



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

September 21, 2021

Specialist's Factual Report

METEOROLOGY

WPR20LA216

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A. ACCIDENT

Location: Ely, Nevada
Date: July 11, 2020
Time: About 1500 Pacific daylight time
About 2200 coordinated universal time (UTC)
Airplane: Alexander Schleicher ASW 27-18 glider; Registration: N167TM

B. METEOROLOGIST

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

C. SUMMARY

On July 11, 2020, at 1500 Pacific daylight time, an Alexander Schleicher ASW 27-18 glider, N167TM, was destroyed when it was involved in an accident near Ely, Nevada. The pilot was fatally injured. The airplane was operated as a Title 14 *Code of Federal Regulations (CFR)* Part 91 personal flight.

D. 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 Pacific daylight time (PDT) based upon the 24-hour clock, local time is -7 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 main wreckage site was estimated at latitude 39.2975° N and longitude 114.78054° W, at an elevation of approximately 8,800 ft over the Schell Creek Mountain Range.

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) 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 western portion of the NWS Surface Analysis Chart for 1400 PDT with the general topography is included as figure 1 with the approximate accident site marked by a red star. The chart depicted a thermal low-pressure system¹ at 1006-hectopascals (hPa) near the Arizona, California, and Nevada borders. High pressure systems were located to the northwest over northern California at 1019-hPa and to the southeast of the accident site over northern Arizona at 1016-hPa. A col² or a saddleback in the pressure field was located over central Nevada in the vicinity of the accident site. The closest station model to the accident site depicted a south-southwesterly wind of 15 knots, clear skies, temperature of 94° Fahrenheit (F), with a dew point temperature of 32° F.

¹ A thermal low, or heat low, is a non-frontal low-pressure system that occurs over the continents in the subtropics during the warm season, as the result of intense heating when compared to their surroundings.

² A col is a neutral point in the pressure field and is typically located between two high’s and two lows pressure regions.

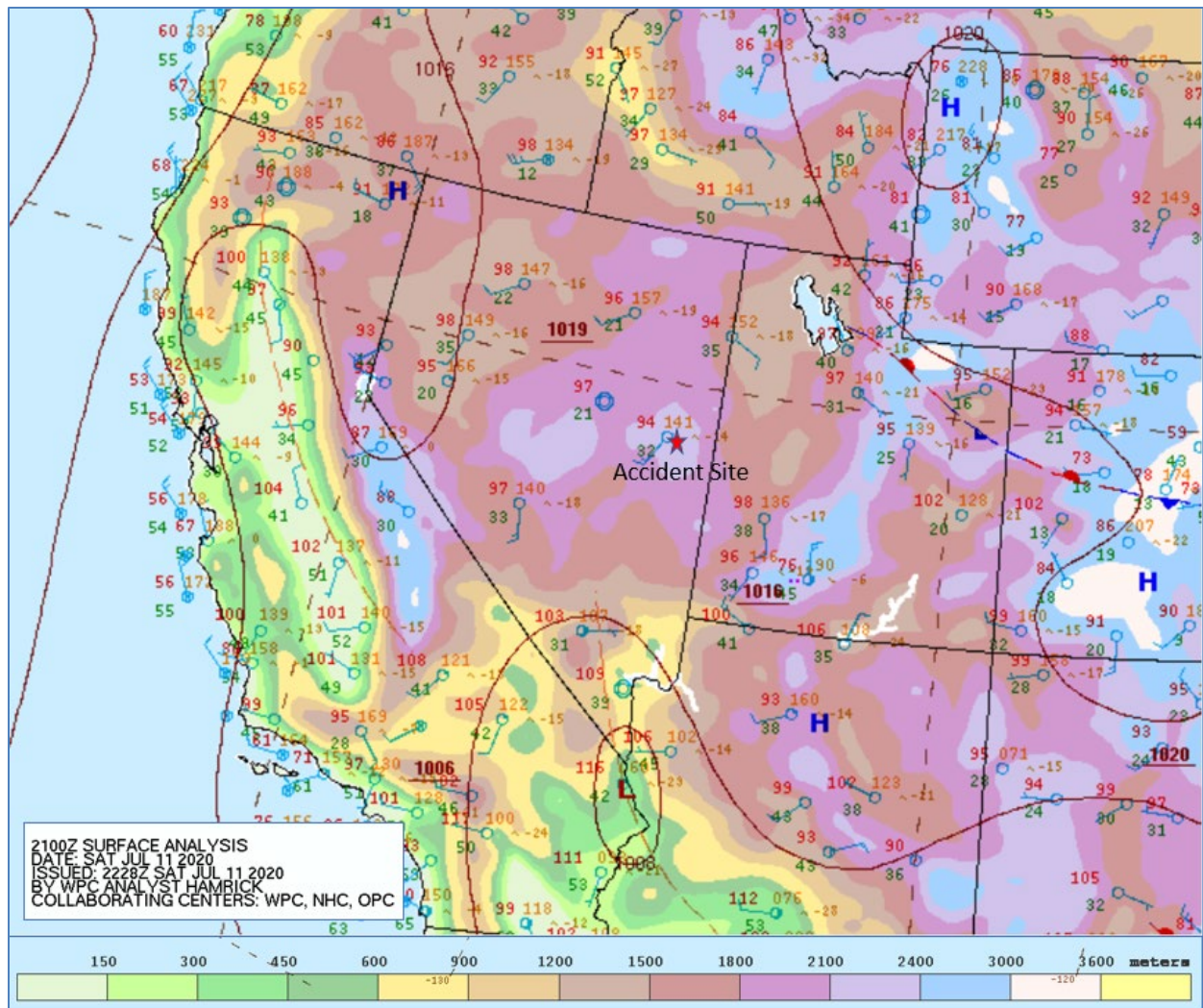


Figure 1 – Western portion of the NWS Surface Analysis for 1400 PDT with accident site marked by star.

1.2 Streamline Analysis

A streamline³ analysis of the wind field from surface observations was obtained from Plymouth State University archive surface data⁴ for 1500 PDT over the southwest and is included as figure 2 with the approximate accident site noted by a red star. The streamlines indicated a general south-southwesterly wind profile over the area at the time of the accident.

³ A streamline is a line that is tangent to the velocity of flow of the wind and is equivalent to the path of a specific particle in that flow.

