National Transportation Safety Board

Office of Aviation Safety
Washington, D.C. 20594-2000
September 4, 2002

METEOROLOGY FACTUAL REPORT

LAX02GA201

A. ACCIDENT

Location: Walker, California
Date: June 17, 2002
Time: 1445 Pacific Daylight Time
Aircraft: Lockheed C-130A, registration: N130HP

B. METEOROLOGICAL SPECIALISTS

Kevin R. Petty and Donald E. Eick.
Meteorologists
National Transportation Safety Board
Operational Factors Division, AS-30
Washington, D.C. 20594-2000

C. SUMMARY

On June 17, 2002, approximately 1445 Pacific Daylight Time (2145Z[1]), a Lockheed C-130A, N130HP, broke apart in flight while executing a fire retardant delivery near Walker, California. The three flight crewmembers were fatally injured and the airplane was destroyed. A company flight plan had been filed. The airplane was operated by the U.S. Department of Agriculture - Forestry Service for the public-use firefighting flight under 14 CFR Part 91. The airplane was registered to Hawkins and Powers Aviation, Inc., Greybull, Wyoming. The airplane had departed Minden, Nevada, about 1429 PDT, to participate in firefighting efforts near Walker.

[1] Z – is an abbreviation for Zulu time, which is a global time scale based upon the local time observed on the Prime Meridian (also called Universal Coordinate Time (UTC)).

D. DETAILS OF INVESTIGATION

All the weather data used in this report were obtained from official National Weather Service (NWS) sources, including the National Climatic Data Center (NCDC). All times are Zulu Time (Z) based upon the 24-hour clock. Local time of Pacific Daylight Time (PDT) is +7 hours to Z. Directions are referenced to true north and distances in nautical miles. Heights are above mean sea level (MSL) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

1. Synoptic Situation

The synoptic (large scale) weather systems influencing the area were documented using standard NWS charts issued by the National Center for Environmental Prediction (NCEP) located in Silver Springs, Maryland. These are the fundamental 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 00-45.

1.1 Surface Analysis Chart

Fig. 1 shows the surface analysis for 2100Z (1400 PDT) on June 17, 2002. This NWS chart illustrates the meteorological conditions at the Earth's surface within an hour of the accident. The synoptic features of interest included a trough[2] extending from southwestern Montana, through Nevada, and into southern Oregon. A secondary trough was positioned off the northwest coast of the United States exhibiting a north-south orientation and was associated with a low pressure system (1008 hectopascals[3]) just to the west of Vancouver. To the south of this trough was an area of high pressure, with a central pressure over 1024 hPA. The analysis chart also revealed the existence of two pressure systems in northwestern Arizona. The central pressure of the low and high pressure systems were 1001 and 1013 hPA, respectively.

The 2100Z analysis did not supply a large number of station models in the vicinity of the accident site. The closest models to the accident were reporting temperatures in the middle to upper 80s (degrees Fahrenheit (^{o}F)), while the dew point temperatures were as low as 30^{o}F and as high as 54^{o}F. Observed winds from the surrounding station models ranged from southwest to northwest winds at about 10 knots. The surface pressure went from about 1016 hPA along the California coast to 1008 hPA in southern Nevada.

[2] Trough is an elongated area of relatively low atmospheric pressure.
[3] Hectopascals (hPa) is the standard unit of pressure and is interchangeable with the term and units of millibars (mb).

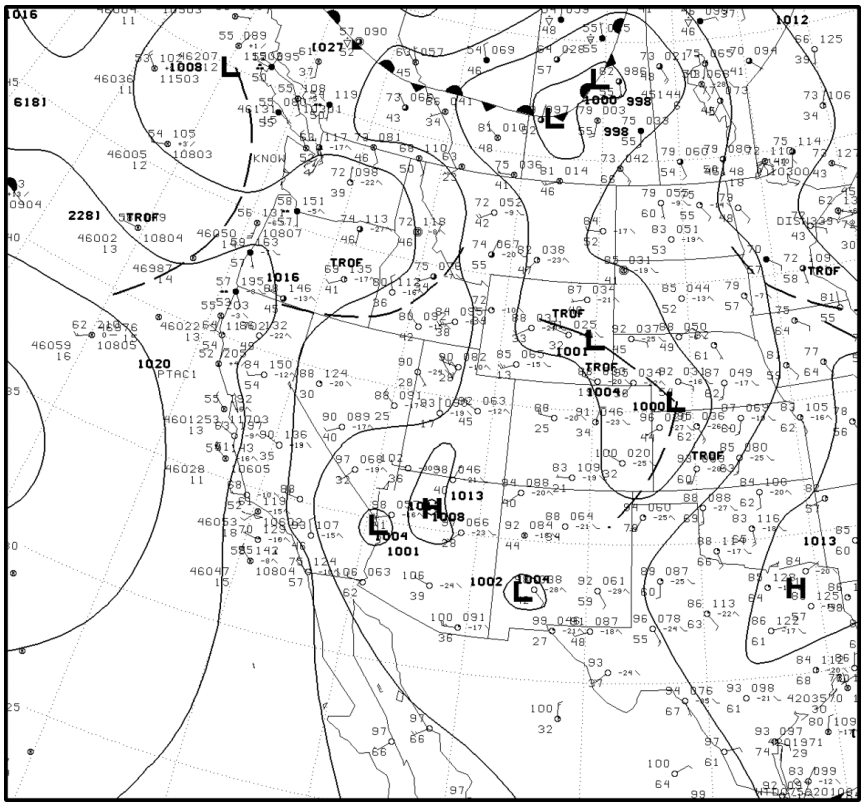

Fig. 1. Surface analysis for 2100Z

1.2 Radar Summary Chart

The radar summary chart issued for 2115Z on June 17, 2002 did not display any echo returns over California and Nevada, except for a small region in the extreme northwestern corner of California. For reference, this radar summary is supplied in Appendix A.

1.3 Constant Pressure Charts

National Weather Service Constant Pressure Charts (850, 500, and 300 millibars) valid at 0000Z on June 18, 2002 (1700 PDT, June 17) are supplied in Appendix B, C, and D.

2. Surface Observations

The location of the accident site and the surrounding weather reporting stations are plotted in Fig. 2. The figure was produced utilizing DeLorme Topo USA version 3.0. Appendix E supplies ancillary information about terrain elevation near the accident site. In addition to the standard weather sites found in Fig. 2., three supplementary sites are displayed. Two of the three supplementary sites were in very close proximity to the accident location. The sites included two Remote Automated Weather Stations (RAWS) and an automated weather site (Coleville weather station) just to the northeast of the accident site. The Walker RAWS, just to the north of the accident site (3 miles away), is owned and operated by the Forest Service,

an agency of the U.S. Department of Agriculture. To the southeast approximately 32 miles away is the Brawley Peaks RAWS, which is owned and operated by the U.S. Department of Interior's Bureau of Land Management. These sites collect and transmit weather data to the National Interagency Fire Center in Boise, Idaho. The Coleville automated weather station (CWS) is owned, operated, and maintained by a private party. On a daily basis, data from this station is transmitted to the NWS forecast office in Reno. The data from the most relevant weather reporting sites in the area of the accident are outlined in the following paragraphs.

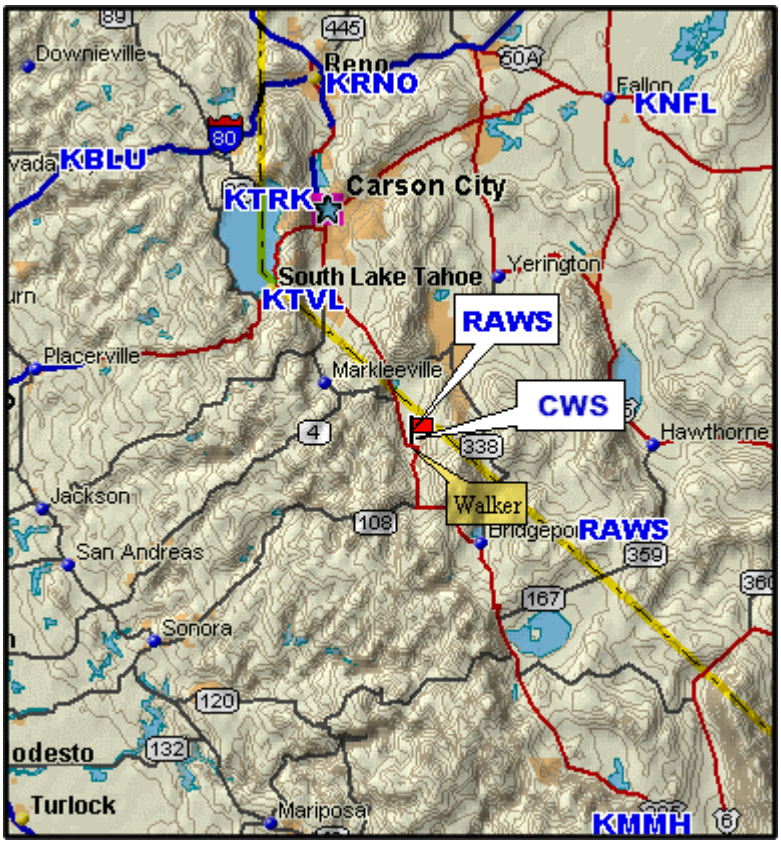

Fig. 2. Accident location (red flag) and local weather station sites (blue). Included are two Remote Automated Weather Station (RAWS) sites and Coleville automated weather site (CWS).

