



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

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Specialist's Factual Report

METEOROLOGY

WPR20LA211

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A. ACCIDENT

Location: Payson, Arizona
Date: July 7, 2020
Time: 1213 mountain standard time
1913 Universal Coordinated Time (UTC)
Airplane: Bell UH-1H; Registration: N623PB

B. METEOROLOGIST

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C. SUMMARY

On July 7, 2020, about 1213 mountain standard time, a Bell/Garlick UH-1H helicopter, N623PB, was destroyed when it was involved in an accident near Payson, Arizona. The pilot was fatally injured. The helicopter was operated as a Title 14 *Code of Federal Regulations* Part 133 external load flight.

This report provides a meteorological review on the weather conditions and National Weather Service (NWS) aviation weather products applicable to the accident region around the accident time.

D. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) Senior Meteorologist was not on scene for this investigation and conducted the meteorology phase of the investigation from the Washington D.C. office, collecting data from official NWS sources including the Weather Prediction Center (WPC) and the National Center for Environmental Information (NCEI). All times are mountain standard time (MST) based upon the 24 hour clock, local time is +7 hours to UTC, and UTC=Z. 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 34.271945° N and longitude 111.52749° W, at an elevation of approximately 4,380 ft on the Polles Mesa¹ west of the city of Payson, in Gila County, Arizona.

¹ A mesa is an isolated, flat-topped elevation, ridge or hill, which is bounded from all sides by steep escarpments and stands distinctly above a surrounding plain. Mesas characteristically consist of flat-lying soft sedimentary rocks capped by a more resistant layer or layers of harder rock. The term mesa was adapted from the Spanish word meaning *table*.

E. 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) 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 southwest section of the NWS Surface Analysis Chart for 1100 MDT with the approximate accident site marked by a red star and the general color coded topography is included as figure 1. The chart depicted a thermal low-pressure system² over southern Nevada and southeastern California at 1004-hectopascals (hPa)³ with a trough of low pressure extending southward across the California and Arizona border into the Baja of California. A high pressure ridge extended from northern New Mexico into northeastern Arizona to the north west of the accident site, resulting in a general weak pressure gradient over Arizona. The chart depicted calm to light west to southwesterly winds of 10 knots or less in the vicinity of the accident site, with winds of 15 to 20 knots reported over northern Arizona to the north and northeast of the accident site. The station model immediately east of the accident site depicted clear skies below 12,000 ft, with a temperature of 88° Fahrenheit (F), and a dew point of 21° F.

² A thermal low or heat low, are non-frontal low-pressure systems that occur over the continents in the subtropics during the warm season, as a result of intense surface heating when compared to their surrounding environments and are typically associated the monsoon season.

³ Hectopascals is the NWS international term for reporting sea level pressure and is interchangeable with the term millibar (mb) with the same units. The International Standard Atmosphere (ISA) is based on a sea-level pressure of 1013.25-hPa at a temperature of 59° F or 15° Celsius (C).