⁴ <https://vortex.plymouth.edu/myowxp/sfc/ovrmap-a.html>

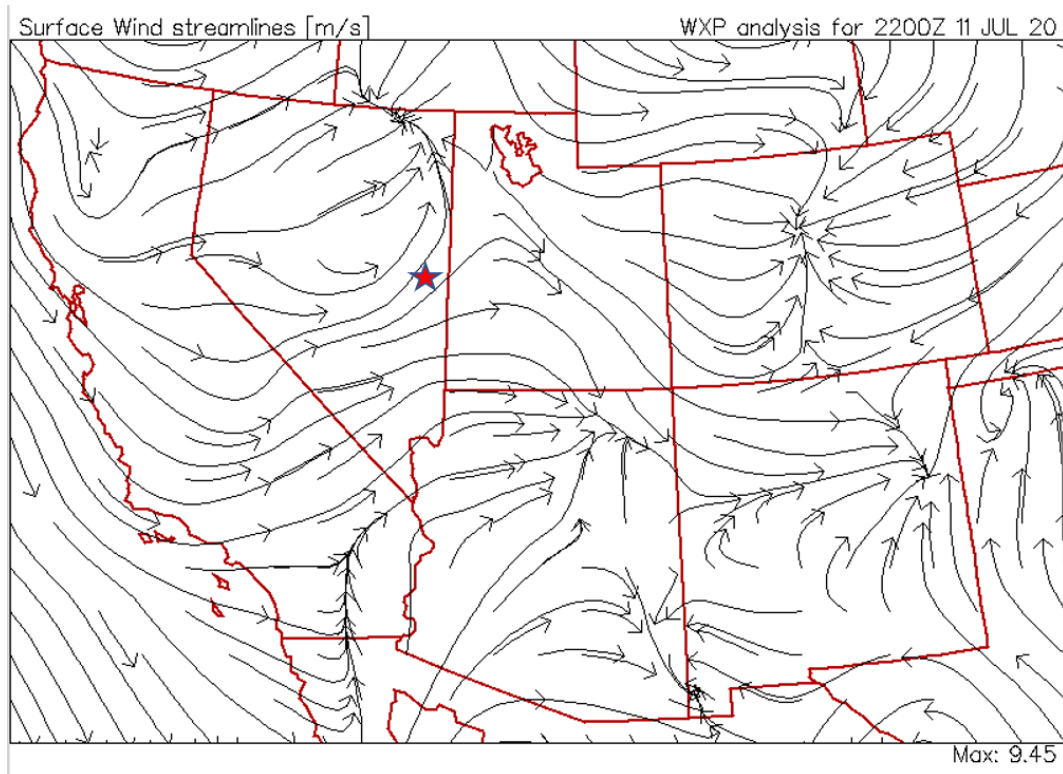


Figure 2 - Streamline analysis for 1500 PDT with the accident site marked by a red star.

1.2 Convective Outlook

The NWS Storm Prediction Center's Convective Outlook issued at 1300 PDT is included as figure 3 and depicted no thunderstorms expected over Nevada during the period. General airmass type thunderstorms were expected from Arizona northward into Utah, immediately east of the accident area.

Jul 11, 2020 2000 UTC Day 1 Convective Outlook

Updated: Sat Jul 11 19:58:06 UTC 2020
 Probabilistic to Categorical Outlook Conversion Table

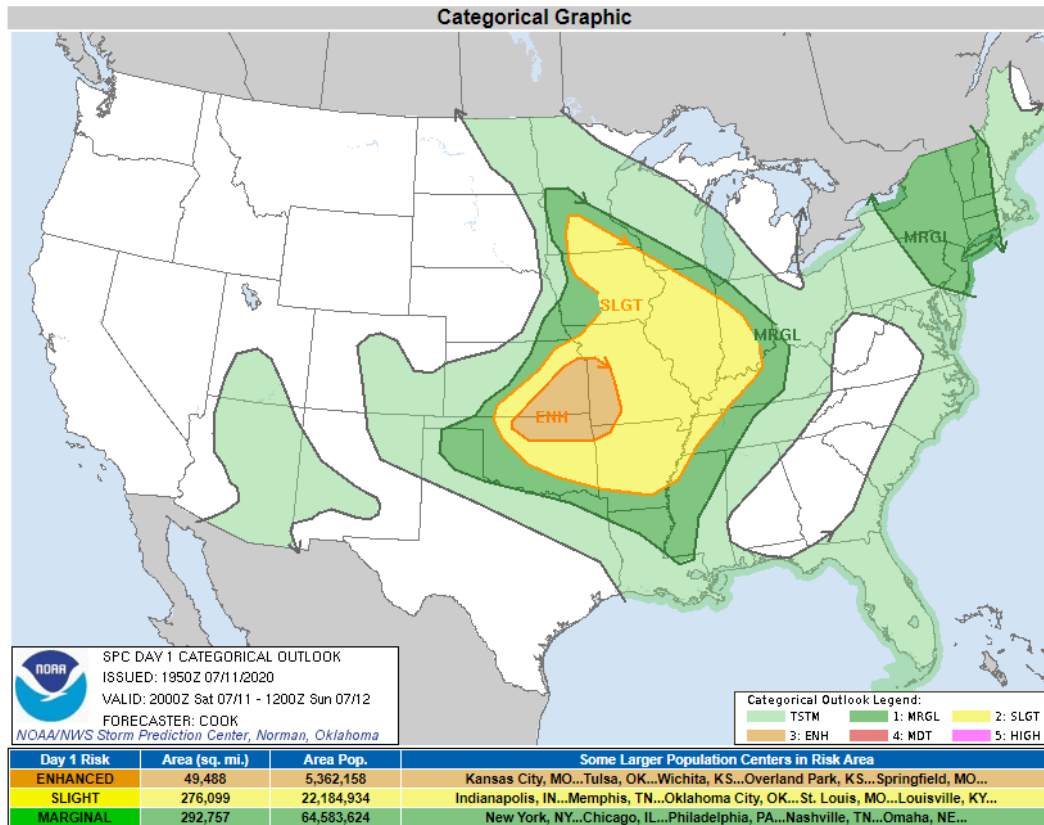


Figure 3 - NWS Convective Outlook issued at 1700 PDT.

2.0 Observations

The official observations issued surrounding the accident site were documented using standard Aviation Routine Weather Reports (METARs⁵) and Specials Reports (SPECI) issued surrounding the period. Cloud heights are reported above ground level (agl) in the following section, and the magnetic variation was estimated at 12.5° west based on the sectional chart for the area.

The accident airplane departed from Ely Airport/Yelland Field (KELY) at approximately 1119 PDT. KELY was located approximately 4.5 miles west of the accident site at an elevation of 6,260 ft. The airport had an Automated Surface Observation System (ASOS), which was not augmented by any human observers. The following conditions were reported at the approximate time of the accident.

KELY weather observation at 1453 PDT, automated, wind from 210° at 14 knots with gusts to 27 knots, visibility 10 miles or more, skies clear below 12,000 ft agl, temperature 33° C (91° F), dew point 1° C (33° F), altimeter of 30.25 inches of mercury. Remarks: automated station with a precipitation discriminator, peak wind from 220° at 30 knots

⁵ METAR is an abbreviation for meteorological aerodrome reports.

occurred at 1443 PDT, sea level pressure 1014.0-hPa, temperature 32.8° C, dew point 0.6° C.

The observation indicated a 58° F temperature-dew point spread, with the relative humidity of 12%, and the calculated density altitude was 9,344 ft. The next observation reported a peak wind from 220° at 31 knots at 1508 PDT. The raw observation surrounding the period from 1153 through 1653 PDT were as follows:

METAR KELY 111853Z AUTO VRB05G15KT 10SM CLR 32/M01 A3032 RMK AO2 SLP147 T03221011=

METAR KELY 111953Z AUTO 24009G19KT 10SM CLR 33/M01 A3030 RMK AO2 SLP147 T03281006=

METAR KELY 112053Z AUTO 21017G24KT 10SM CLR 34/00 A3028 RMK AO2 SLP141 T03440000 58014=

METAR KELY 112153Z AUTO 21014G27KT 10SM CLR 33/01 A3025 RMK AO2 PK WND 22030/2143 SLP140 T03280006=

Accident 2200Z

METAR KELY 112253Z AUTO 22015G25KT 10SM CLR 34/01 A3024 RMK AO2 PK WND 22031/2208 SLP130 T03440006=

METAR KELY 112353Z AUTO 21010KT 10SM CLR 33/02 A3023 RMK AO2 PK WND 21028/2308 SLP133 T03280017 10356 20300 56014=

3.0 Pilot Reports

The following pilot reports (PIREPs) were recorded over Nevada and Utah within 120 miles surrounding the time of the accident from 0900 through 1600 PDT.