The Coleville weather station, represented by "CWS" in Fig. 2, was situated approximately 2 miles away from the accident site at 40 degrees (°). The weather system is a Davis Weather System comprised of an anemometer mounted 4 feet above rooftop [25 feet above ground level (AGL)] and a standard instrument shelter outside over a grassy location (8 feet AGL). Temperature, dew point temperature, relative humidity, wind speed, wind direction, precipitation, and barometric pressure are elements the system is capable of reporting at 5-minute intervals. Operation and maintenance of the system is the responsibility of the owner, an amateur meteorologist with approximately 20 years of experience as an Air Force pilot. This individual also has weather spotter training and provides support for the Reno, Nevada Weather Service Forecast Office. Weather data from this station can be found in Table 1.

Table 1. Weather data reported on June 17, 2002 from Coleville weather site (CWS). Data covers a one hour time period, including the time of the accident.

Time (PDT)	Temperture (°F)	Dew Point (°F)	Relative Humidity (%)	Wind Speed (knots)	Gusts (knots)	Wind Direction (magnetic)	Barometric Pressure. (inches of Mercury)
13:50	85.9	36.1	17	13.9	22.6	NW	30.052
13:55	85.7	35.9	17	15.6	26.1	WNW	30.051
14:00	85.5	35.8	17	14.8	29.5	WNW	30.051
14:05	85.5	35.8	17	13.9	19.1	NW	30.05
14:10	85.7	35.9	17	13.9	20.8	NW	30.049
14:15	85.9	34.6	16	13.9	20.8	WNW	30.048
14:20	86	36.2	17	15.6	22.6	WNW	30.051
14:25	86.1	36.2	17	14.8	20	NW	30.047
14:30	86.3	36.4	17	13	18.2	NW	30.046
14:35	86.3	36.4	17	16.5	24.3	NW	30.048
14:40	85.8	37.4	18	17.4	26.9	NW	30.048
14:45	85.3	37	18	15.6	23.4	NW	30.051
14:50	84.9	35.3	17	17.4	27.8	NW	30.047
14:55	84.6	35	17	16.5	23.4	NW	30.048
15:00	84.4	37.7	19	16.5	24.3	NW	30.048

As previously noted, two RAWS sites were located near the accident. These stations are capable of measuring wind speed, direction, wind gusts, precipitation, temperature, dew point temperature, relative humidity, and fuel moisture. Temporal resolution of these data is hourly. Data from the Walker (5440 feet MSL) and Brawley Peaks (8080 feet. MSL) stations are presented in Tables 2 and 3, respectively. It should be noted that the wind direction from the Walker site contained an 180° error. This error has been taken into account, and the Walker data displayed in Table 2 has been corrected.

Table 2. Hourly weather data from Walker RAWS site.

Time (PDT)	Temperature (°F)	Dew Point (°F)	Relative Humidity (%)	Wind Speed (knots)	Gusts (knots)	Wind Direction
5:47	61	1	9	1.7	5.2	E
6:47	66	5	9	7	12.2	S
7:47	68	15	13	2.6	10.4	W
8:47	71	15	12	2.6	7	N
9:47	77	20	12	3.5	10.4	N
10:47	79	20	11	4.3	19.1	W
11:47	81	25	13	13	20.8	W
12:47	85	24	11	13.9	21.7	SW
13:47	84	26	12	13	23.4	SW
14:47	86	25	11	13	22.6	W

Table 3. Hourly weather data from Brawley Peaks RAWS site.

Time (PDT)	Temperature (°F)	Dew Point (°F)	Relative Humidity (%)	Wind Speed (knots)	Gust (knots)	Wind Direction
6:03	50	-6	9	0	4.3	N
7:03	63	3	9	7	4.3	W
8:03	66	0	7	4.3	10.4	W
9:30	70	6	8	5.2	5.2	W
10:03	70	8	9	13	13	NW
11:03	74	9	8	6.1	14.8	W
12:03	74	9	8	10.4	10.4	NW
13:03	78	9	7	7	17.4	W
14:03	77	11	8	10.4	17.4	W
15:03	77	4	6	7	20	SW

Additional stations from Fig. 1 were selected. These stations include South Lake Tahoe (KTVL), Truckee-Tahoe (KTRK), Reno (KRNO), and Mammoth/June Lake (KMMH). The data from these stations are presented below.

South Lake Tahoe (KTVL), California

This station was located approximately 34 miles from the accident site at 314°. The station has an elevation of 6263 feet MSL. KTVL is an augmented Automated Surface Observing System (ASOS)[4].

Time--2053Z: type—METAR; winds—variable at 6 knots, with gusts to 17 knots; visibility—10 statute miles; cloud cover—few (1-2 eighths sky coverage) at 9,000 feet; temperature— 23 degrees Celsius (°C); dew point temperature— 1°C; altimeter setting—30.21 inches of Mercury (in Hg); remarks—sea level pressure was 1018.0 hPA, temperature in tenths was 22.8°C, dew point in tenths 0.6°C, and pressure decreased by 0.3 hPA during the previous three hours

Time--2153Z: type—METAR; winds—190° at 15 knots, with gusts to 21 knots; visibility—10 statute miles; cloud cover—clear below 12,000 feet; temperature— 24°C; dew point temperature— 2°C; altimeter setting-30.20 in Hg; remarks—sea level pressure of 1017.8 hPA, temperature of 24.4 °C, and a dew point temperature of 1.7 °C

Truckee-Tahoe(KTRK), California

The Truckee-Tahoe station was positioned about 57 miles from the accident site at 328°**.** Elevation of the station is 5899 feet MSL. The site is an augmented Automated Weather Observing System (AWOS).

[4] Refer to http://www.faa.gov/asos/asos.htm for additional information on ASOS and AWOS.

Time-2045Z; type-METAR; winds—220° at 7 knots, gusting to 18 knots; visibility—30 statute miles; cloud cover—skies clear; temperature— 25°C; dew point temperature— 3°C; altimeter setting—30.18 in Hg

Time-2150Z; type-METAR; winds—260° at 15 knots, gusting to 20 knots; visibility—30 statute miles; cloud cover—skies clear; temperature— 24°C; dew point temperature— 3°C; altimeter setting—30.17 in Hg; remarks—temperature in tenths of degrees 24.4°C, dew point temperature in tenths 2.8°C

Time-2245Z; type-METAR; winds—230° at 12 knots, gusting to 19 knots; visibility—30 statute miles; cloud cover—few (1-2 eighths coverage) at 7,500 feet; temperature— 24°C; dew point temperature— 3°C; altimeter setting—30.17 in Hg; remarks—Altocumulus Standing Lenticular northeast, temperature in tenths of degrees 24.4°C, dew point temperature in tenths 2.8°C

Reno (KRNO), Nevada

The Reno weather observation site was located 60 miles away from the accident site at 346°, with an elevation of 4412 feet MSL. The site is an augmented ASOS site.

Time-2056Z; type-METAR; winds—260° at 16 knots, gusting to 21 knots; visibility—10 statute miles; cloud cover—few (1-2 eighths coverage) at 14,000 feet; temperature— 31°C; dew point temperature— 1°C; altimeter setting—30.04 in Hg; remarks—sea level pressure 1011.9 hPA, Alto Cumulus Standing Lenticular north, temperature in tenths of degrees 30.6°C, dew point temperature in tenths 1.1°C, and pressure over the last three hours dropped by 1.5 hPA

Time-2156Z; type-METAR; winds—270° at 12 knots, gusting to 21 knots; visibility—10 statute miles; cloud cover—few (1-2 eighths coverage) at 15,000 feet; temperature— 30°C; dew point temperature— 1°C; altimeter setting—30.04 in Hg; remarks—sea level pressure 1012.0 hPA, Altocumulus Standing Lenticular north, temperature in tenths of degrees 30.0°C, dew point temperature in tenths 1.1°C

Mammoth/June Lakes (KMMH), California

KMMH was about 62 miles from the accident site at 150°. Elevation of the site is approximately 7129 feet MSL, and the station is an AWOS.

