



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

August 31, 2021

Specialist's Factual Report

METEOROLOGY

WPR21FA211

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A. ACCIDENT

Location: Eden, Utah
Date: May 29, 2021
Time: 1000 mountain daylight time
1600 Coordinated Universal Time (UTC)
Airplane: Cessna 172S; Registration: N1727T

B. METEOROLOGIST

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

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) Meteorologist did not travel for this investigation and gathered the weather data for this investigation from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources and also from the National Centers for Environmental Information (NCEI). This Specialist Factual Report contains the meteorological factors pertinent to the weather surrounding the accident time. All times are mountain daylight time (MDT), and are based upon the 24-hour clock, where local time is -6 hours from UTC. 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. NWS station identifiers use the standard International Civil Aviation Organization 4-letter station identifiers versus the International Air Transport Association 3-letter identifiers, which deletes the initial country code designator "K" for U.S. airports.

The accident site was located at latitude 41.361298° N, Longitude 111.759616° W, with an approximate elevation of 8,000 feet (ft).

D. FACTUAL INFORMATION

1.0 Synoptic Situation

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

1.1 Surface Analysis Chart

The NWS Surface Analysis Chart centered over the Central Great Basin and the Rockies for 0900 MDT is provided as figure 1 with the location of the accident site within the red circle. The chart depicted several low-pressure systems in Colorado and southern Utah at 1011- to 1007-hectopascals (hPa) with a stationary frontal boundary extending from the low from central Colorado into southern Utah, and then trailing westward into Nevada. A trough² of low-pressure was located from eastern Utah northeastward into South Dakota. Fronts and troughs can act as lifting mechanisms to help produce clouds and precipitation if sufficient moisture is present. The accident site was located north or on the cool air side of the frontal boundaries and northwest of the trough.

The station models around the accident site depicted air temperatures in the mid 60’s degrees Fahrenheit (°F), dew point temperatures in the upper 20’s to mid 30’s °F with temperature-dew point spreads of 27°F or more, light winds, and mostly clear skies.