HND UA /OV GOG235015 /TM 1603 /FL155 /TP PA32 /SK SKC /TA 01 /WV 22017KT /RM SMOOTH

ELY UA /OV ILC270008 /TM 1622 /FL095 /TP RV8 /SK BKN150 /WX FV50SM /TA 21 /WV 20015KT /TB NEG /RM SMOOTH

DPG UA /OV MIJ330017 /TM 1734 /FL155 /TP PA32 /WX FV99SM /TA 01 /WV 25030KT /TB NEG /RM SMOOTH

MLF UA /OV MLF320010 /TM 2113 /FL110 /TP SR20 /TB LGT - MOD /RM ZLC

4.0 Sounding

To determine the vertical structure of the atmosphere over the accident site a High Resolution Rapid Refresh (HRRR) numerical model⁶ was retrieved from the National Oceanic and Atmospheric Administration (NOAA) Air Resource Laboratory for the coordinates at 39.50° N,

⁶ 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.

114.75° W. The 1500 PDT HRRR data was then plotted on a standard Skew T log P diagram⁷ using the complete Rawinsonde Observation RAOB software program⁸ from the surface to 400-hPa or approximately 23,000 ft as seen in figure 4.

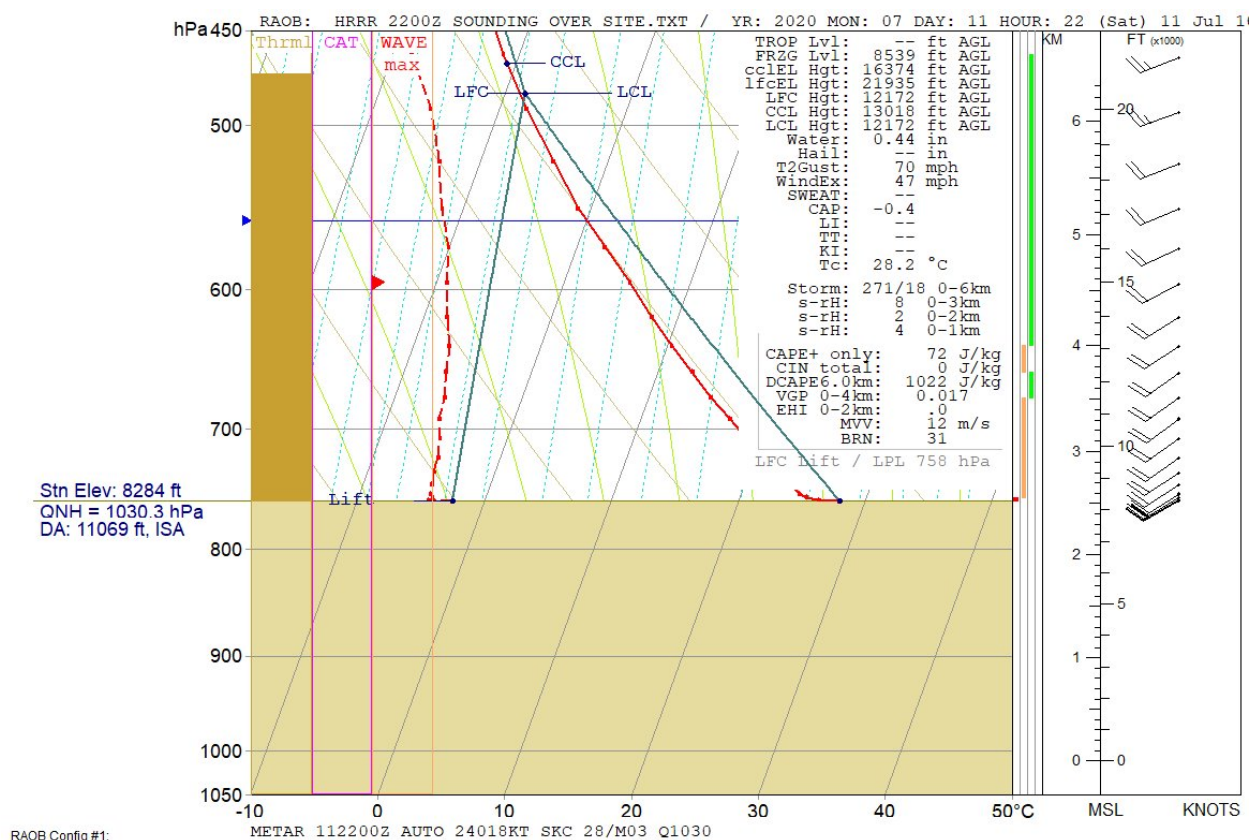


Figure 4 - HRRR numerical model sounding for 1500 PDT over the accident site coordinates.

The sounding depicted an elevation of 8,284 ft with a near surface temperature of 28° C (82° F), a dew point of -2.5° C (28° F), with a relative humidity of 13%, which provided a density altitude of 11,069 ft. The sounding depicted a dry low-level environment with the lifted condensation level (LCL)⁹ and level of free convection (LFC)¹⁰ at 12,172 ft agl, with the convective condensation level (CCL)¹¹ at 13,089 ft agl. The RAOB program indicated the potential for strong thermals from the surface through 21,000 ft with the atmosphere characterized as

⁷ 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.

⁸ 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.

⁹ Lifted Condensation Level (LCL) - the level at which a lifted parcel becomes saturated. The LCL height corresponds to cloud base height for forced ascent.

¹⁰ 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.

¹¹ Convective Condensation Level (CCL) – the level at which condensation will occur if sufficient lifted. Found at the intersection of the saturation mixing ratio line and the environmental temperature.

unstable below 5,000 ft agl (13,000 ft msl). The convective available potential energy (CAPE)¹² was 72 J/kg, with the maximum vertical velocity (MVV) of the potential convective updrafts at 24 knots (12 m/s), with the downdraft CAPE (DCAPE)¹³ of 1,022 J/kg. The WindEx¹⁴ or microburst potential indicated the potential for outflow winds of 41 knots (40 mph) and the T² Gust¹⁵ or outflow winds from potential thunderstorms was calculated at 72 knots (70 mph). The freezing level was identified above at 16,800 ft with no structural icing conditions indicated by RAOB. The precipitable water content at 0.44 inches.

The HRRR wind profile indicated a surface wind from 240° at 18 knots with little variation in direction or wind speed with height through 15,000 ft. The HRRR wind profile did not depict any significant vertical wind shears. The mean 0 to 6 kilometer wind was from 240° at 24 knots, and the level of maximum wind identified at 40,650 ft from 260° at 48 knots. The HRRR sounding did reflect a predominate mountain wave near 15,000 ft using the RAOB's maximum default values, which indicated a wavelength of 7.8 miles, a maximum vertical velocity of 513 feet per minute (fpm), and with possible light turbulence which is depicted in figure 5.

¹² Convective Available Potential Energy (CAPE) - is the integrated amount of work that the upward (positive) buoyancy force would perform on a given mass of an air parcel if it rose vertically through the entire atmosphere. Positive CAPE will cause the air parcel to rise, while negative CAPE will cause the air parcel to sink.