Time-2058Z; type-METAR; winds—270° at 14 knots; visibility—10 statute miles; cloud cover—clear below 12,000 feet; temperature— 28°C; dew point temperature— -4°C; altimeter setting—30.24 in Hg; remarks— density altitude 9,800 feet

Time-2250Z; type-METAR; winds—290° at 14 knots; visibility—10 statute miles; cloud cover—clear below 12,000 feet; temperature— 28°C; dew point temperature— -2°C; altimeter setting—30.22 in Hg; remarks— density altitude 9,900 feet

3. Upper Air /Winds Aloft Data

The closest location of upper air sounding information was Reno, Nevada. . Sounding data for 0000Z on June 18, 2002 is plotted in Fig. 3. Additional data from this sounding is supplied in Appendix E, including stability parameters and energy analytics. The Skew-T log P diagram[5] presented in Fig. 3 and the analysis found in Appendix F were constructed using the NTSB's McIDAS software package.

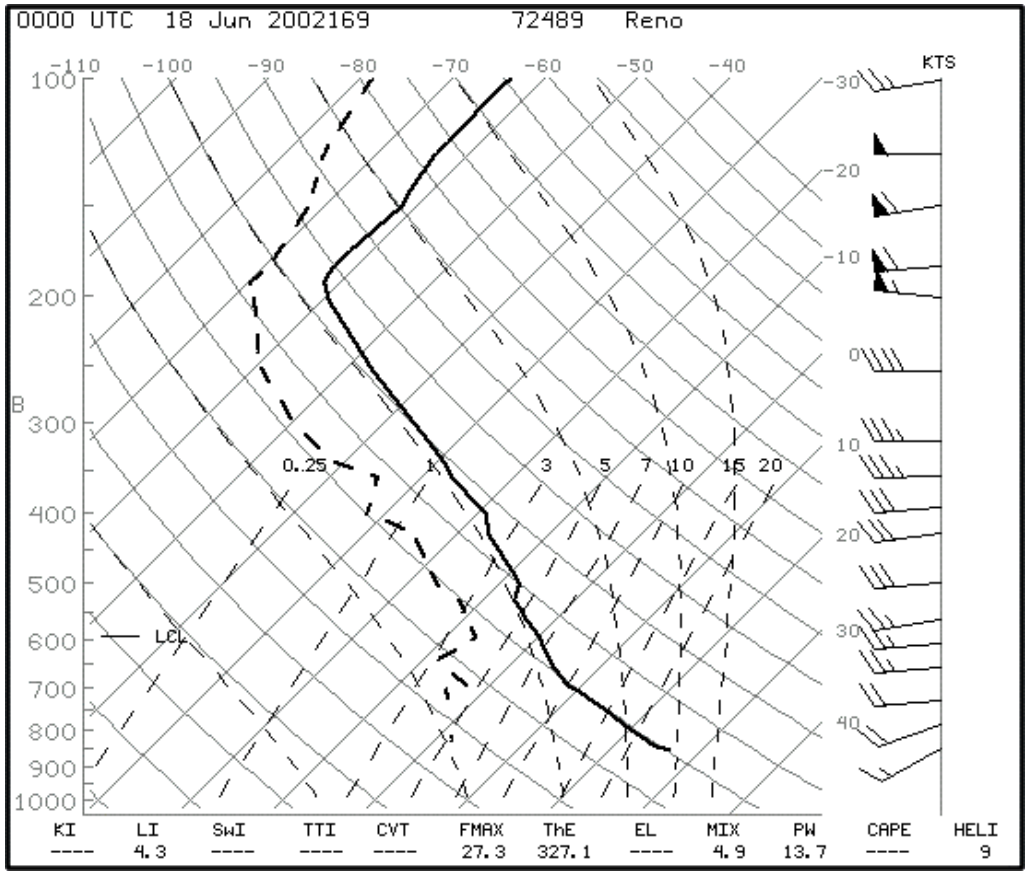

Fig. 3. Sounding for 0000Z June 18, 2002 from Reno, Nevada (KRNO)

The 0000Z sounding represents atmospheric conditions within 2 ½ hours of the official time of the accident. The Lifted Index (LI[6]) was 4.3 and the precipitable water (PW) was

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

[6] Lifted Index (LI) - A common measure of atmospheric instability. Its value is obtained by computing the temperature that air parcel near the ground would have if it were lifted to some higher level (around 18,000 feet, usually) and comparing that temperature to the actual temperature at that level. Negative values indicate instability - the more negative, the more unstable the air is, and the stronger the updrafts are likely to be with any developing thunderstorms. However, there are no "magic numbers" or threshold LI values below which severe weather becomes imminent.

13.7 millimeters (0.53 inches). These indices provide a measure of atmospheric stability and moisture.

Winds are also displayed on the y-axis along the right-hand side of the figure. At the surface, winds were out of the west-southwest at about15 kts. Winds shifted in a clockwise direction with height to become westerly at 700 mb. Maximum wind speeds were approximately 60 knots at the 200 mb level.

4. Mountain Wave Model (MWAVE)

Data from the MWAVE model, an experimental mountain wave forecast model developed by the Experimental Forecast Facility (EFF) at the Aviation Weather Center (AWC) in Kansas City, MO, are included herein. Wind speed, atmospheric stability and terrain height are the key input parameters for wave forecasts produced by the model. Turbulence intensity resulting from mountain wave activity is determined by the computed breaking pressure drag. This is the drag exerted by the mountain wave on the atmosphere. Table 4 shows turbulence intensity with respect to breaking pressure drag.

Table 4. MWAVE model thresholds as they relate to turbulence intensity

Breaking Pressure Drag (millibars-mb)	Turbulence Intensity
1 mb	Light-Moderate
2 mb	Moderate
3 mb	Moderate-Severe
5 mb	Severe

Output from MWAVE's 3-hour forecast valid at 2100Z on June 17 is displayed in Fig. 4. The figure provides profiles of wind speed, stability, and breaking pressure drag. Additionally, the wind direction and magnitude are displayed along the right side of the figure. In this MWAVE forecast, both wind speed and stability began increasing around 300 millibars.