¹

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

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

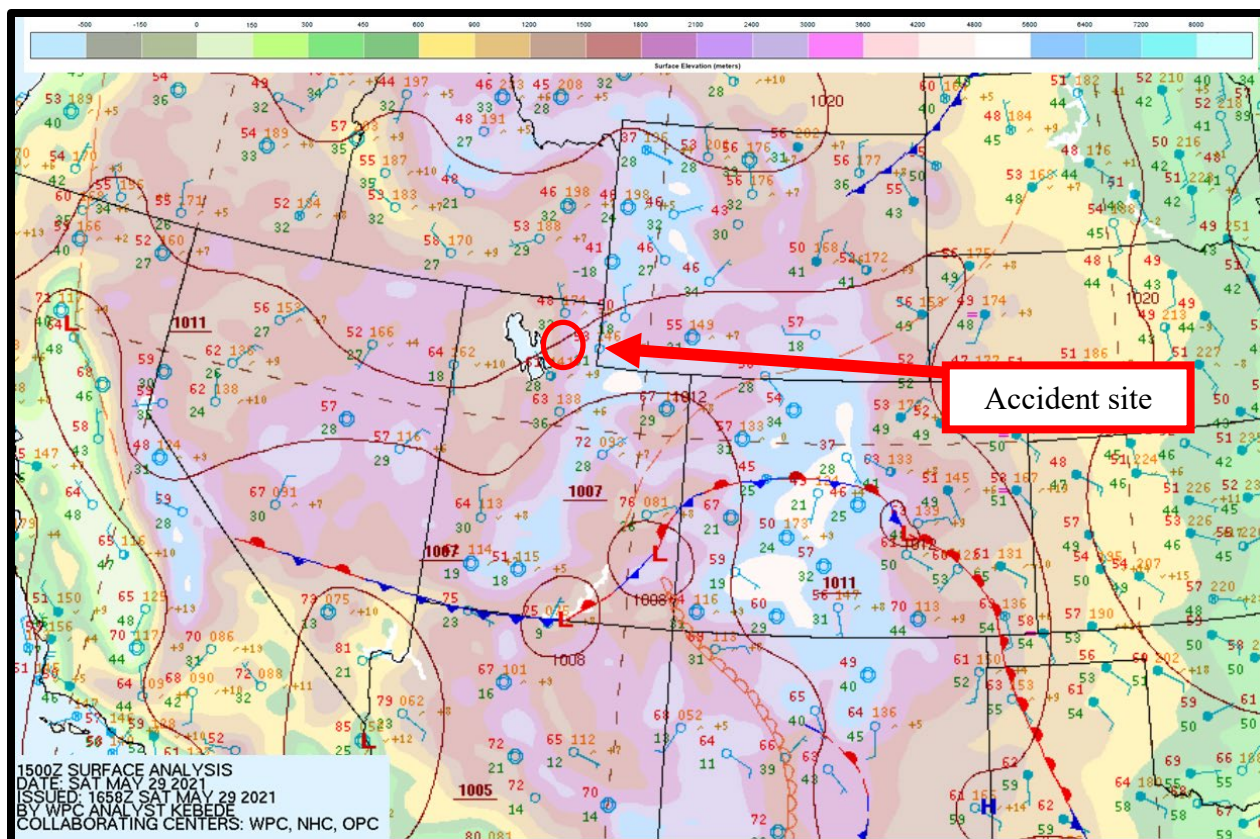


Figure 1 – NWS Surface Analysis Chart for 0900 MDT.

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 0600 MDT at 700-, 500-, and 300-hPa are presented in figures 2 through 4. There was a west wind at 5 knots at 700-hPa with the wind remaining westerly through 300-hPa. The wind speed increased to 35 knots at 500-hPa and to 45 knots at 300-hPa.