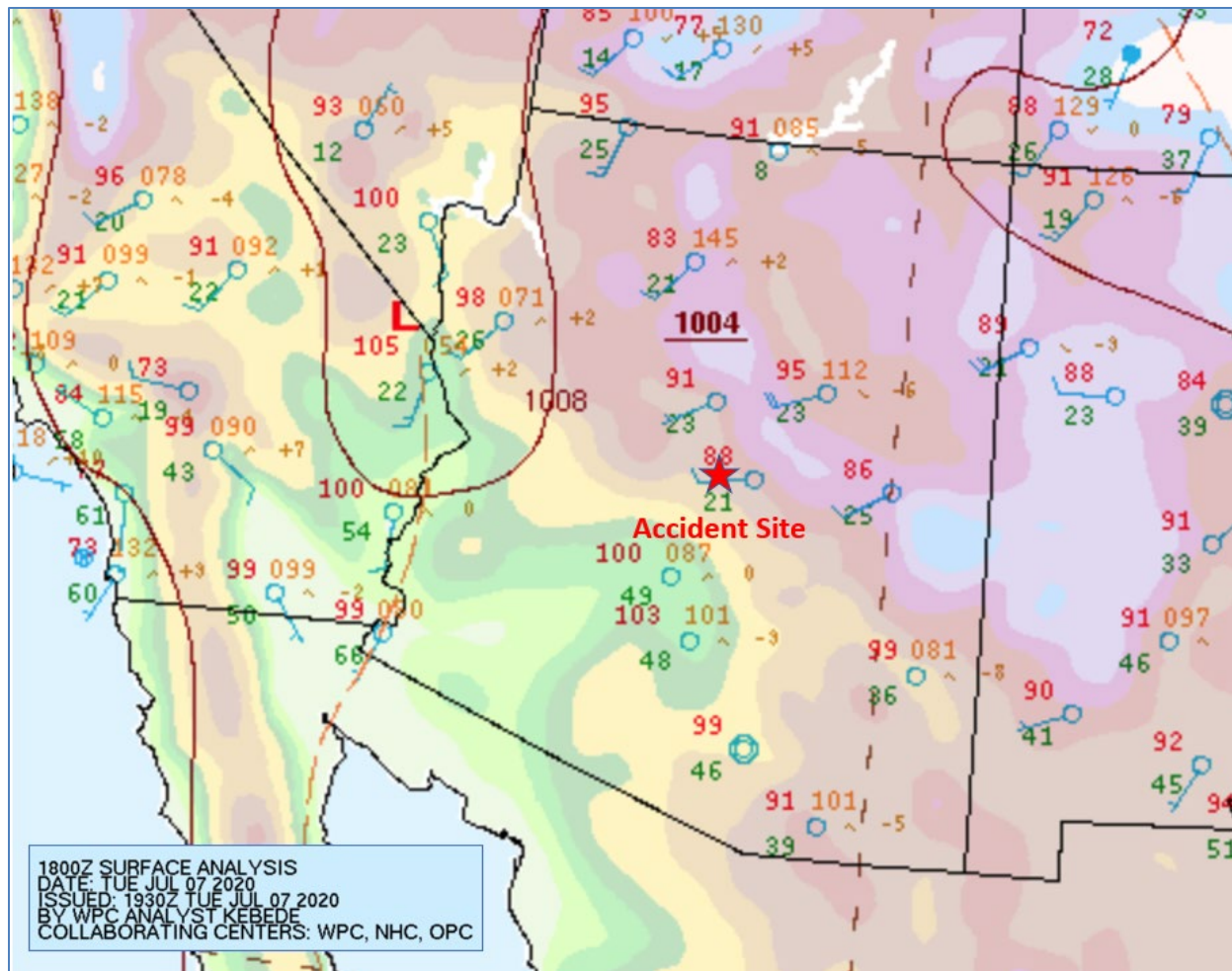


Figure 1 - Southwest section of the NWS Surface Analysis Chart for 1100 MST with topography and the approximate accident site marked by the red star

1.2 Streamline Analysis

A streamline analysis⁴ of the wind field was obtained from Plymouth State's archive website. Figure 2 is the southwest United States streamline analysis for 1200 MST with the approximate accident site marked by a red star. The image depicted general convergence over southeastern California associated with the thermal low and trough, with general southwest to west-southwest winds over Arizona and the accident site.

⁴ Streamline analysis is a depiction of the surface wind field. Streamlines are drawn parallel to the wind or tangent to the velocity vector of the flow and shows the direction in which a massless fluid element will travel at any point in time.

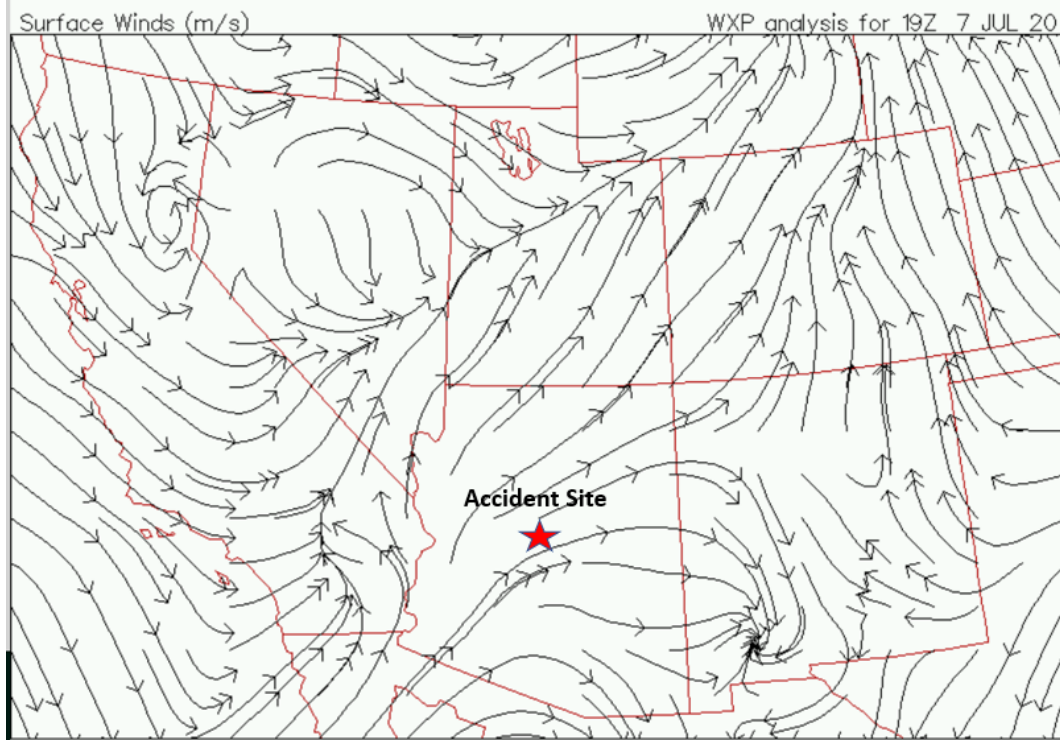


Figure 2 - Streamline Analysis of the wind field for 1200 MST with the approximate accident site marked by a red star

2.0 Surface Observations

The official NWS Meteorological Aerodrome Reports (METARs) and Special Reports (SPECIs) surrounding the period were documented for the area. The cloud heights are reported above ground level (agl), and the magnetic variation over the region was estimated as 10.5° E based on the sectional chart for the area.