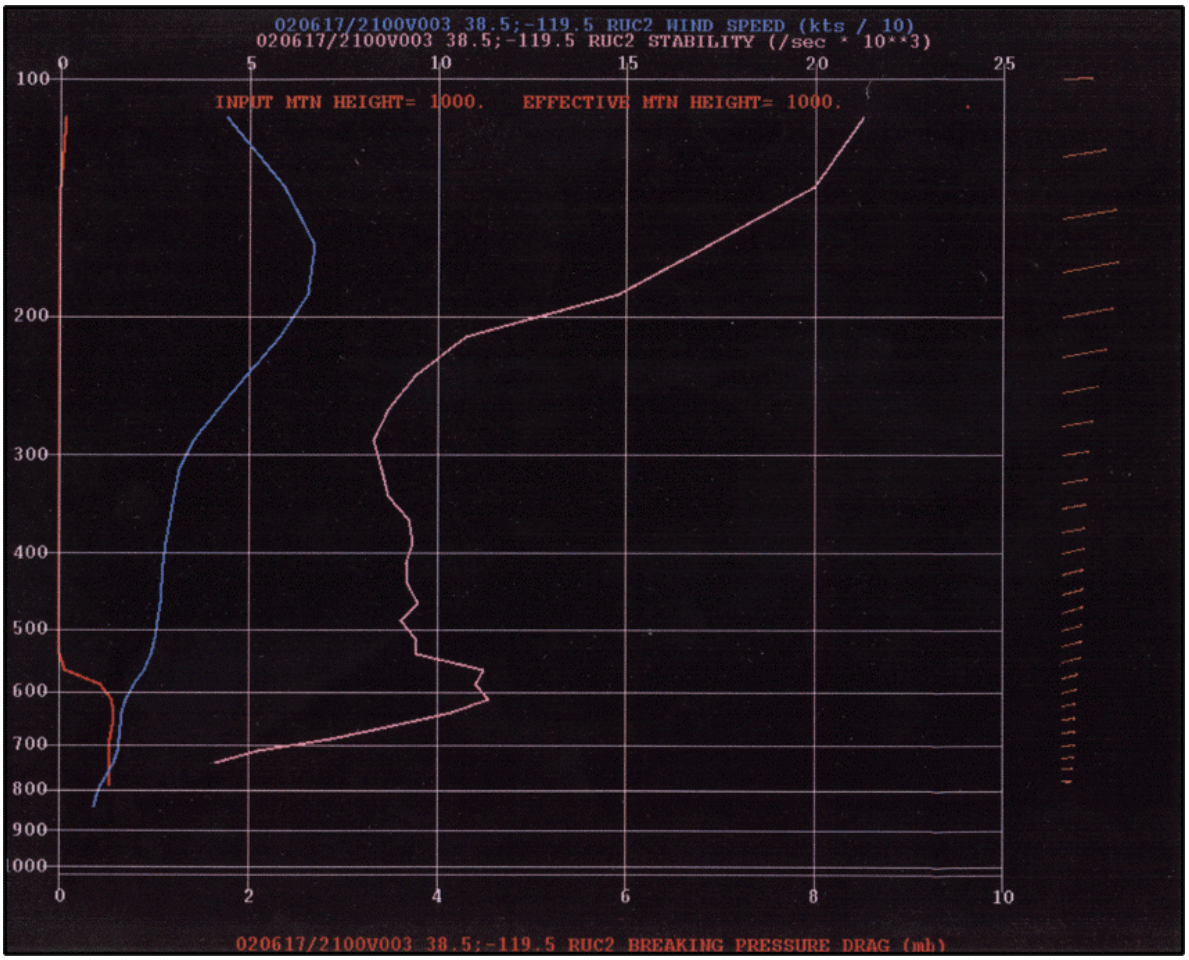

Fig. 4. MWAVE model output. Breaking pressure drag (red line), wind speed (blue), and stability (purple) are presented. Lines along the right side represent wind direction and magnitude. Valid time is 2100Z on June 17, 2002.

The value of the breaking pressure drag was less that 1 mb throughout the atmosphere. A one-hour forecast valid at 2200Z is provided in Appendix G. It is very similar to Fig. 4 in that a small breaking pressure drag was forecasted.

5. Pilot Reports (PIREPs)

This section contains four pilot reports that were recorded within 1 ½ hours the accident.

Routine Reno (RNO) Pilot Report: over—along route from Marysville to Reno; time—2033Z; flight level—9,500 feet; type of aircraft—Cessna 182; turbulence—light to moderate

Routine Reno (RNO) Pilot Report: over—along route from Susanville, California to Cedarville, California; time—2105Z; flight level—unknown; type of aircraft—Cessna

182; turbulence—moderate from 7,500 to 9,500 feet; remarks—from 20 miles south of Susanville to Cedarville

Routine Las Vegas (LAS) Pilot Report: over—Las Vegas; time 2112Z; flight level—unknown; type of aircraft—Boeing 737; turbulence—moderate; remarks—repeated by at least two Boeing 737s during climb southwest bound

Routine Reno (RNO) Pilot Report: over—12 miles southeast of Reno; time—2150Z; flight level—12,000 feet; type of aircraft—Airbus A320; turbulence—light between 12,000 and 18,000 feet; remarks—encoding facility Oakland

6. Satellite Data

The Geostationary Operational Environmental Satellite (GOES) 10 data were obtained from the National Climatic Data Center and displayed using McIDAS. Both visible and infrared imagery were obtained for the period surrounding the time of the accident. The visible imagery (band 1) at a wavelength of 0.65 microns (μm) provided a resolution of 1 kilometer (km), and the infrared imagery (band 4) at a wavelength of 10.7 μm provided a 4-km resolution, with radiative cloud top temperatures. Fig. 5 shows the visible image for 2130Z on June 17. A 2130Z visible image providing additional coverage of the western United States can be found in Appendix H.

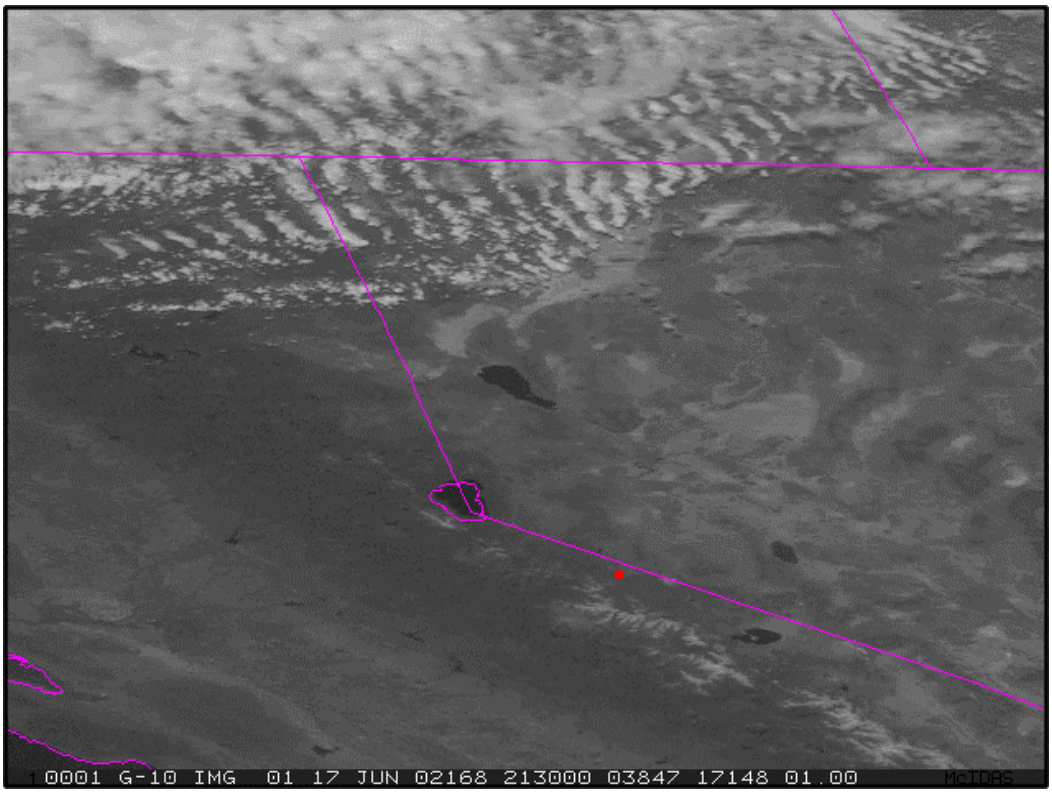

Fig. 5. GOES 10 visible satellite image for 2130Z on June 17, 2002. Accident location indicated by red square.

7. Area Forecast

The Area Forecast (FA) is an aviation forecast of general weather conditions over an area the size of several states. It is used to determine forecast en route weather and to interpolate conditions at airports that do not have Terminal Aerodrome Forecasts (TAFs) issued. The NWS Aviation Weather Center (AWC) located in Kansas City, Missouri, issues the FA at regular intervals and issues specials reports as necessary usually in the form of an AIRMET. The region that covers eastern California and western Nevada falls under the SFO (San Francisco) and SLC (Salt Lake City) regional forecast. The forecast valid for this accident was issued at 1945Z on June 17. Clouds and weather were valid until 0800Z on June 18, and the outlook valid until 1400Z. Relevant portions of the area forecasts are presented in this section.

SLCC AREA FORECAST FOR 1945Z on June 17:

For the southern portion of Nevada- sky clear, outlook-visual flight rules.

SFOC AREA FORECAST FOR 1945Z on June 17:

For the Sierras- skies scattered (3-4 eighths coverage) at 12,000 feet, by 0300Z sky clear, outlook-visual flight rules.

8. In-Flight Weather Advisories

The NWS issues in-flight weather advisories designated as Severe Weather Forecast Alerts (AWWs), Convective SIGMETs (WSTs), SIGMETs (WSs), Center Weather Advisories (CWAs), and AIRMETs (WAs). In-flight 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 a preflight briefing. Whether or not the condition described is potentially hazardous to a particular flight is for the pilot and/or aircraft dispatcher to evaluate on the basis of experience and the operational limits of the aircraft. In this case, there were no AWWs, WSTs, WSs, or CWAs issued around the time of the accident.

AIRMET (WA)

The following AIRMET TANGO was issued at 1945Z for the region north of the accident location.