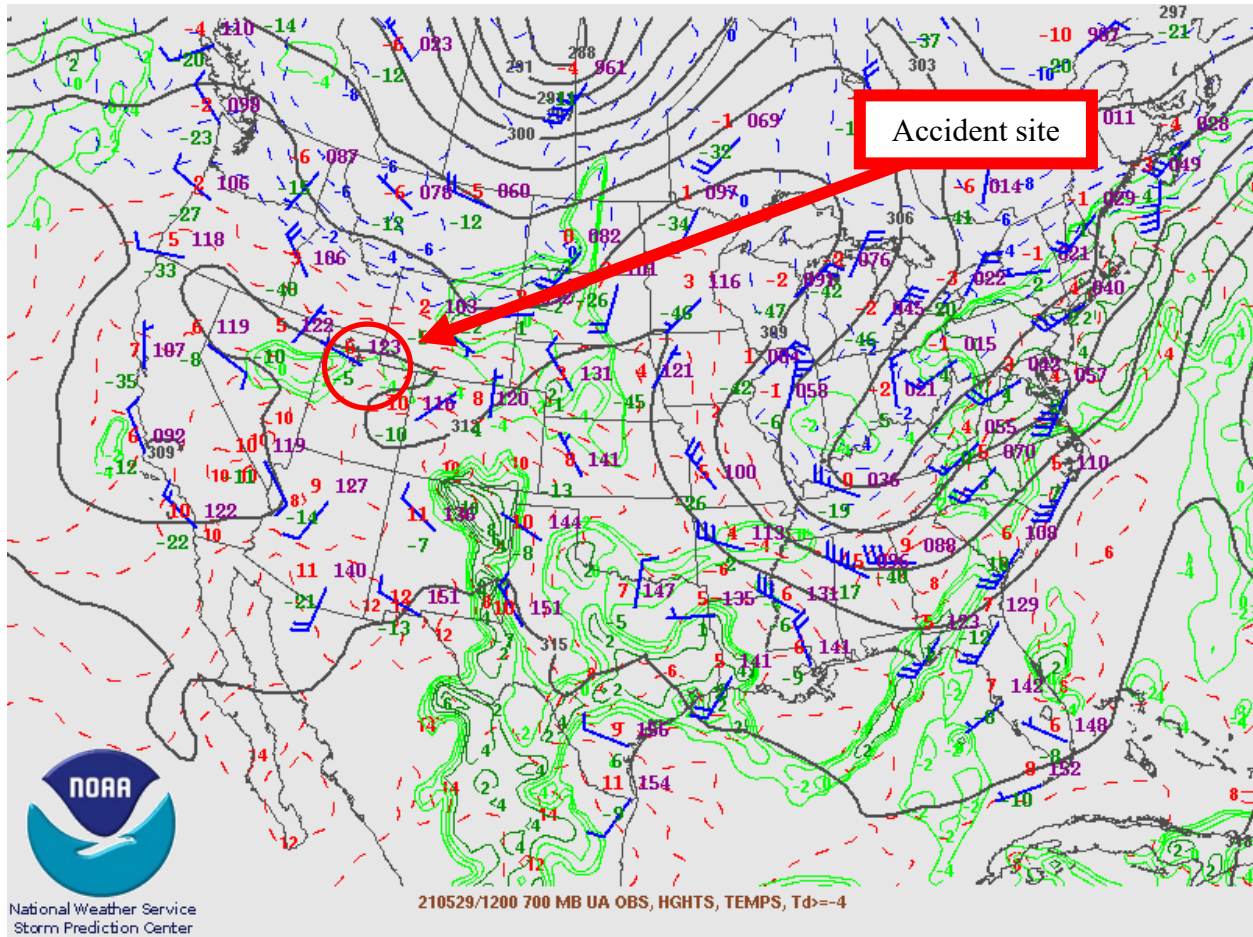


Figure 4 – 700-hPa Constant Pressure Chart for 0600 MDT.