2.1 Payson, Arizona

The closest official weather reporting facility to the accident site was from the Payson Airport (KPAN), Payson, Arizona, located approximately 11 miles east of the accident site at an elevation of 5,157 ft. The airport had an Automated Weather Observation System (AWOS) and issued observations every 20-minutes. The following conditions were reported at the time of the accident.

Weather observation for KPAN at 1215 MST, automated, wind from 240° at 9 knots with gusts to 18 knots, visibility 10 miles or more, sky clear below 12,000 ft, temperature 32° C (90° F), dew point -6° C (21° F), altimeter 30.18 inches of mercury. Remarks: automated station with a precipitation discriminator.

The calculated relative humidity was 8% and the density altitude based on the conditions reported was 7,980 ft. The raw observations from 0815 through 1315 MST were as follows with the accident time and observation above highlighted in bold type. The high temperature was reported at 1435 MST of 34° C (93° F).

METAR KPAN 071515Z AUTO 00000KT 10SM CLR 29/M08 A3020 RMK AO2=
METAR KPAN 071535Z AUTO 00000KT 10SM CLR 29/M07 A3020 RMK AO2=
METAR KPAN 071555Z AUTO 21004KT 10SM CLR 29/M08 A3020 RMK AO2=
METAR KPAN 071615Z AUTO 21006G12KT 10SM CLR 30/M08 A3020 RMK AO2=
METAR KPAN 071635Z AUTO 29009KT 10SM CLR 30/M08 A3020 RMK AO2=
METAR KPAN 071655Z AUTO 24009G14KT 10SM CLR 31/M07 A3020 RMK AO2=
METAR KPAN 071715Z AUTO 27008G16KT 9SM CLR 31/M07 A3020 RMK AO2=
METAR KPAN 071735Z AUTO 27007G14KT 250V310 10SM CLR 31/M06 A3019 RMK AO2=
METAR KPAN 071755Z AUTO 26011G18KT 10SM CLR 31/M06 A3019 RMK AO2=
METAR KPAN 071815Z AUTO VRB06G17KT 10SM CLR 31/M06 A3019 RMK AO2
METAR KPAN 071835Z AUTO 25009G14KT 10SM CLR 32/M05 A3018 RMK AO2
METAR KPAN 071855Z AUTO 27010G19KT 10SM CLR 32/M06 A3018 RMK AO2

Accident 1913Z

METAR KPAN 071915Z AUTO 24009G18KT 10SM CLR 32/M06 A3018 RMK AO2

METAR KPAN 071935Z AUTO 24010G23KT 9SM CLR 33/M05 A3017 RMK AO2
METAR KPAN 071955Z AUTO 27014G19KT 10SM CLR 33/M04 A3016 RMK AO2
METAR KPAN 072015Z AUTO 29010G18KT 10SM CLR 33/M04 A3015 RMK AO2
METAR KPAN 072135Z AUTO 29013G23KT 230V310 10SM CLR 34/M04 A3013 RMK AO2=
METAR KPAN 072155Z AUTO 26008G22KT 230V300 10SM CLR 34/M04 A3013 RMK AO2=
METAR KPAN 072215Z AUTO 26014G24KT 10SM CLR 34/M03 A3012 RMK AO2=
METAR KPAN 072235Z AUTO 28009G21KT 10SM CLR 34/M02 A3011 RMK AO2=
METAR KPAN 072255Z AUTO 30008G24KT 270V330 10SM CLR 33/M02 A3011 RMK AO2=

2.2 Aviation Weather Centers METAR Display

The NWS Aviation Weather Center's METAR display for 1215 MST is included as figure 3 with the accident site marked by a red star. The wind gusts are indicated by a red flag over the wind barb, and temperature and dew point temperatures are reported in °F. The image depicted westerly winds over Payson at 10 knots gusting to 20 knots, with stations north of the area at Prescott (KPRC), Flagstaff (KFLG), Williams (KCMR), and Winslow (KINW) reporting west to

west-southwesterly winds of 15 to 20 knots with gusts to 30 knots. Clear skies were depicted over the area with no significant weather or restrictions to visibility.