AIRMET TANGO UPDATE 4 FOR TURBULENCE VALID UNTIL 0200Z ON JUNE 18.

AIRMET Turbulence…WA, OR, CA, ID, MT, NV

From LETHBRIDGE/ALTA (YQL) to BILLINGS, MT (BIL) to MALAD CITY, ID (MLD) to BATTLE MOUNTAIN, NV (BAM) to FORTUNA, CA (FOT) to NEAH BAY , WA (TOU) to PRINCETON, BC (YDC) to YQL. (see Fig. 6.)

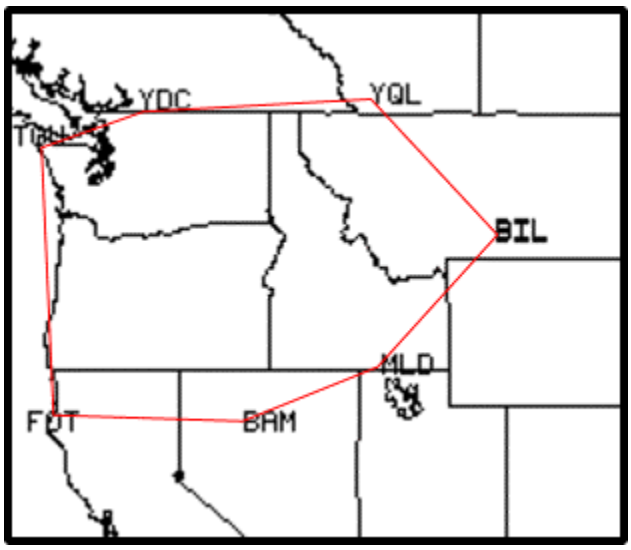

Fig. 6 AIRMET TANGO Coverage.

Occasional moderate turbulence below 18,000 ft. Conditions continuing beyond 02Z through 08Z.

9. Fire Weather Forecast

The following are relevant portions of the fire weather forecast issued by the National Weather Service Forecast Office in Reno, NV at 1430Z on June 17.

DISCUSSION: Upper low off the Pacific Northwest coast will move inland over the next 24 hours. This will result in increasing westerly flow over Nevada and eastern California today and cooling temperatures Tuesday. Moderate to strong west-southwest surface winds are expected over most areas today and will continue tonight mainly over the upper elevations.

For west central Nevada including mineral county and southern Lyon county, portions of the Humboldt-Toiyabe NF, east central California including eastern Alpine county and northern Mono county to Mono Lake, East of the Sierra crest and portions of the Humboldt-Toiyabe NF.

TODAY…

Sky/Weather……	Mostly sunny and locally windy
Max temperature:	Valley floor…83-93
	Mid-Slope…..75-85
	24 hour trend…down 1-2
Min Humidity:	Valley floor…5-12%

Mid-Slope…..12-18%
24 hour trend…little change

Wind-20 ft.

Slope/Valley…west 15-25 mph with gusts to 30 mph

Ridge top…….west 20-30 mph

LAL[7] …….1
Haines index[8]……5
Mixing heights[9]…….13000 ft MSL
Transport Winds[10]. ……West 20 mph

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10. Astronomical Data

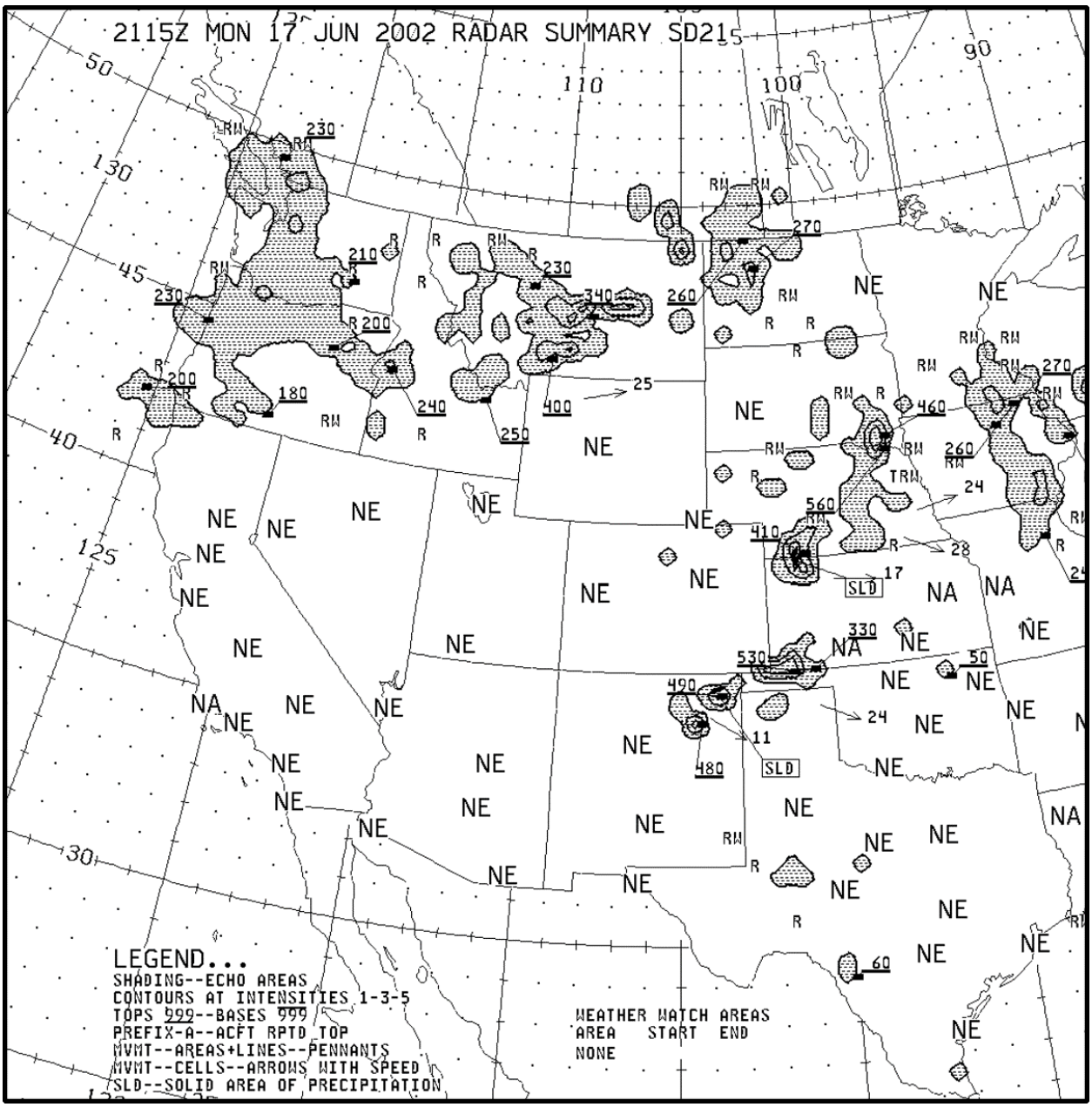
Data computed using a National Transportation Safety Board software package:

Location:	Lat 38:31:00 Lon 119:28:00
Time of day:	2145Z
Sunrise:	1226Z
Altitude of the sun:	63.9^{o}
True bearing of the sun:	244^{o}