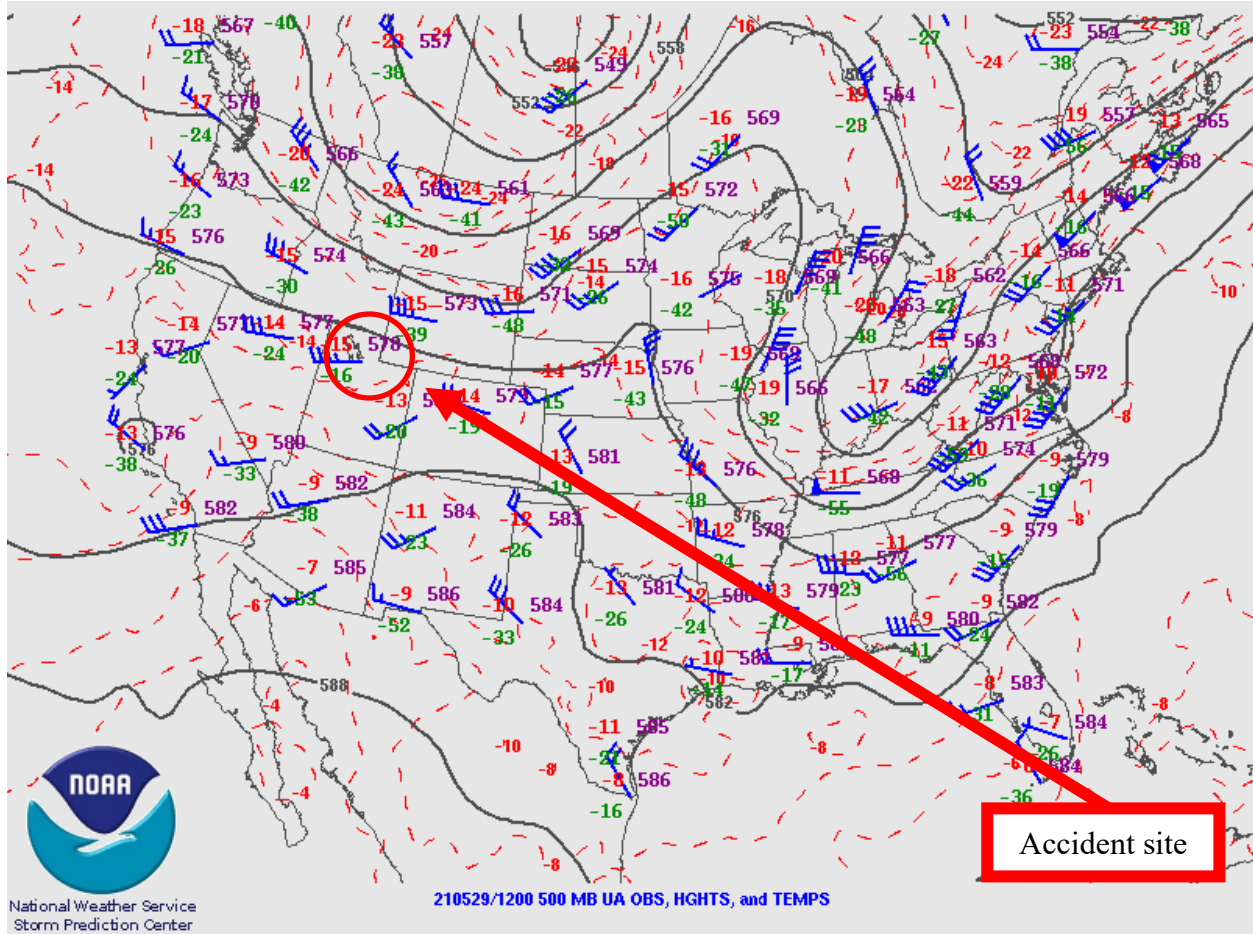


Figure 5 – 500-hPa Constant Pressure Chart for 0600 MDT.