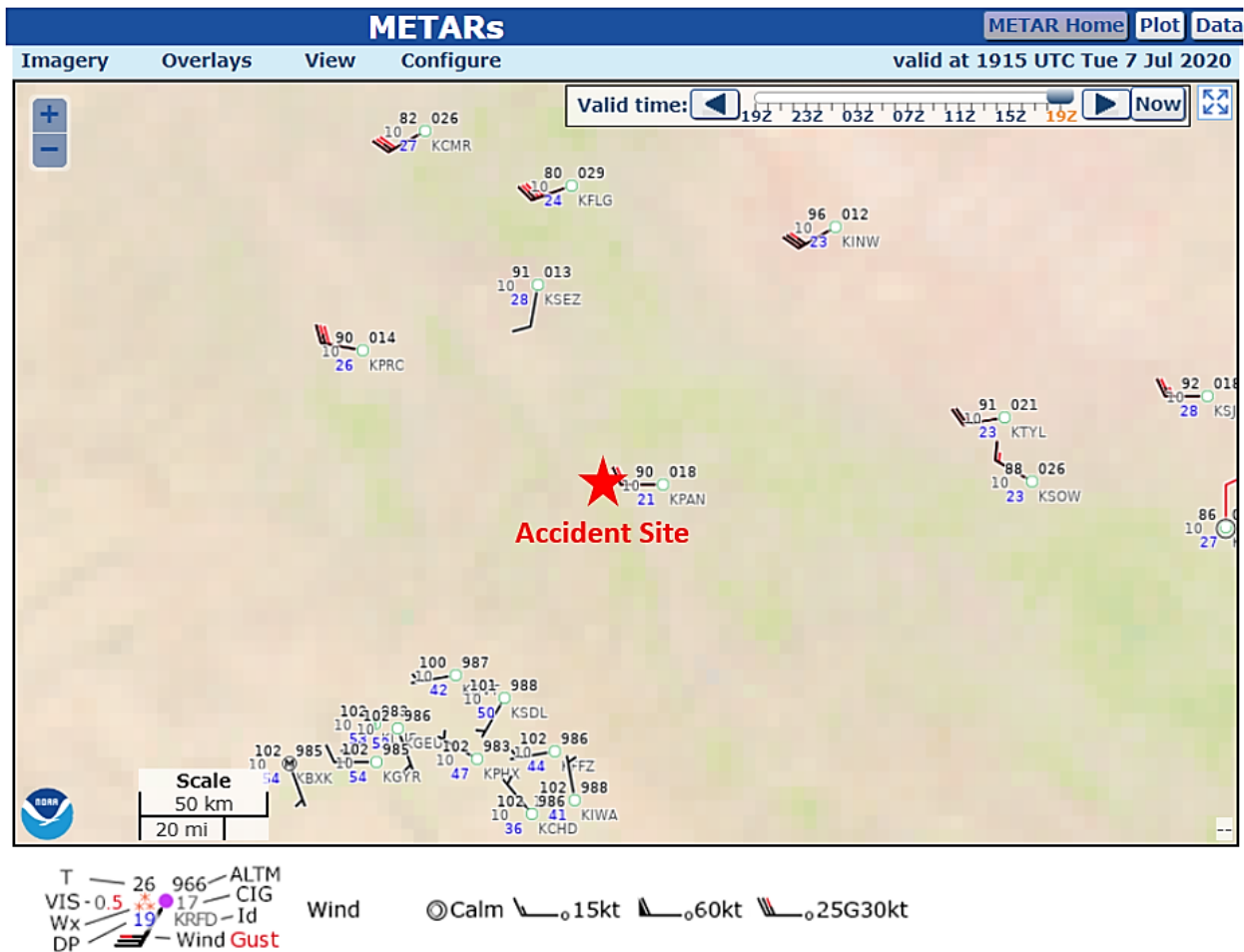


Figure 3 - NWS Aviation Weather Center's METAR display for 1215 MST over the area with the accident site marked by the red star

3.0 Remote Automated Weather System Observations

In addition to the METAR data the local Remote Automated Weather Stations (RAWS) operated by the United States Forestry Service and the Bureau of Land Management were also documented. The RAWS data report temperatures in °F, relative humidity in percent, and wind speeds in miles per hour (mph). Figure 4 is a depiction of the METAR and RAWS observations at 1220 MST along with the topography of the area.