¹³ Downdraft CAPE (DCAPE) - can be used to estimate the potential strength of rain-cooled downdrafts within deep convection and is similar to CAPE. It is obtained by following the moist adiabat down to the ground from the minimum theta-e value in the lowest 400-hPa of the sounding, and then calculate positive and negative area. DCAPE values greater than 1000 J/kg have been associated with increasing potential for strong downdrafts and damaging outflow winds.

¹⁴ McCann, D. W., "WINDEX C A New Index for Forecasting Microbursts," Proceedings of 13th Conference on Weather Analysis and Forecasting, Vienna, VA, American Meteorological Society, pp. 482-485, 1993.

¹⁵ T² Gust - This method first finds the surface temperature identified by the moist adiabat that intersects the wet bulb temperature (WBZ). This temperature is then subtracted from the surface dry-bulb temperature, which is then applied to a non-linear relationship between the calculated temperature difference and surface gusts (AWS/TR 200).

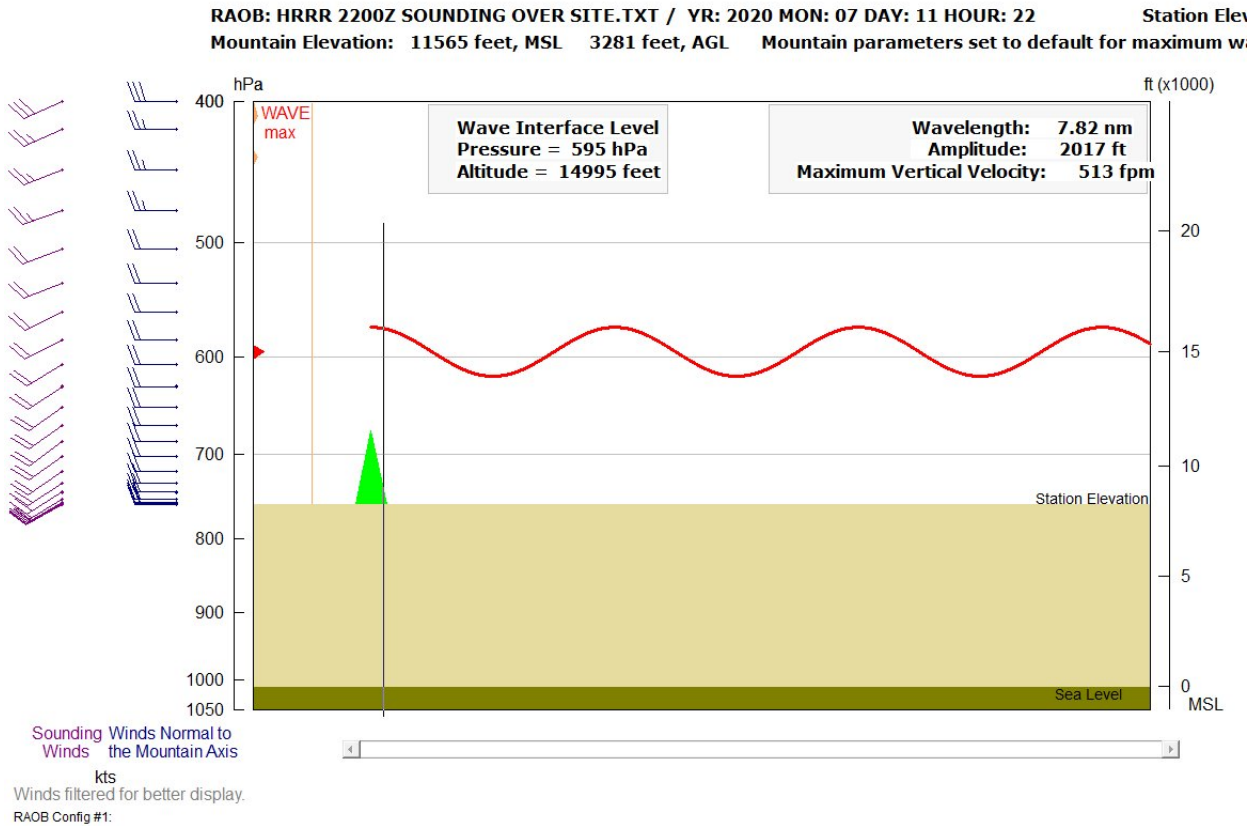


Figure 5 - RAOB mountain wave potential at 15,000 ft using default worst case conditions.

Figure 6 is a table of the HRRR sounding parameters of height, pressure (Pres), temperature (T), dew point (Td), relative humidity (RH), wind direction and speed (DD/FF), and RAOB algorithm derived clear air turbulence (CAT), low-level wind shear (LLWS), icing, and potential mountain wave conditions from the surface to approximately 20,000 ft.

Height (ft-MSL)	Pres (hPa)	T (C)	Td (C)	RH (%)	DD / FF (deg / kts)	CAT (FAA)	LLWS	Icing - Type (AFGWC method)	Wave/x---W---Turb nm fpm max
8284	758	28.0	-2.5	13	238 / 18				
8322	757	26.3	-4.4	13	238 / 18		LIGHT		
8398	755	25.3	-4.2	14	237 / 20				
8512	752	24.6	-4.4	14	236 / 21				
8818	744	23.6	-4.6	15	235 / 21				
9204	734	22.3	-4.8	16	234 / 21				
9672	722	20.7	-4.9	17	233 / 21				
10264	707	18.9	-5.3	19	232 / 21				
10865	692	17.0	-5.9	20	231 / 21				
11516	676	14.9	-6.1	23	232 / 21				
12304	657	12.7	-6.7	25	232 / 21				
13108	638	10.3	-7.2	28	234 / 20				
13974	618	7.9	-8.2	31	236 / 19				
14995	595	5.2	-9.2	34	240 / 19				7.82 513 LIGHT
16046	572	2.2	-10.1	40	243 / 19				
17176	548	-1.0	-11.7	44	246 / 20				
18542	520	-4.3	-13.3	49	247 / 21				
20017	491	-7.9	-15.4	55	248 / 23				

Figure 6 - HRRR numerical sounding parameters and potential CAT, LLWS, icing, and mountain wave conditions.

To compare the HRRR numerical model to actual observed conditions, the NWS Elko (KEKO) station 72582 sounding at 1700 PDT was also obtained. KEKO was located approximately 100 miles north-northwest of the accident site at an elevation of 4,485 ft. Figure 7 is the KEKO 1700 PDT sounding from the surface to 24,000 ft. The KEKO sounding indicated a surface temperature of 36° C, had a density altitude of 8,510 ft, and also supported strong thermals with a conditionally unstable atmosphere. The KEKO sounding DCAPE values increased to 1,836 J/kg, and the WindEx to 41 knots (47 mph) and T² Gust factors at 72 knots (82 mph). The wind profile indicated lighter winds from the southwest than the HRRR sounding with little directional variation with height, but did not indicate any support for mountain wave conditions below 18,000 ft.

The KEKO sounding parameters to 20,000 ft are included in figure 8, and only indicated the potential for light turbulence below 18,000 ft.