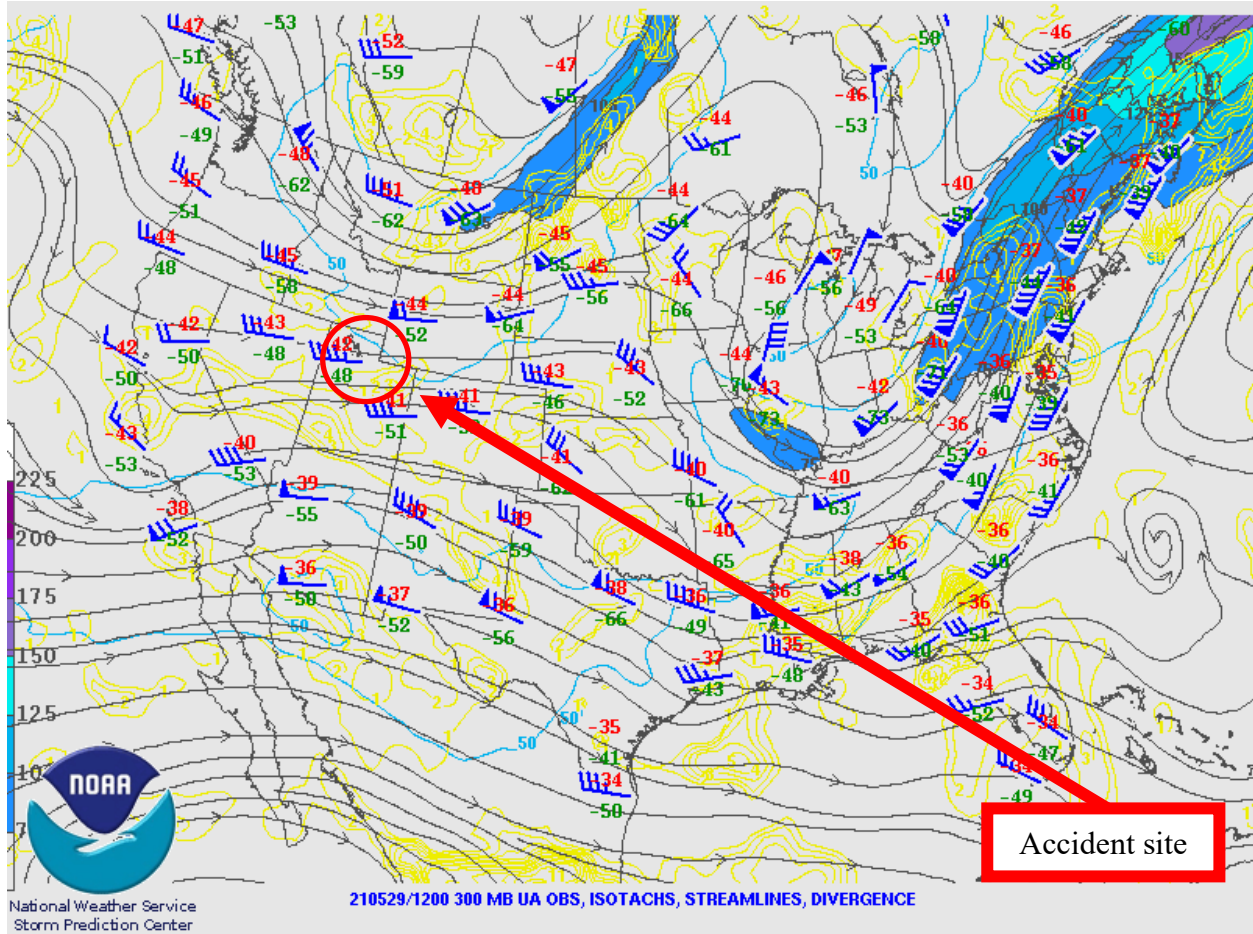


Figure 4 – 300-hPa Constant Pressure Chart for 0600 MDT.

2.0 Surface Observations

The area surrounding the accident site was documented using official Aviation Routine Weather Reports (METARs) and Specials (SPECIs). The following observations were taken from standard code and are provided in plain language. Figure 5 is a local sectional chart with the accident site and the closest weather reporting location marked.



Figure 5 – Sectional map of the accident area with the location of the accident site and surface observation site.

Ogden-Hinckley Airport (KOGD) had the closest official weather station to the accident site. KOGD had an Automated Surface Observing System (ASOS³) whose longline⁴ reports were augmented by air traffic control (ATC) when the tower was in operation⁵. The KOGD ASOS was located 15 miles southwest of the accident site, at an elevation of 4,473 ft, and had a 11° easterly magnetic variation⁶ (figure 5). The following automated longline observations were disseminated during the times surrounding the accident:⁷

[0553 MDT] KOGD 291153Z AUTO 32009KT 10SM CLR 12/M03 A3004 RMK AO2 SLP123 T01221033 10211 20122 50007

³ ASOS – Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, weather phenomena, ceiling, temperature, dewpoint, altimeter, and barometric pressure.

⁴ “Longline” refers to the dissemination of weather observations with the intent that they are available in near-real time to national databases (effectively, the whole world) and accessible to the general global public from a large number of vendors. This does not include public accessibility to observations from a reporting station’s Very High Frequency (VHF; line-of-site) or telephone broadcast, where applicable. Longline dissemination of weather observations is the primary vehicle through which the general global public has access to surface weather observations, particularly outside of the aviation community.

⁵ ATC hours from 0700 to 2000 local time.

⁶ Magnetic variation – The angle (at a particular location) between magnetic north and true north. Latest measurement taken from <https://skyvector.com/>

⁷ The bold sections in this NWS product and the rest of the products in this report are intended to highlight the text that directly reference the weather conditions that affected the accident location around the accident time. The local times in this section next to the METARs are provided for quick reference between UTC and local times around the accident time.