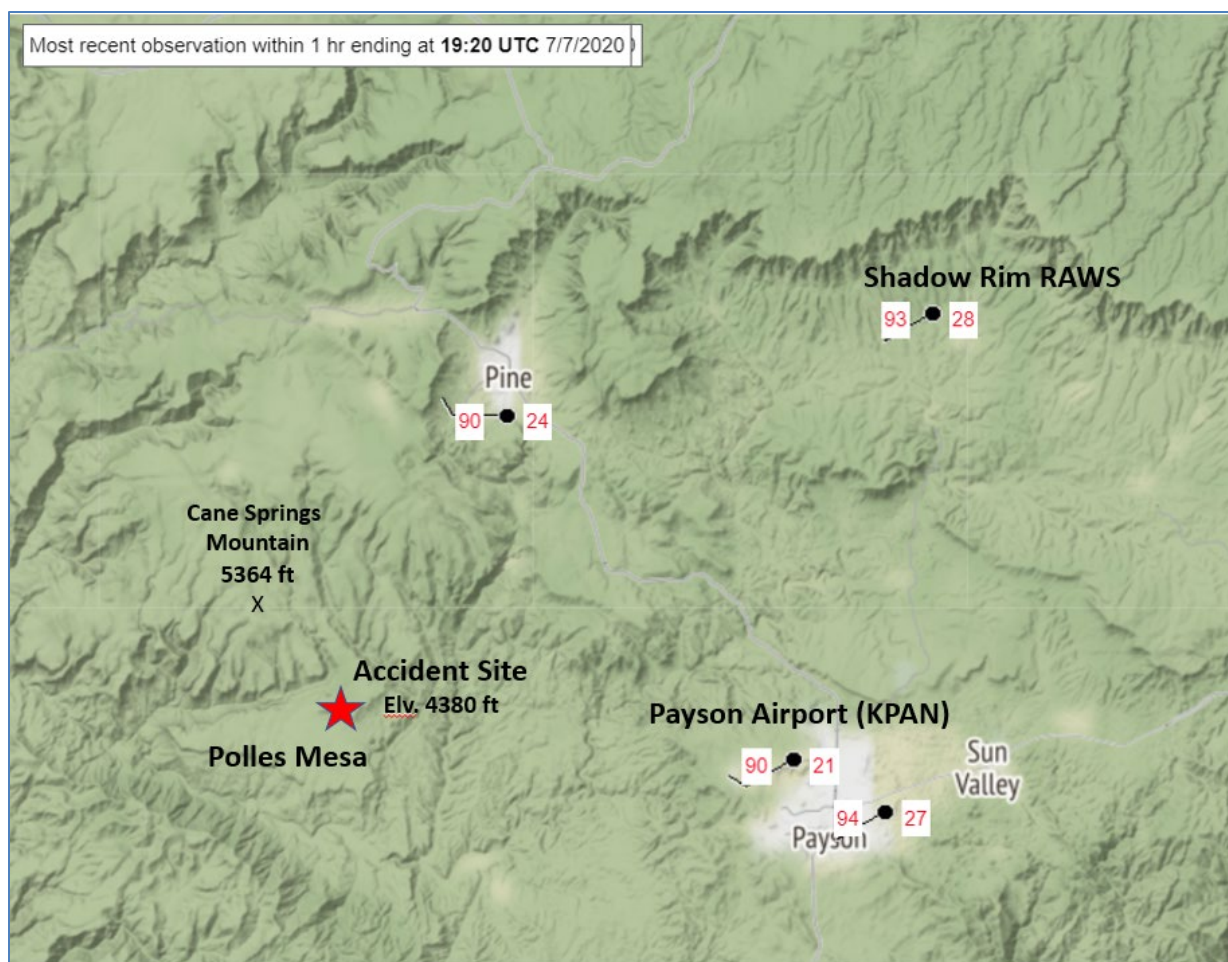


Figure 4 - METAR and RAWS observation for 1220 MST with the accident site noted

Pine RAWS (QPNA3) Elev. 5387 ft; Lat. 34.371722°N/Long. 111.455694°W

Located approximately 8 ½ miles NNE of the accident site.

Time (MST)	Temp (°F)	Dew Point (°F)	RH (%)	Wind Direction	Wind Speed (mph)
1122	90	24	9	W	8 G 21
1222	93	26	9	SW	10 G 20
1322	95	28	9	SW	7 G 17

Payson RAWS (QPAA3) Elev. 4975 ft; Lat. 34.239167°N/Long. 111.302778°W

Located approximately 11 miles E of the accident site.

Time (MST)	Temp (°F)	Dew Point (°F)	RH (%)	Wind Direction	Wind Speed (mph)
1111	92	26	9	SW	8 G 15
1211	94	27	9	WSW	7 G 16
1311	94	27	9	WNW	8 G 15

Shadow Rim RAWS (QSRA3) Elev. 5543 ft.; Lat. 34.405833° N/Lat. 111.283056°W

Located approximately 14 ½ miles NE of the accident site.

Time (MST)	Temp (°F)	Dew Point (°F)	RH (%)	Wind Direction	Wind Speed (mph)
1109	90	27	10	S	3 G 9
1209	93	29	10	WSW	2 G 15
1309	94	30	10	S	2 G 11

All three RAWS sites indicated temperatures between 93° to 94° F, with relative humidity's of 9 to 10%, and with a southwest to west-southwest wind component with wind speeds from 2 to 10 mph with gusts from 15 to 20 mph.

4.0 Sounding

To determine the vertical structure and state of the atmosphere a High-Resolution Rapid Refresh (HRRR)⁵ numerical model data were retrieved from the NOAA Air Resources Laboratory archive for the accident site coordinates. The HRRR numerical model was then plotted on a standard Skew T log P diagram⁶ using the complete Rawinsonde Observation RAOB program software⁷. Figure 5 is the HRRR numerical model sounding for 1200 MST over the accident site coordinates from the surface to 400-hPa or approximately 24,000 ft. The HRRR sounding depicted an elevation of 4,373 ft over the site with a near surface temperature of 35° C (95° F), a dew point temperature of -2° C (28° F), and a relative humidity of 9%, which resulted a density altitude of 7,450 ft. The sounding depicted a dry low-level environment with a lifted condensation level (LCL)⁸ at 19,099 ft msl. The sounding supported strong thermals from the surface through 17,000 ft and was characterized as conditional unstable in that layer. The freezing level was identified at 15,560 ft, with no icing conditions indicated.