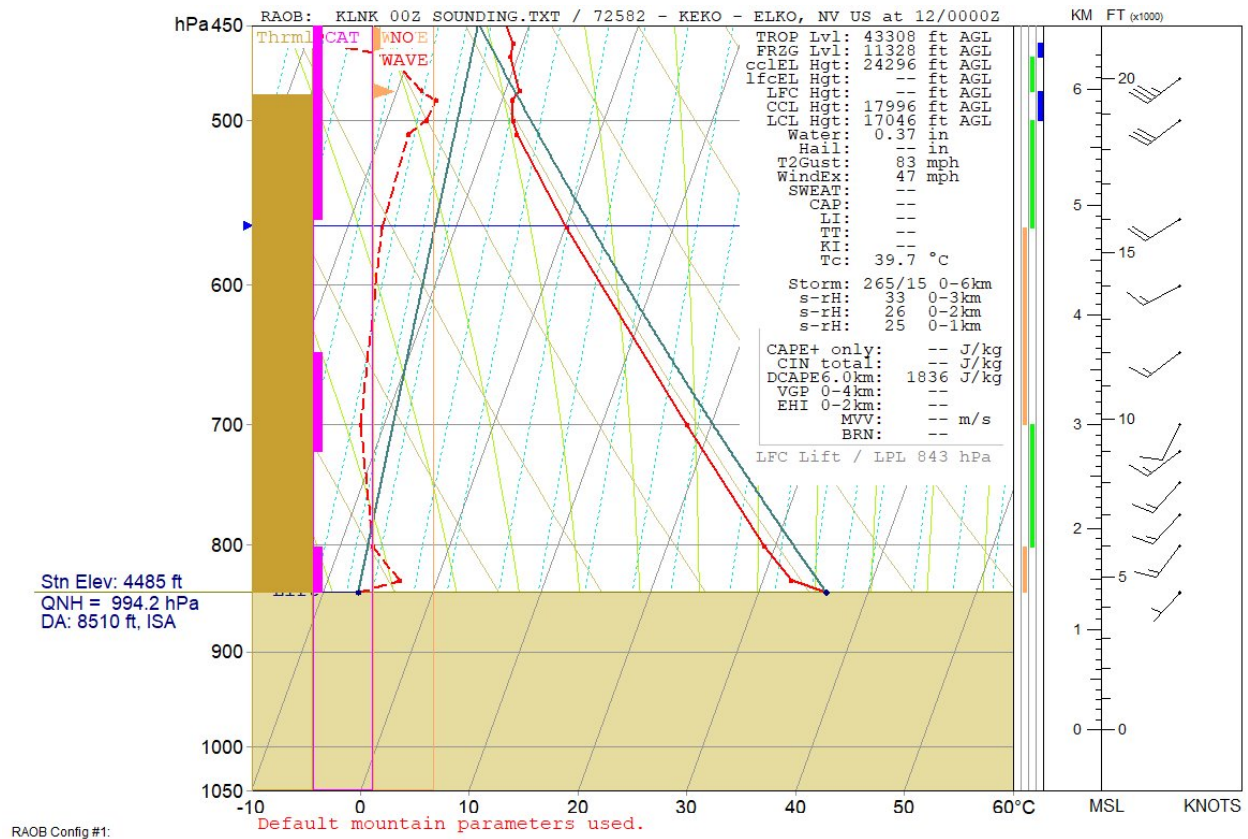


Figure 7 - KEKO observed sounding for 1700 PDT.

Height (ft-MSL)	Pres (hPa)	T (C)	Td (C)	RH (%)	DD / FF (deg / kts)	CAT (FAA)	LLWS	Icing - Type (AFGWC method)	Wave/x---W---Turb nm fpm max
4485	843	36.2	-6.8	6	220 / 7				
4874	832	32.6	-3.4	10		LGT			
5985	801	29.0	-7.0	9	215 / 15				
7000	773				220 / 16				
8000	746				220 / 14				
9000	721				230 / 14	LGT			
9832	700	17.8	-12.2	12	205 / 12	LGT			
12000	646				230 / 16				
14000	600				240 / 15				
15744	563	0.2	-16.8	27					
16000	557				235 / 18				
18409	508	-7.5	-17.5	45		LGT			
18814	500	-8.3	-16.3	52	230 / 29				
19380	489	-9.1	-16.1	57					
19641	484	-8.7	-17.7	48		LGT			4.97 722 LT-MD
20000	477				230 / 33				
20601	466	-10.7	-21.7	40					
20983	459	-10.9	-27.9	23					4.74 972 MD-SV

Figure 8 - KEKO sounding parameters from the surface to 20,000 ft.

5.0 Topographical Features

A depiction of the departure airport and the local topography with the accident site marked by the red star is included as figure 9. The approximate accident site marked by the red star was located near the peak on the lee side of the Schell Creek Mountain Range.

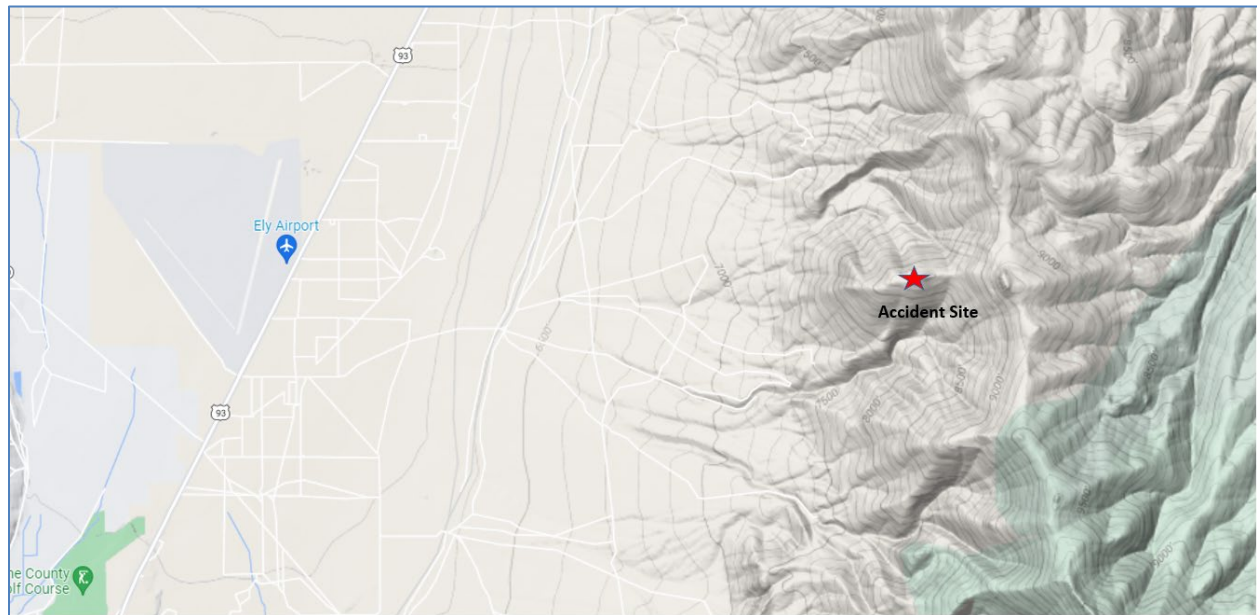


Figure 9 - Topographical map of the accident site and departure airport.