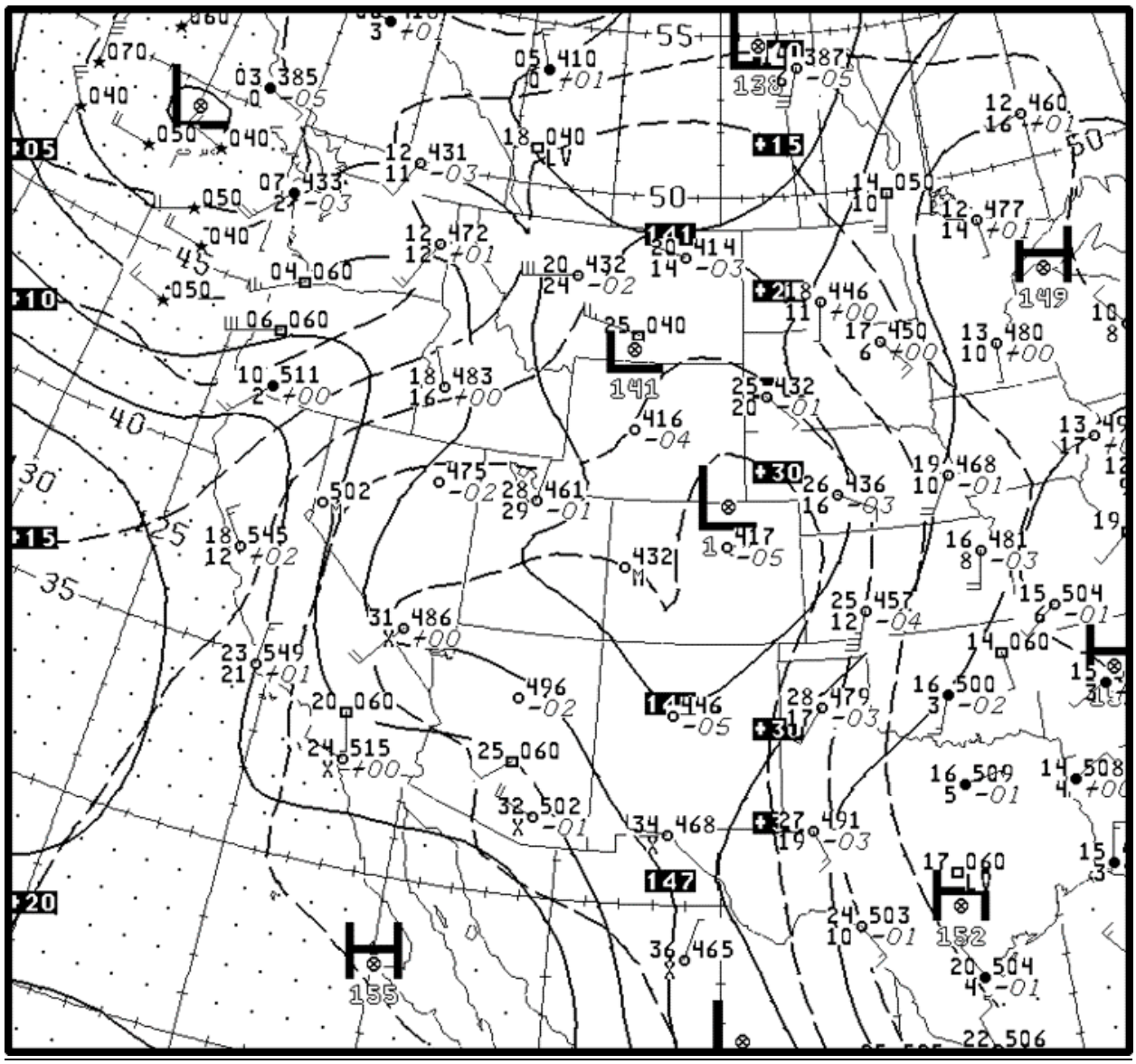
Kevin R. Petty and Donald E. Eick
NTSB Meteorologists

[7] (**L**)ightning (**A**)ctivity (**L**)evel- (e.g. 1=none, 5=numerous thunderstorms with heavy rain, 6= dry lightning no rain present).
[8] Stability Index used to predict the likelihood for substantial fire growth and/or erratic fire behavior.
[9] Top of the layer through which relatively vigorous mixing will take place.
[10] Mean wind speed and direction within the mixed layer.

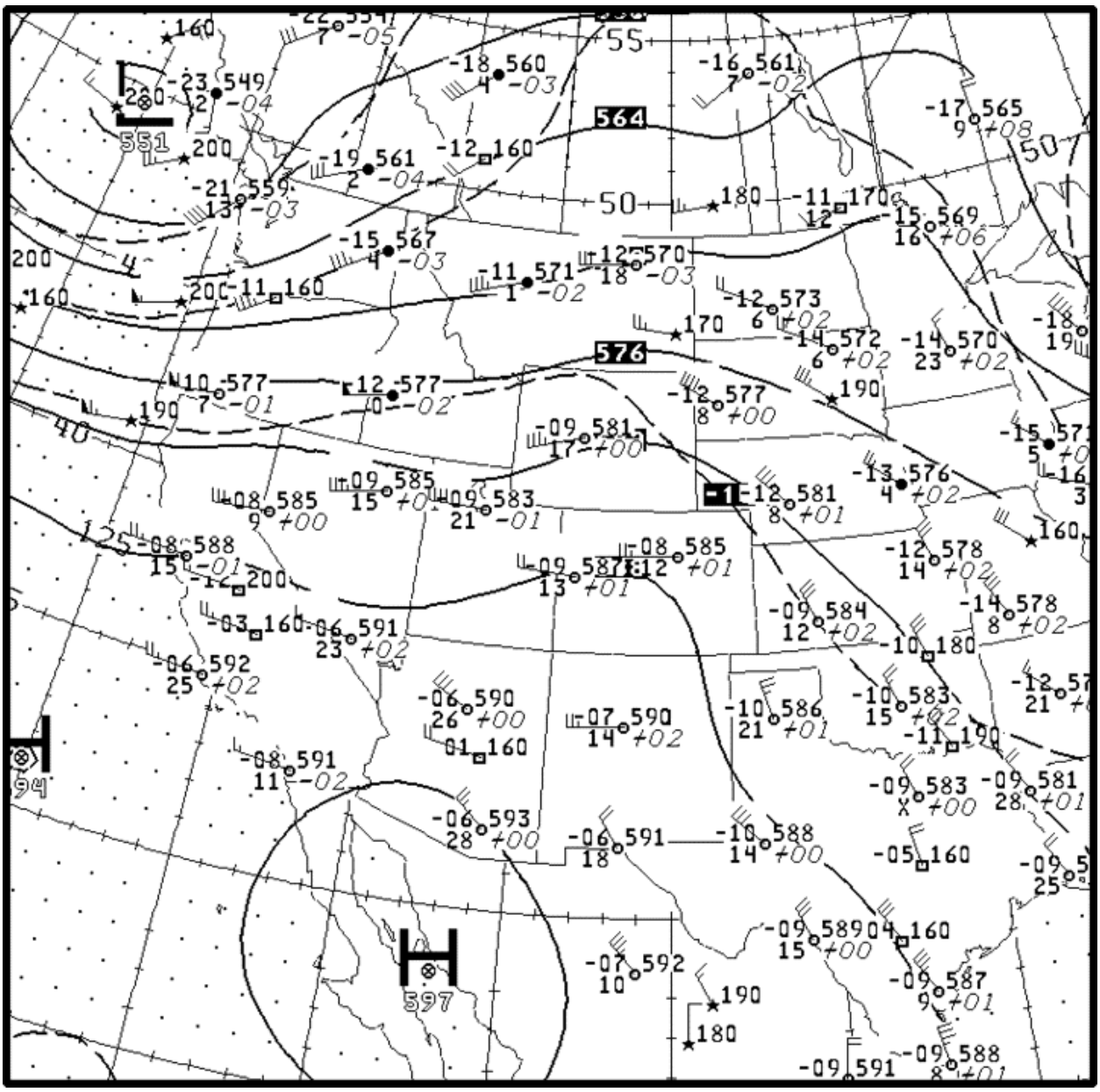
APPENDIX A: RADAR SUMMARY FOR 2115Z ON JUNE 17, 2002