The HRRR numerical model wind profile indicated a surface wind from 260° at 14 knots with wind speeds increasing to 20 knots immediately above the surface, with the wind backing slightly to the west-southwest with height through 21,000 ft. No strong vertical wind shears were noted to produce any significant layers of clear air turbulence (CAT), and only the potential for thermal turbulence was noted.

⁵ The HRRR is a National Oceanic and Atmospheric Administration (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.

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

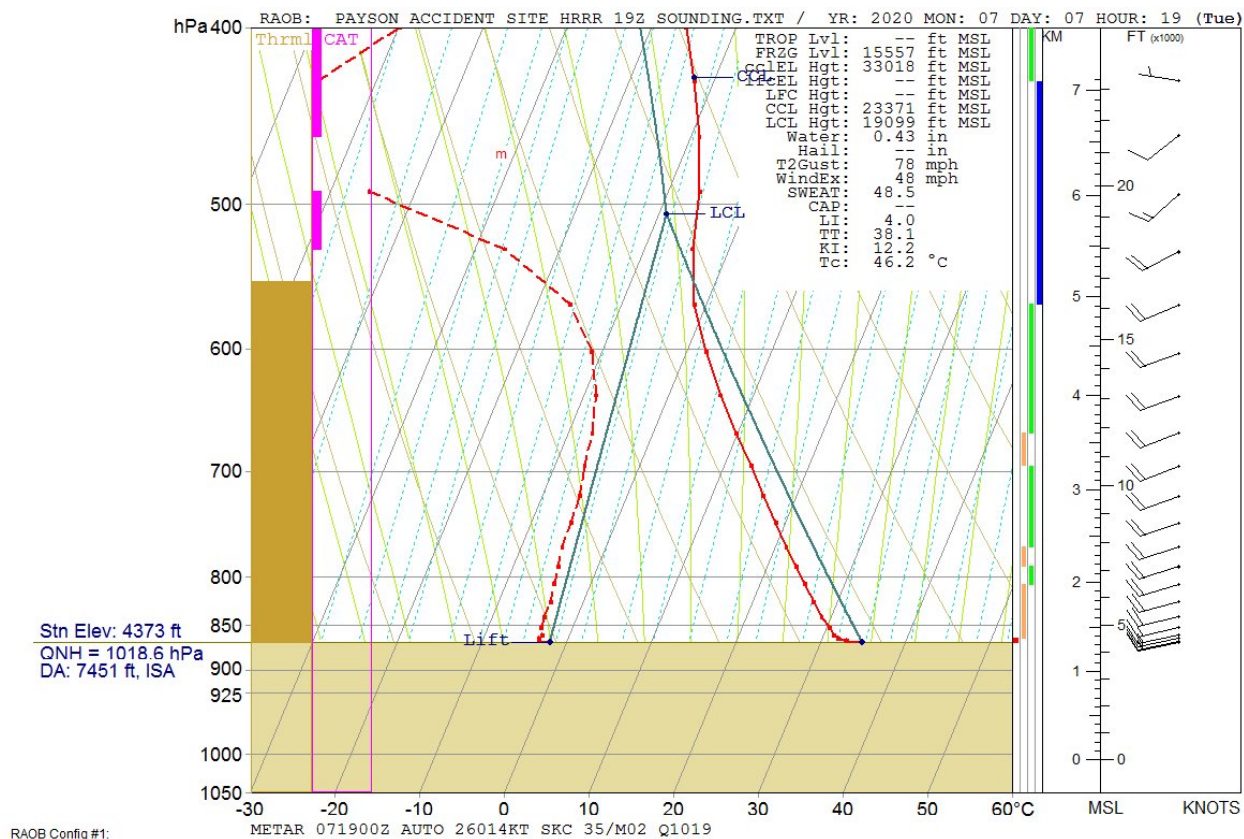


Figure 5 - HRRR numerical model sounding for 1200 MST over the accident site

5.0 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 Data Access System (McIDAS) software. The infrared⁹ and visible imagery were reviewed surrounding the accident time period, and the closest images to the accident time were documented. Figure 6 is the GOES-16 visible image at 1216 MST at normal magnification and a resolution of 0.54 nm, and the accident site marked by the red square. The visible image depicted clear skies over the accident site and fair weather cumulus clouds over the Arizona and New Mexico border well to the east of the accident site. No thunderstorms or cumulonimbus clouds typically associated with the Arizona monsoon¹⁰ were noted at the time of the accident.

⁹ The infrared image was not reproduced due to the lack of any cloud cover over the region.

¹⁰ The Arizona monsoon or southwest monsoon, is a pattern of pronounced increased thunderstorms and rainfall over a large area over the southwestern United States, typically occurring between July and mid-September. During the monsoon, thunderstorms are fueled by daytime heating and build up during the afternoon-early evening and dissipate by evening.