6.0 Satellite Imagery

The Geostationary Operational Environmental Satellite number 17 (GOES-17) imagery data were 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 (McIDAS) software. The infrared long wave, low-level water vapor and visible imagery were obtained for times surrounding the time of the accident, with the images closest to the time of the accident documented below. The infrared long wave imagery (band 13) at a wavelength of 10.3 microns (μm) provided radiative cloud top temperatures with a nominal spatial resolution of 2 km, with the water vapor (band 10) with a wavelength of 7.3 μm and at 2 km resolution. The visible (band 2) at a wavelength of 0.64 μm provided images at a resolution of 0.5 km.

Figure 10 is the GOES-17 infrared image for 1501 PDT at 4X magnification with a standard MB temperature enhancement curve applied. The image depicted a large area of clouds over southern and eastern Nevada with scattered to broken cumulus clouds, with a transverse band pattern¹⁶ over the northeastern portion of the state. A review of the water vapor imagery failed to depict any significant moisture channel darkening.

¹⁶ Transverse band feature are clouds which form perpendicular to the mean wind and often indicated the presence of turbulence and a wave like flow in the wind pattern.



Figure 11 - GOES-17 visible image at 1451 PDT at 4X magnification.



Figure 12 - GOES-17 visible image at 1456 PDT at 4X magnification.



Figure 13 - GOES-17 visible image at 1501 PDT at 4X magnification.



Figure 14 - GOES-17 visible image at 1506 PDT at 4X magnification.

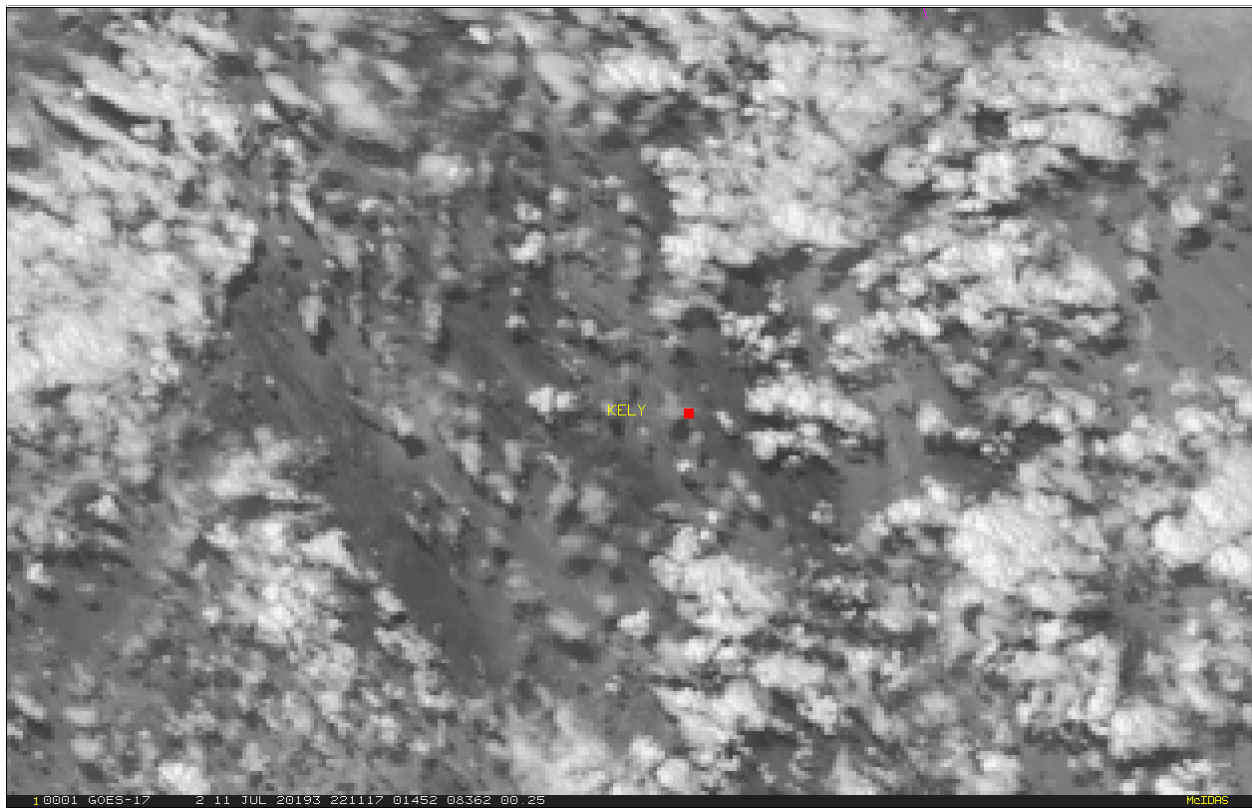


Figure 15 - GOES-17 visible image at 1511 PDT at 4X magnification.



Figure 16 - GOES-17 visible image at 1516 PDT at 4X magnification.

7.0 Weather Surveillance Radar

A review of the NWS Weather Surveillance Radar 1988 Doppler (WSR-88D) radar network (figure 17) indicated the Ely, NV area is in an area without radar coverage below 10,000 ft.

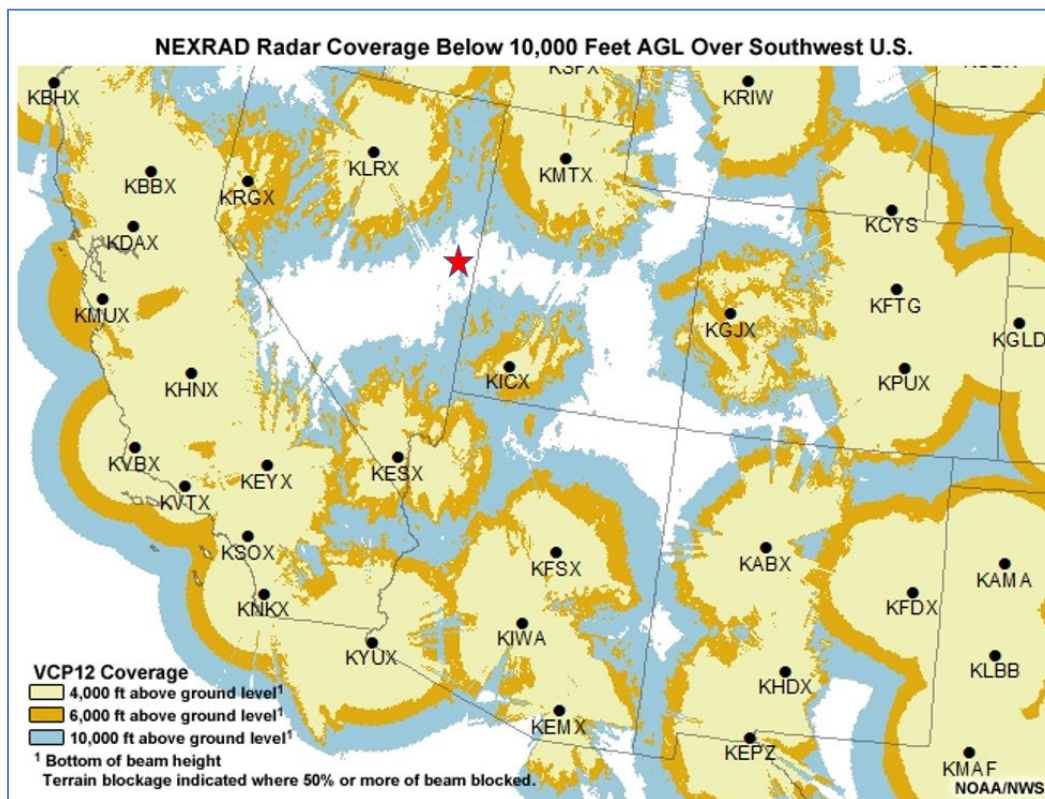


Figure 17 - NWS WSR-88D/NEXRAD radar coverage over the southeast.