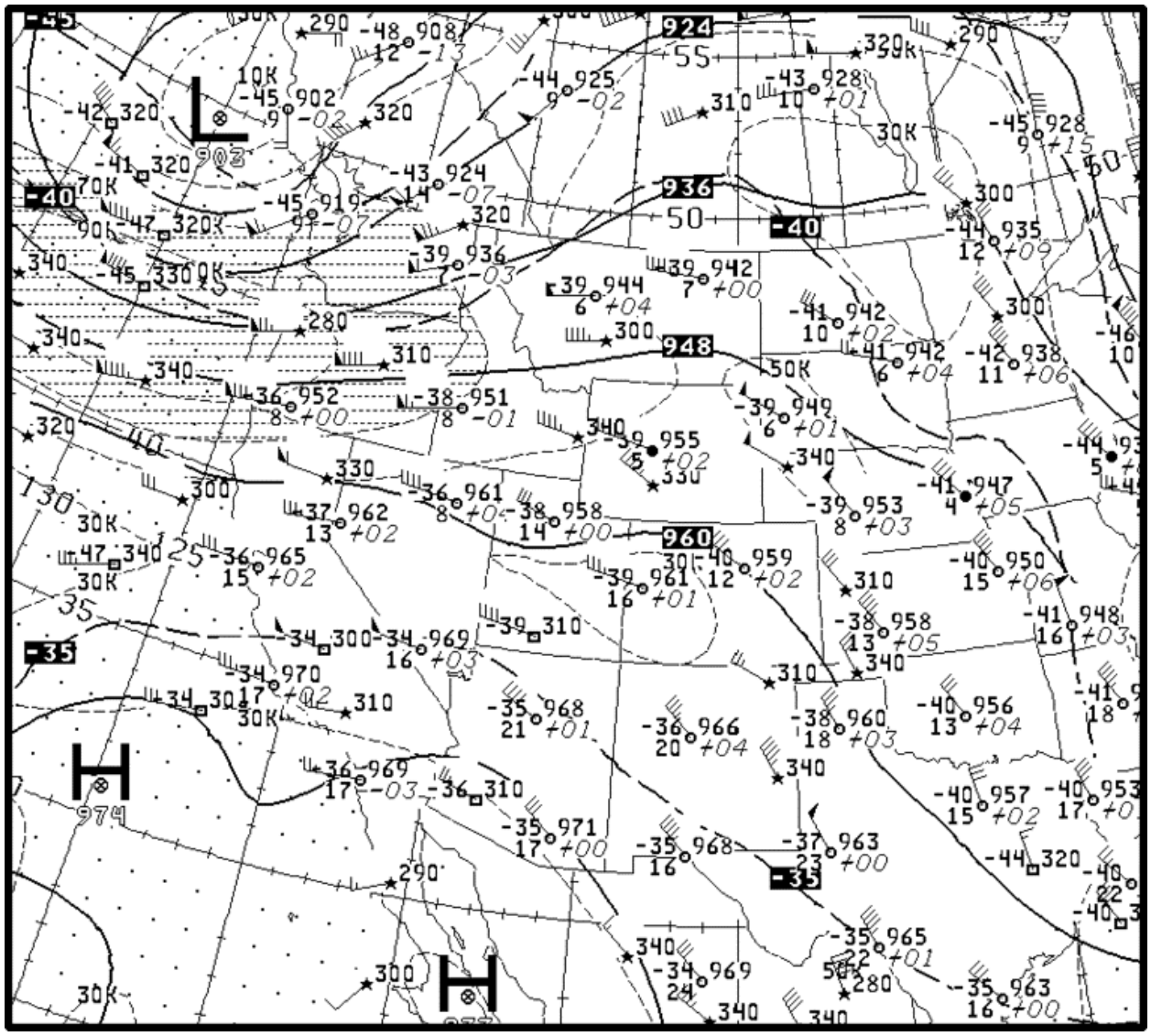
APPENDIX B: 850 hPA CONSTANT PRESSURE CHART 0000Z JUNE 18, 2002



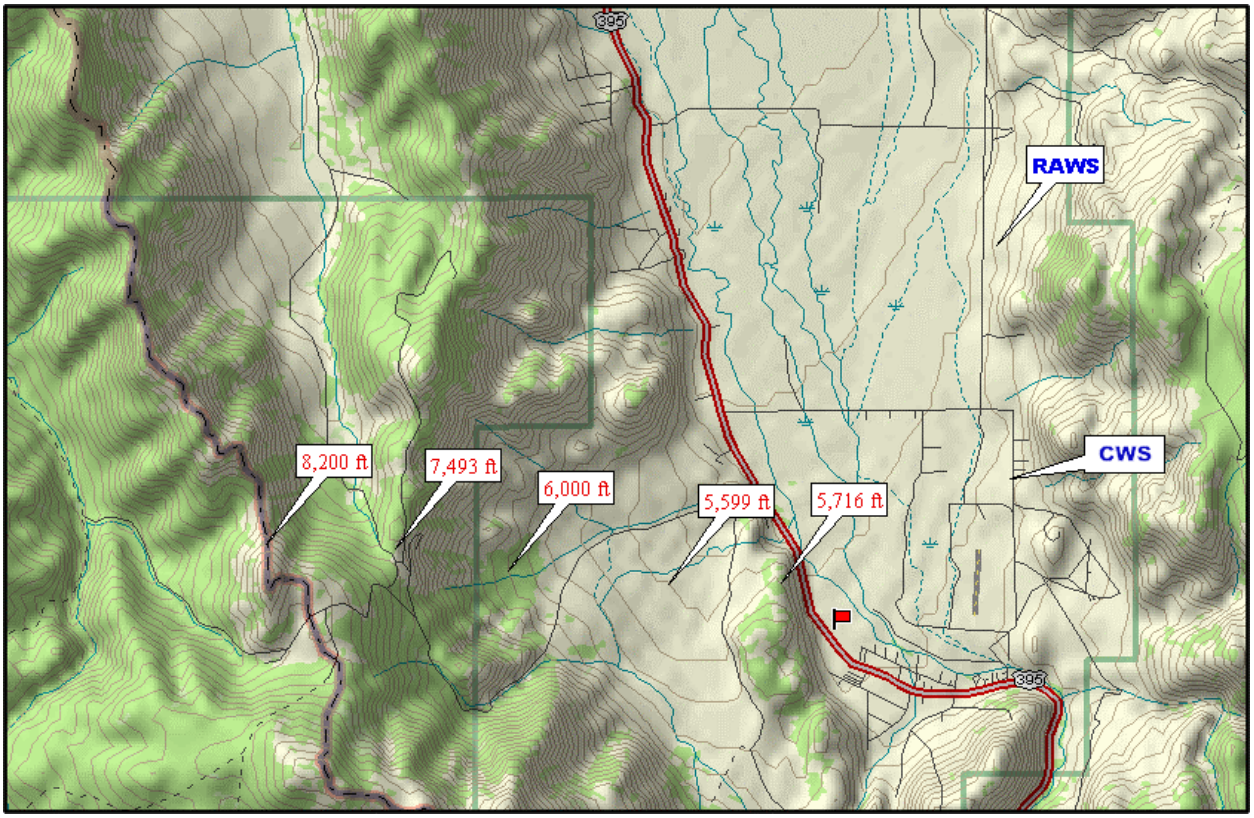
APPENDIX C: 500 hPA CONSTANT PRESSURE CHART 0000Z JUNE 18, 2002



APPENDIX D: 300 hPA CONSTANT PRESSURE CHART 0000Z JUNE 18, 2002



APPENDIX E: TERRAIN ELEVATION INFORMATION TO THE WEST OF THE ACCIDENT SITE (RED FLAG)



APPENDIX F: DETAILED UPPERAIR DATA FOR KRNO AT 0000Z ON JUNE 18, 2002

Level Type	Pressure [MB]	Temp [C]	Dew Point [C]	Dir [deg]	Speed [KTS]	Height [M]	Theta [K]	Mix [g/kg]
SFC	849.0	26.2	3.2	240.0	15.0	1463.0	313.7	5.683
SIGT	839.0	24.2	2.2	238.6	16.7	1566.9	312.7	5.353
SIGW	813.6	21.7	1.0	235.0	21.0	1829.0	312.8	5.080
SIGW	785.0	18.8	-.3	250.0	22.0	2134.0	312.9	4.774
SIGW	757.4	15.8	-1.6	260.0	21.0	2439.0	312.9	4.482
SIGW	730.8	12.9	-3.0	265.0	19.8	2743.0	312.9	4.204
SIGW	705.1	10.0	-4.3	270.0	21.0	3048.0	312.9	3.938
MAND	700.0	9.4	-4.6	270.0	21.0	3110.1	312.9	3.885
SIGT	690.0	8.2	-2.8	268.9	21.6	3229.3	312.9	4.515
SIGW	654.8	5.0	-6.7	265.0	23.9	3658.0	314.0	3.544
SIGT	638.0	3.4	-8.6	265.0	24.6	3871.2	314.5	3.131
SIGW	607.4	1.0	-7.5	265.0	25.8	4268.0	316.2	3.592
SIGT	595.0	.0	-7.0	263.6	26.4	4434.3	316.9	3.805
SIGW	562.6	-3.1	-9.7	260.0	28.0	4878.0	318.3	3.264
SIGW	541.4	-5.3	-11.5	260.0	28.9	5182.0	319.2	2.931
SIGT	528.0	-6.7	-12.7	261.6	30.2	5380.7	319.9	2.728
MAND	500.0	-8.1	-17.1	265.0	32.8	5805.5	323.2	2.001
SIGW	481.3	-10.2	-19.0	265.0	31.9	6097.0	324.1	1.775
SIGT	428.0	-16.7	-24.7	261.8	31.9	6994.7	326.9	1.206
MAND	400.0	-19.3	-32.3	260.0	31.9	7500.8	329.9	.637
SIGW	393.5	-20.4	-32.7	265.0	32.8	7621.0	330.1	.625
SIGT	356.0	-26.9	-34.9	267.4	33.9	8354.9	330.9	.555
SIGT	340.0	-29.3	-41.3	268.5	34.3	8685.2	332.0	.302
SIGW	318.4	-33.3	-45.8	270.0	35.0	9146.0	332.8	.197
MAND	300.0	-36.9	-49.9	270.0	36.9	9565.7	333.4	.136
SIGW	254.8	-46.8	-58.9	270.0	40.8	10670.0	334.7	.063
MAND	250.0	-47.9	-59.9	275.0	42.0	10798.5	334.9	.056
SIGW	201.1	-59.8	-67.9	275.0	53.8	12195.0	337.5	-----
MAND	200.0	-60.1	-68.1	275.0	53.8	12231.4	337.6	-----
SIGT	191.0	-61.9	-69.9	270.1	56.3	12517.6	339.2	-----
TRO1	182.0	-62.7	-69.7	265.0	58.9	12815.8	342.6	-----
MAXW	174.0	-62.5	-70.2	260.0	66.8	13093.5	347.3	-----
MAND	150.0	-61.9	-71.9	260.0	61.8	14010.5	363.5	-----
SIGW	142.4	-62.5	-73.1	265.0	65.9	14329.0	367.8	-----
SIGT	127.0	-63.9	-75.9	268.9	52.8	15035.9	377.6	-----
SIGW	122.8	-63.9	-76.3	270.0	49.0	15243.0	381.2	-----
SIGW	100.6	-63.9	-78.8	260.0	24.9	16463.0	403.6	-----
MAND	100.0	-63.9	-78.9	260.0	24.9	16501.4	404.3	-----
SIGT	95.2	-66.1	-80.1	263.5	22.2	16801.4	405.7	-----
SIGT	90.6	-64.3	-79.3	266.9	19.6	17103.2	415.1	-----