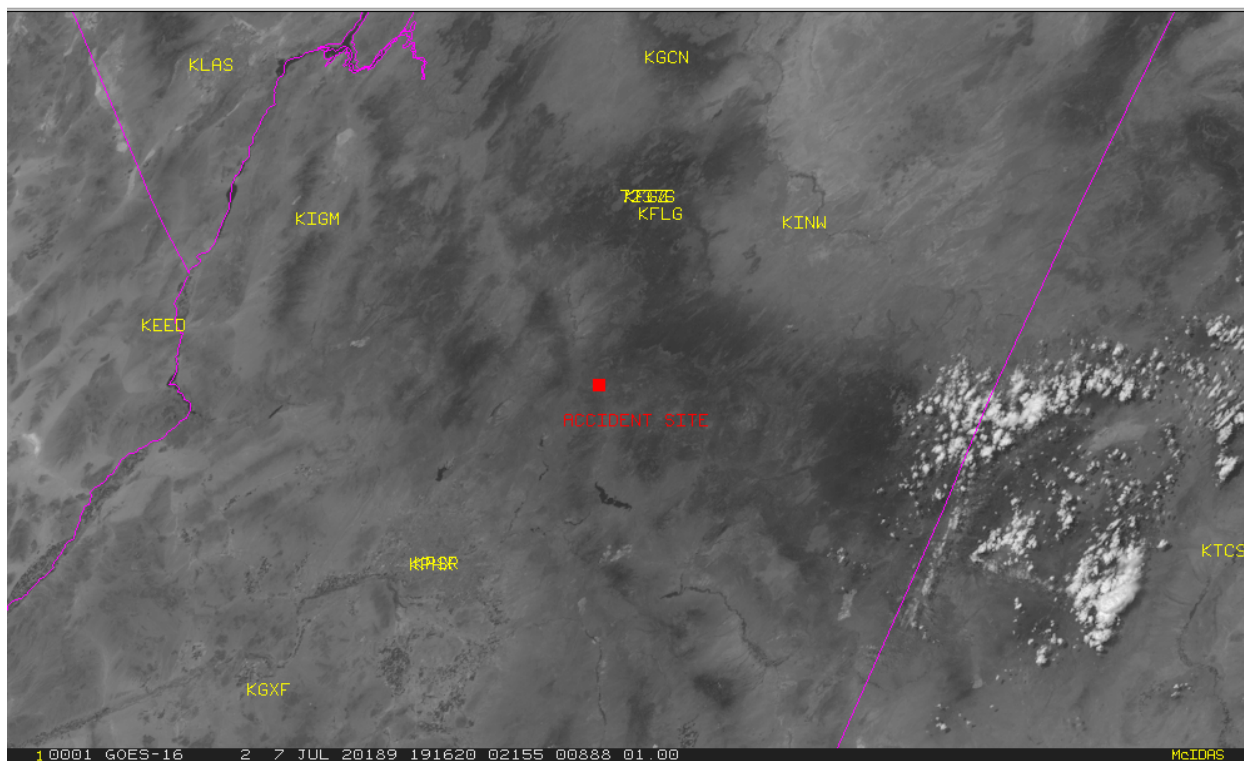


Figure 6 - GOES-16 visible image at 1216 MST at normal magnification

6.0 Pilot Reports

A search of pilot reports (PIREPs) in the NWS database over the region surrounding the period from 0900 through 1400 MST below 18,000 ft provided the following reports.

DVT UA /OV E63-DVT /TM 1624 /FL045 /TP C172 /TB NEG

DVT UA /OV E63-DVT/TM 1639/FL035/TP C172/TB NEG

BXK UA /OV KGYR-BXK /TM 1822 /FL055 /TP BE33 /TB NEG

FFZ UA /OV KFFZ/TM 1942/FL085/TP CL2T/SK SKC/TB NEG 085/BLO/RM DURC NW BOUND

The PIREPs indicated no reports of any turbulence below 8,500 ft.

7.0 Winds and temperature Aloft Forecast

The NWS Winds and Temperature Aloft Forecast for Arizona that was issued at 0657 MST and valid for 1100 MST and for use between 0700 and 1400 MST was as follows.

FBUS31 KWNO 071357

FDIUS1

-DATA BASED ON 071200Z

VALID 071800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
-PHX	3005	9900+25	2614+18	2522+10	2113-04	3213-15	322531	312740	292552
-PRC		2418+17	2427+09	2212-06	2720-16	303732	294240	273352	

The forecast for Phoenix (PHX) approximately 60 miles southwest of the accident site for 3,000 ft expected a wind from 300° at 5 knots, and for 6000 ft light and variable winds under 10 knots with a temperature of 25° C. The forecast for Prescott (PRC) approximately 48 miles west-northwest of the accident site for 9,000 ft expected wind from 240° at 18 knots with a temperature of 17° C.