8.0 NWS Forecasts

The standard aviation weather forecasts were documented over the area. The NWS Elko, NV, Weather Forecast Office (WFO) was responsible for the local area, with the accident site located in White Pine County of Nevada.

8.1 Terminal Aerodrome Forecasts

The Terminal Aerodrome Forecast (TAF) for KELY was issued at 1035 PDT and valid for a 24-hour period, for a 5-miles radius around the airport. The forecast current at the time of the accident is in dark old type and was as follows:

*TAF KELY 111735Z 1118/1218 22009KT P6SM SKC
FM111900 22010G20KT P6SM FEW120 SCT200
FM120100 21012KT P6SM SCT120 SCT200
FM120600 14005KT P6SM FEW100 FEW200
FM120900 20005KT P6SM SKC=*

The forecast current between 1200 through 1800 PDT expected winds from 220° at 10 knots gusting to 20 knots, visibility unrestricted at 6 miles or more, with a few clouds at 12,000 ft agl, and scattered clouds at 20,000 ft.

8.2 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 forecast discussion issued by the Elko WFO at 1438 PDT without the long-term forecast section was as follows:

*FXUS65 KLKN 112138
AFDLKN*

*Area Forecast Discussion
National Weather Service Elko NV
238 PM PDT Sat Jul 11 2020*

.SYNOPSIS...Very warm or hot conditions expected through this weekend before a slight cool down by the start of the work week. Temperatures return to the mid to upper 90s by mid-week.

.SHORT TERM...This afternoon through Monday.

Overview:

*An approaching cold front/500mb trof induced a lee side trof in western NV, as well as pulled some mid level moisture northeastward into southern and parts of central NV this afternoon and evening. **This resulted in a tightening surface gradient across western areas and an increase in surface dewpoints (30s) and PWATs (.50 to .55 inches) across Nye and White Pine County.** The southern portion of the boundary weakens as sags southward towards the area from the Pacific NW tonight and tomorrow. It stalls out over NW Nevada tomorrow before digging southward into the area late tomorrow or early on Monday as the orientation of the 500mb trof turns slightly more negative. Some mid level moisture accompanies the boundary across far northern Nevada but jet dynamics stay to the north. This boundary digs into central NV late on Monday before stalling and falling apart. The overall upper level flow turns northwest on the backside of the 500mb trof as 500mb heights drop into the mid 580s dm range in northern NV. .*

Sensible Weather:

Precipitation:

Some virga or a dry thunderstorm possible in eastern White Pine County this afternoon, as well as tomorrow afternoon. A few buildups in northern NV on Monday but no precip is expected.

Winds:

Slight increase in winds today and tomorrow but still nothing out of the ordinary for early July. Gusts in the 20s to near 30 in the higher terrain. Decrease in speed and direction change to W to NW on Monday.

Temperatures:

Very warm to hot high temperatures this afternoon and tomorrow but no records expected. Some locations may hit their first 100 of the year. This does push the heat risk into elevated areas, especially in West Wendover as the overnight temperature remains in the low 70s tonight. A slight drop in high temperatures tomorrow, with additional drop on Monday in northern NV, while central NV see very little on Sunday or

Monday. As for overnight lows, 50s and 60s, with West Wendover staying in the 70s tonight. A slight drop in overnight lows for tomorrow night but still above average.

.AVIATION...A few high clouds under very warm/hot conditions across northern, NV creating high density attitudes. Slightly cooler tomorrow with increase in winds. For central NV sites, afternoon buildups is expected but not anticipating any thunderstorms. Less cloud cover and very warm temperatures expected tomorrow.

.LKN WATCHES/WARNINGS/ADVISORIES...

None.

The synopsis indicated that warm summertime conditions were expected to prevail with temperatures in the 90's to near 100° F. With the short-term forecast noted a tightening of the surface pressure gradient across the western portion of the area which were expected to increase the surface winds with gusts from 20 knots and to 30 knots in higher elevation areas, with an increase in precipitable water content with time. The discussion noted that some virga or dry thunderstorms were possible across eastern Pine County during the afternoon, with little to no surface rain expected.

8.3 Numerical Guidance

The NWS Point Forecast Guidance¹⁷ current at the time is included below for Ely and White Pine County, NV.

```
NVZ035-120015-
Ely-White Pine NV
39.29N 114.85W Elev. 6262 ft
159 AM PDT Sat Jul 11 2020

Date                Sat 07/11/20                Sun 07/12/20                Mon 07/13/20
PDT 3hrly           02 05 08 11 14 17 20 23 02 05 08 11 14 17 20 23 02 05 08 11 14 17
UTC 3hrly           09 12 15 18 21 00 03 06 09 12 15 18 21 00 03 06 09 12 15 18 21 00

Max/Min              94              53              94              53              92
Temp                62 56 73 88 93 92 81 71 60 53 72 88 94 93 83 68 59 53 69 86 90 91
Dewpt              17 19 24 32 34 33 31 26 20 21 20 25 27 26 23 18 11 15 15 23 26 22
RH                 17 23 16 13 13 12 16 18 21 28 14 10  9  9 11 15 15 22 12 10 10  8
Wind dir            S  S  S SW SW SW SW  S SW SW SW  W  W  W  W NW  W NW NW  W  W  W
Wind spd            5  5  4 11 17 14  6  4  4  4  3  5 10 11  5  4  4  3  4  6 10 12
Clouds              CL FW CL SC SC SC SC FW CL CL CL CL FW FW SC FW FW FW CL CL FW FW
PoP 12hr              10              10              5              10              5
QPF 12hr              0              0              0              0              0
Snow 12hr            00-00            00-00            00-00
Tstms                S  S  S  S
```

The forecast expected a maximum temperature of 94° F during the period, with the conditions at 1400 PDT a temperature of 93 F, a dew point temperature of 34° F, with a relative humidity of 13%, wind from the southwest at 17 knots, with scattered clouds. The probability of precipitation for the 12-hour period was 10%, with a slight chance of thunderstorms.

8.4 Winds and Temperature Aloft Forecast

The Winds and Temperature Aloft Forecast current for the period was issued at 1255 PDT and was valid for 1700 PDT and for use between 1300 through 2000 PDT. The forecast was as follows:

FBUS31 KWNO 111955

¹⁷ Based on the FOUS55 bulletin. The forecast is often used by meteorologists, dispatchers, and pilots for more time specific forecasts of temperature, dew point temperature, winds, and cloud cover at 3-hour intervals.

FDIUSI
WINDS ALOFT FORECASTS
DATA BASED ON 111800Z
VALID 120000Z FOR USE 2000-0300Z. TEMPS NEG ABV 24000
FT 3000 6000 9000 12000 18000 24000 30000 34000 39000
ELY 2416+24 2417+15 2620-07 2527-18 254133 264542 265152

The forecast for Ely at 9,000 ft was for winds from 240° at 16 knots with a temperature of 24° C, at 12,000 ft from 240° at 17 knots with a temperature of 15° C.

9.0 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 Aviation Weather Center (AWC), as well as from the Center Weather Service Units (CWSU) associated with FAA 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. The following advisories were current during the period.