[0653 MDT] KOGD 291253Z 00000KT 10SM CLR 12/M01 A3006 RMK AO2 SLP135
T01221011

[0753 MDT] KOGD 291353Z 30003KT 10SM CLR 13/M01 A3006 RMK AO2 SLP136
T01331011

[0853 MDT] KOGD 291453Z VRB04KT 10SM CLR 15/M02 A3007 RMK AO2 SLP138
T01501017 51009

**[0953 MDT] KOGD 291553Z VRB04KT 10SM CLR 18/M04 A3007 RMK AO2 SLP135
T01781039**

ACCIDENT TIME 1000 MDT

**[1053 MDT] KOGD 291653Z 27005KT 10SM CLR 19/M02 A3006 RMK AO2 SLP133
T01891017**

[1153 MDT] KOGD 291753Z 00000KT 10SM CLR 21/M01 A3006 RMK AO2 SLP126
T02061011 10206 20106 58005

The bold type observations decoded in plain language were as follows:

KOGD weather at 0953 MDT, variable wind at 4 knots, visibility 10 miles or greater, clear skies below 12,000 ft above ground level (agl), temperature of 18° Celsius (C), dew point temperature of -4°C, and an altimeter setting of 30.07 inches of mercury (inHg). Remarks: automated station with a precipitation discriminator, sea level pressure 1013.5 hPa, temperature of 17.8°C, dew point temperature of -3.9°C.

KOGD weather at 1053 MDT, wind from 270° at 5 knots, visibility 10 miles or greater, clear skies below 12,000 ft agl, temperature of 19°C, dew point temperature of -2°C, and an altimeter setting of 30.06 inHg. Remarks: automated station with a precipitation discriminator, sea level pressure 1013.3 hPa, temperature of 18.9°C, dew point temperature of -1.7°C.

The observations from KOGD surrounding the accident time indicated VFR⁸ conditions prevailed with surface winds of 5 knots or less.

⁸ As defined by the NWS and the FAA Aeronautical Information Manual (AIM) section 7-1-7 defines the following general flight categories:

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

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

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

3.0 Upper Air Sounding

The Salt Lake City, Utah (KSLC) was the closest site with an upper air sounding, was 37 miles south-southwest of the accident site with a site elevation of 4,226 ft and had a station ID of 72572. The 0600 MDT KSLC sounding was plotted on a standard Skew-T Log P diagram⁹ with the derived stability parameters included in figure 6 with data from the surface to 500-hPa (or approximately 19,000 ft msl). These data were analyzed using the RAOB¹⁰ software package. The sounding depicted the lifted condensation level (LCL)¹¹ at 11,668 ft msl and the convective condensation level (CCL)¹² at 17,291 ft msl. The freezing level was located at 13,075 ft msl. The precipitable water value was 0.53 inches.