8.0 Inflight Weather Advisories

There were no Significant Meteorological Advisories (SIGMETs), Convective SIGMETs, Center Weather Advisories (CWAs), or Airmen Meteorological Advisories (AIRMETs) current for any turbulence, icing, thunderstorms, or strong winds or low-level wind shear over Arizona or the accident site during the period.

9.0 Astronomical Conditions

The astronomical conditions for Payson, Arizona indicated the following conditions. The time of the accident has been added on bold italic print for reference.

Sun

Begin civil twilight	0451 MST
Sunrise	0520 MST
<i>Accident</i>	<i>1215 MST</i>
Culmination	1230 MST
Sunset	1940 MST
End civil twilight	2009 MST

At the time of the accident the Sun was 77.7° above the horizon at an azimuth of 162°.

10.0 Witness Statement

Several of the forest fire fighters who witnessed the accident provided statements regarding the wind and general weather conditions. Figure 7 presents the locations of the witnesses relative to the accident site, the Helispot 2 (H-2) departure point and the destination at Helispot 5 (H-5). All of the witnesses indicated that there were no clouds or thunderstorms in the area during the period. The full witness interviews are in the docket, and the general weather conditions reported by those witnesses are summarized below. In follow-up questions with the witnesses, two responded (witness 1 and 2) seeing dust devils¹¹ in the area the day prior, day of, and day after the accident.

¹¹ See section 11.0 of the report for details on dust devils.



Figure 7 - Witness locations

Witness 1 – was a Fire Line Safety Officer and was located east of the accident site. He indicated that the winds were 5 to 10 mph, with winds generally stronger in the afternoon with gusts, and indicated it was a little breezier on top of the mesa. He also indicated that on multiple days prior to the accident they would see huge dust devils, which would typically originate from within the burned area of the fire. He added that the dust devils were regular forming, a couple every hour. When asked if he observed any dust devils on the day of the accident, he indicated that he recalled seeing them but did not have a clear memory of where and at what time he observed them.

Witness 2 – was a Fire Lookout who was positioned at the top of the ridge immediately north-northeast of the accident site, indicated that the conditions at the time of the accident that the weather was still with light winds predominantly from the southwest, with no gusts. He indicated that the wind gusts came later in the afternoon. With regards to seeing any dust devils, he indicated seeing “ash whirls” in the area but could not remember the specifics of what days or times he witnessed them. He did indicate that the “ash whirls” developed in or near close proximity of the fire area of the Tonto north fire near Payson, and that they were very common in that area.

Witness 3 – was working a hot ash-pit on the north side of the Polles fire and was located approximately 200 yards southeast of the accident site. He was facing in the direction of the approaching helicopter, when he heard “weird rotor wash sound from a helicopter, looked up, and saw the helicopter become unstable in flight”. He didn’t notice any winds at the time.

Witness 4 – was located on the northwest edge of the fire and to the south of the accident site. He indicated that light winds from the southwest, with no gusts, with clear skies, and added he didn’t see any kind of cumulus clouds.

11.0 Dust Devil Reference

According to the American Meteorological Society, a dust devil is defined as: A well-developed dust whirl; a small but vigorous whirlwind, usually of short duration, rendered visible by dust, sand, and debris picked up from the ground. Wind speeds range from an average of 40 knots and can exceed 50 knots in intense dust devils which can be occasionally strong enough to cause minor damage (up to EF0 on the Enhanced Fujita scale). Diameters range from about 10 ft to greater than 100 ft; their average height is about 600 ft, but a few have been observed as high as 3,000 ft or more. They have been observed to rotate anti-cyclonically as well as cyclonically. Although the vertical velocity is predominantly upward, the flow along the axis of large dust devils may be downward. Large dust devils may also contain secondary vortices. Dust devils are best developed on a hot, calm afternoon with clear skies, in a dry region when intense surface heating causes a very steep lapse rate of temperature in the lowest 3,000 ft of the atmosphere.

In the United States dust devils have been reported in every state but are most frequently reported in the deserts and flat terrain of the southwest, with Arizona reporting the highest frequency of occurrences. The atmospheric conditions that commonly increase the likelihood of dust devil formation include flat barren terrain, clear skies, and calm to light winds under 10 knots, and surface air temperatures over 90° F (32° C). Since dust devils are associated with intense solar heating, the maximum occurrence typically occurs between 1300 and 1400 local, at the time of maximum soil temperatures and the convective heat flux. They are also most frequent between the months of June through August in Arizona¹² where the study was conducted.

Figure 8 is a photograph of dust devil in Arizona, which had a diameter of 40 ft and extended several hundred feet in the vertical.

¹² NWS data and Peter C. Sinclair “General Characteristics of Dust Devils”, Journal of Applied Meteorology, published in 1969.



Figure 8 - Dust devil observed over Arizona

The creation of eddies of sufficient magnitude have also been documented to trigger dust devil formation due to the increase in relative vorticity¹³.

Submitted by:

Don Eick
Senior Meteorologist

¹³ Relative Vorticity – is the sum of the rotation of an air parcel about the axis of the pressure system and the rotation of the parcel about its own axis.