During the period the NWS AWC had no SIGMET or Convective SIGMETs for any severe turbulence or organized convection or thunderstorms. There were also no AIRMETs current for any turbulence, strong surface winds, low-level wind shear, or icing outside of convective activity, and no instrument flight rule (IFR) conditions, or mountain obscuration over Nevada. The Los Angeles CWSU also had no CWA current for the region.

10.0 Microburst References

The FAA Advisory Circular AC 00-54 "Pilot Windshear Guide" published in 1988 provides general guidelines for identifying and avoiding hazardous windshear conditions. Appendix 1 Microburst Windshear probability guidelines is as follows.

<u>OBSERVATION</u>	<u>PROBABILITY OF WINDSHEAR</u>
PRESENCE OF CONVECTIVE WEATHER NEAR INTENDED FLIGHT PATH:	
- With localized strong winds (Tower reports or observed blowing dust, rings of dust, tornado-like features, etc.)	HIGH
- With heavy precipitation (Observed or radar indications of contour, red or attenuation shadow) ...	HIGH
- With rainshower	MEDIUM
- With lightning	MEDIUM
- With virga	MEDIUM
- With moderate or greater turbulence (reported or radar indications)	MEDIUM
- With temperature/dew point spread between 30 and 50 degrees fahrenheit	MEDIUM
ONBOARD WINDSHEAR DETECTION SYSTEM ALERT (Reported or observed).....	HIGH
PIREP OF AIRSPEED LOSS OR GAIN:	
- 15 knots or greater	HIGH
- Less than 15 knots	MEDIUM
LLWAS ALERT/WIND VELOCITY CHANGE	
- 20 knots or greater	HIGH
- Less than 20 knots	MEDIUM
FORECAST OF CONVECTIVE WEATHER	LOW
NOTE: These guidelines apply to operations in the airport vicinity (within 3 miles of the point of takeoff or landing along the intended flight path and below 1000 feet AGL). The clues should be considered cumulative. If more than one is observed the probability weighting should be increased. The hazard increases with proximity to the convective weather. Weather assessment should be made continuously.	
CAUTION: CURRENTLY NO QUANTITATIVE MEANS EXISTS FOR DETERMINING THE PRESENCE OR INTENSITY OF MICROBURST WINDSHEAR. PILOTS ARE URGED TO EXERCISE CAUTION IN DETERMINING A COURSE OF ACTION.	

Figure 18 - Advisory Circular 00-54 "Pilot Windshear Guide" Appendix 1.

A microburst is defined as a powerful localized downdraft created by a column of sinking air through the base of a cumulus or cumulonimbus cloud that produces precipitation, with a downdraft core of 6,000 to 7,000 feet per minute (fpm), and usually impacts an area less than 2.5 miles with a wind differential of 50 knots or more. This meteorological phenomenon can be divided into dry and wet microburst, depending on rain reaching the surface. A wet microburst is one with from a cumulonimbus type cloud with a defined heavy rain column reaching the surface, while a dry microburst¹⁸ is typically produced from a high based cumulus clouds with virga or rain falling but evaporating before reaching the surface. Both of types of microbursts can cause severe wind damage to the surface below and surrounding objects in their path.

¹⁸ Dry Microburst – A microburst with little or no precipitation reaching the ground; most common in semi-arid regions. They may or may not produce lightning. Dry microbursts may develop in an otherwise fair-weather pattern; visible signs may include a cumulus cloud or small Cb with a high base and high-level virga, or perhaps only an orphan anvil from a dying rain shower. At the ground, the only visible sign might be a dust plume or a ring of blowing dust beneath a local area of virga.

According to the AC 00-54 Appendix 1, the presence of cumulus or convective clouds with rain and/or virga, and a temperature-dew point spread greater than 30° F all fail into the medium risk category for encountering a microburst. Figure 18 is a schematic of a dry microburst from the advisory circular.

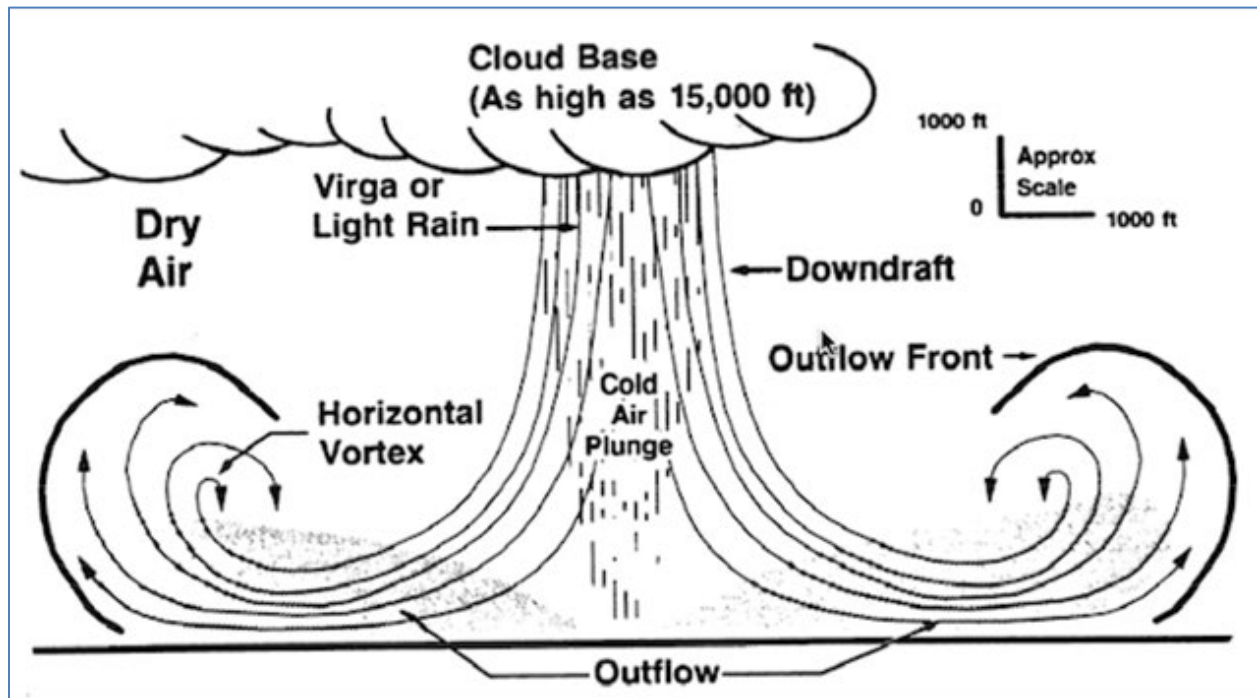


Figure 19 - Dry microburst schematic from Advisory Circular 00-54

An example of a dry microburst is included as figure 20 which was taken over western Nevada in 2015. It shows a ring of dust (1) as a dry microburst strikes the surface. Indications of virga or precipitation falling aloft (2) over the surface dust. Further to the right in the photo another altocumulus cloud with virga falling under the cloud (3). The article further states that despite being a dangerous meteorological phenomenon, a microburst is often invisible. The only clue that dry microbursts might be occurring is the presence of high-based cumulus clouds with virga on an otherwise dry day.



Figure 20 - Dry microburst over western Nevada¹⁹

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¹⁹ Photo taken by meteorologist Honza Rejmanek and published in Cross Country Magazine, November 11, 2015. The publication is designed for parasail and glider pilots.