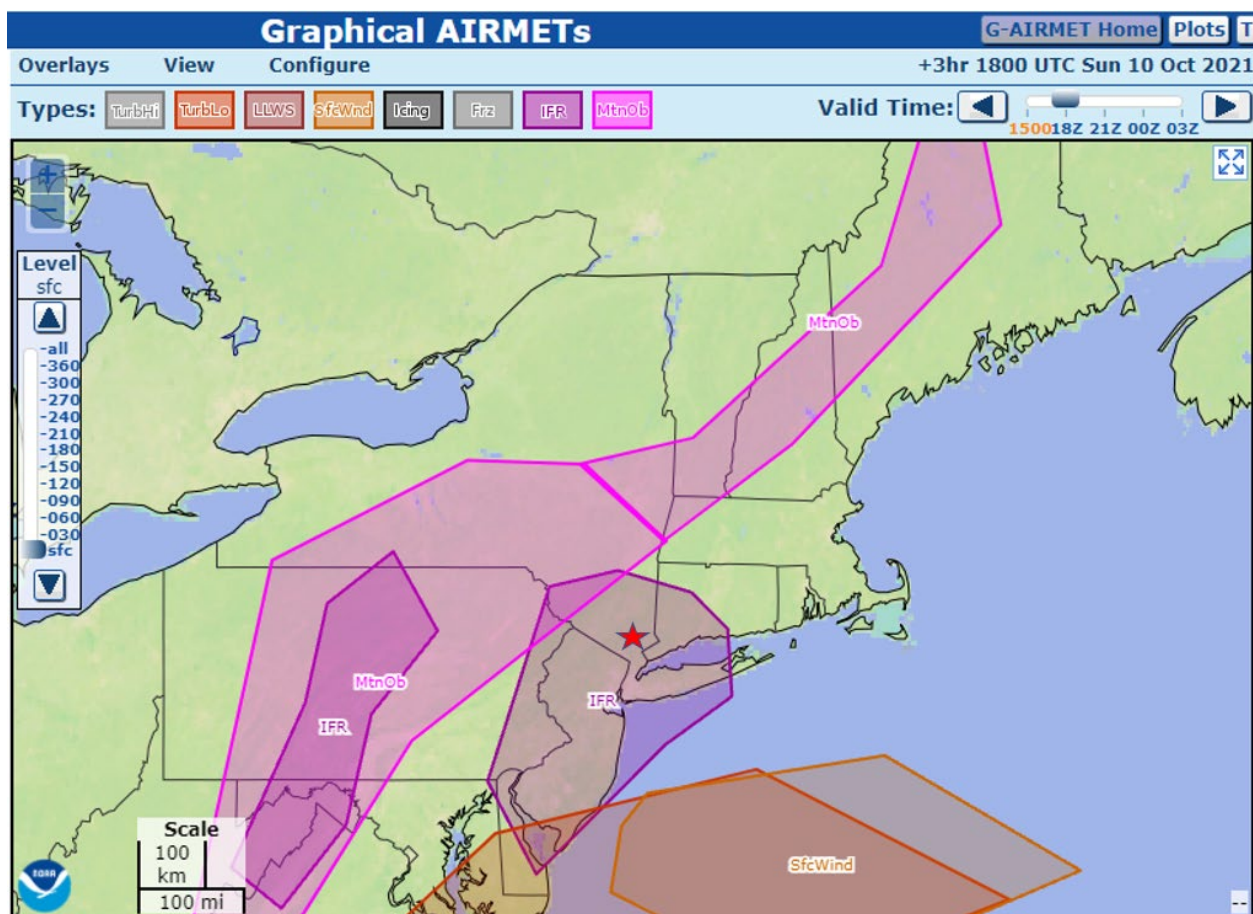


Figure 15 - Depiction of the NWS Graphical AIRMETs at 1400 EDT with the accident site noted.

9.0 Preflight Weather Briefing

A search of the FAA contract Automated Flight Service Station (AFSS) provider Leidos indicated that they and no 3rd party vendors utilizing the Lockheed Flight Service (LFS) System had any contact with the pilot of N637HP on the day of the accident. A separate search of ForeFlight indicated that the pilot had an account with the vender and had used the app at 1113 EDT and created a route string for the flight from KISP to Glens Falls (KGFL) via the Hudson River and back to KISP at 1,000 ft. Prior to the flight the following airports were viewed in the app which includes the latest METAR, TAFs, and NOTAMs for Brookhaven Airport (KHGV), Shirley, New York, and for Minute Man Air Field (6B6), Stow, Massachusetts. The pilot did not view any weather imagery inside the app. No formal route briefing was requested and there is no confirmation the pilot reviewed, searched for the current inflight weather advisories for the area.

10.0 Astronomical Conditions

The United States Naval Observatory's Multiyear Interactive Computer Almanac (MICA) software was used to document the astronomical conditions for Cornwall, NY, on the day of the accident.

<u>Sun</u>	<u>Time (EDT)</u>
Begin civil twilight	0635
Sunrise	0703
Culmination	1243
<i>Accident</i>	<i>1356</i>
Sunset	1822
End civil twilight	1850

At the approximate time of the accident the Sun was 38° above the horizon at an azimuth of 203°.

Submitted by:

Don Eick
Senior Meteorologist