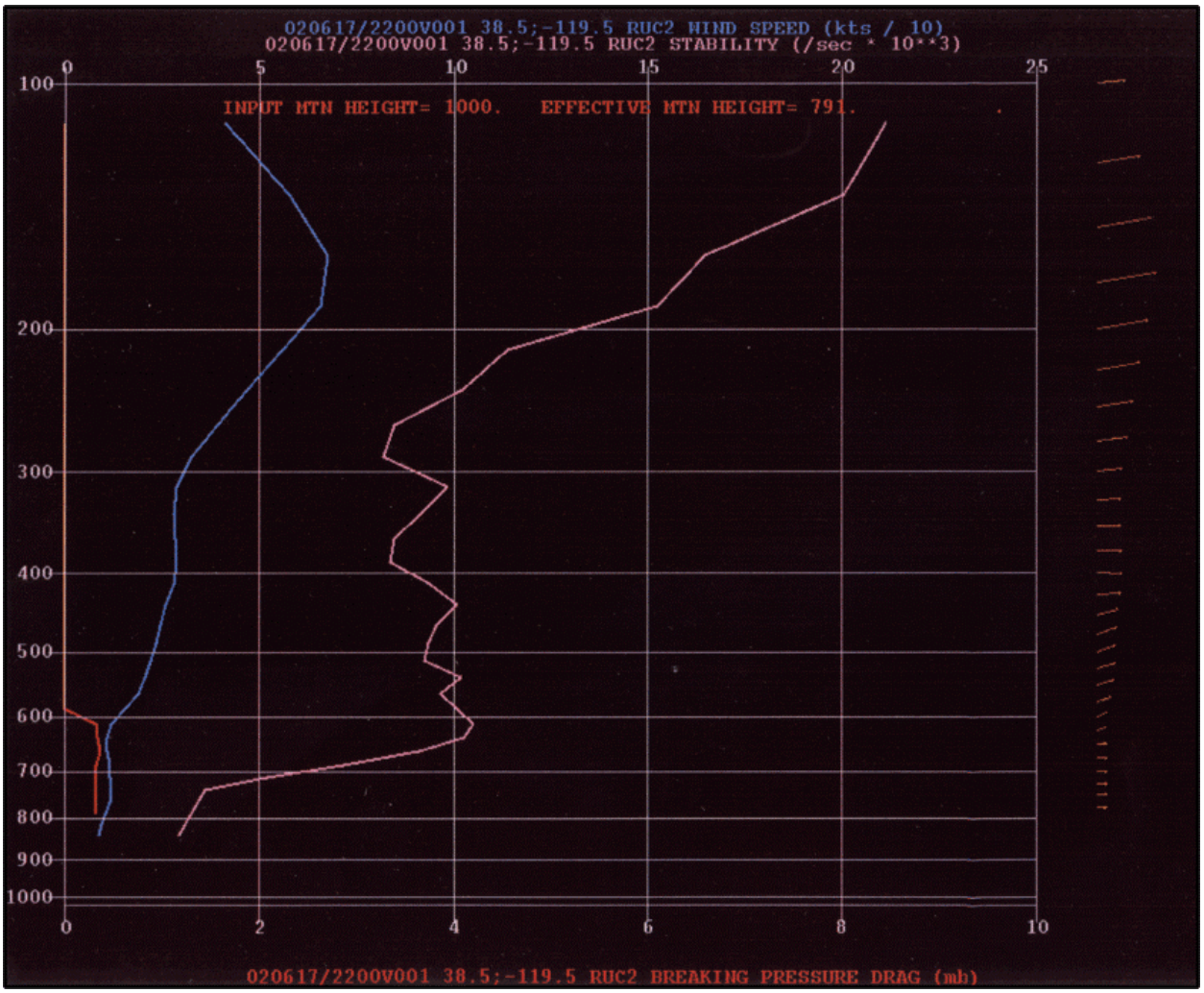
```
    SIGT       79.2   -67.5   -82.5   276.3    12.4  17919.8   424.7   -----
    MAND       70.0   -63.5   -79.5   285.0     5.8  18671.1   448.6   -----
    SIGT       67.6   -61.1   -78.1   297.4     6.0  18886.7   458.2   -----
    MAND       50.0   -60.3   -79.3    45.0     8.0  20764.1   501.4   -----
    SIGT       47.4   -60.9   -79.9    54.7     8.0  21096.7   507.7   -----
    SIGT       34.7   -52.5   -74.5   112.5     8.0  23074.7   577.0   -----
    MAND       30.0   -52.5   -74.5   140.0     8.0  24015.7   601.5   -----
    SIGT       20.9   -43.9   -69.9    82.2     9.7  26398.1   693.1   -----
    MAND       20.0   -44.7   -70.7    75.0     9.9  26693.3   699.4   -----

Parcel Definition for 100 mb Boundary Layer:   0000 UTC 18 Jun 2002169
-------------------------------------------------------------------------
    Dewpoint Temperature (TD)                      =      0.4 C
    Potential Temperature (Th)                     =    312.8 K
    Equivalent Potential Temperature (ThE)         =    327.1 K
    Mixing Ratio (MIX)                             =      4.9 g/kg

Stability Indices and Levels:
-----------------------------
    Lifted Condensation Level (LCL)                =      594 mb
    Temperature at LCL (TLCL)                      =     -3.6 C
    Level of Free Convection (LFC)                 =    -----
    Equilibrium Level (EL)                         =    -----
    Convective Temperature (CVT)                   =    -----
    Forecast Maximum Temperature (FMAX)            =     27.3 C
    K Index (KI)                                   =    -----
    Lifted Index (LI)                              =      4.3
    Severe WEAther Threat Index (SwI)              =    -----
    Showalter Index (ShI)                          =    -----
    Total Totals Index (TTI)                       =    -----
    Precipitable Water (PW)                        =     13.7 mm

Energy Analysis:
----------------
    Helicity (HELI)                                =        9 m**2/s**2
    Convective Available Potential Energy (CAPE)   =    -----
    Convective Inhibition (CIN)                    =    -----
    Theta-E for Forecast Maximum Temperature       =      329 K
    CAPE for Forecast Maximum Temperature          =    -----
    Maximum Theta-E at or below 300 mb             =      333 K
    Pressure Level of Maximum Theta-E              =      318 mb
    CAPE for Maximum Theta-E                       =    -----
```

APPENDIX G: MWAVE ONE HOUR FORECAST VALID AT 2200Z ON JUNE 17, 2002



APPENDIX H: GOES 10 VISIBLE SATELLITE IMAGERY VALID AT 2130Z ON JUNE 17, 2002