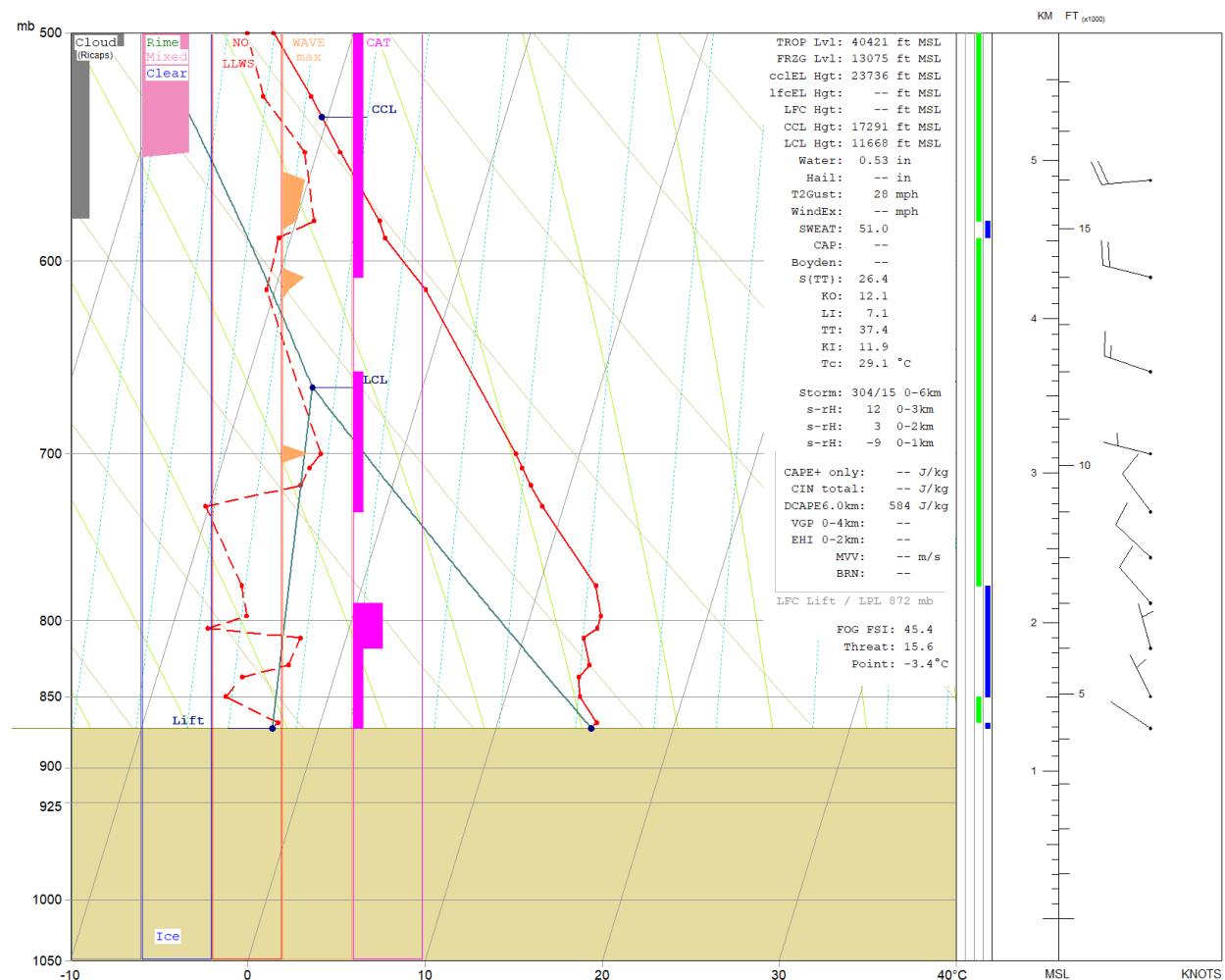


Figure 6 – 0600 MDT KSLC sounding.

⁹ Skew T log P diagram – is a standard meteorological plot using temperature and the logarithmic of pressure as coordinates, used to display winds, temperature, dew point, and various indices used to define the vertical structure of the atmosphere.

¹⁰ RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Eosonde Research Services, The Villages, Florida.

¹¹ LCL - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

¹² CCL – The level in the atmosphere to which an air parcel, if heated from below, will rise dry adiabatically, without becoming colder than its environment just before the parcel becomes saturated.

The 0600 MDT KSLC sounding for the accident site indicated a mainly stable environment from the surface through 7,000 ft msl (~2,800 ft agl) with a conditionally unstable environment above 7,000 ft msl. Clouds were indicated by RAOB above 15,000 ft msl. RAOB indicated the possibility of icing above 16,000 ft msl.

The 0600 MDT KSLC sounding wind profile indicated a near surface wind from 305° at 2 knots with the wind remaining northwest to westerly through 19,000 ft msl. The wind speed increased to 10 knots by 7,000 ft msl with the wind speed to 20 knots from 14,000 ft msl and above. RAOB did not indicate the possibility of low-level wind shear (LLWS). RAOB indicated the possibility of light clear-air turbulence in several layers between the surface and 19,000 ft msl. At the approximate accident site altitude (around 8,000 ft), the wind was from 315° at 10 knots, temperature of 11.6°C and a dew point temperature of -7.8°C. RAOB indicated the possibility of mountain wave conditions around 10,000 ft msl with updraft and downdraft speeds of ~500 ft/min.

4.0 Satellite Data

The Geostationary Operational Environmental Satellite number 17 (GOES-17) visible and infrared 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 software. Visible and infrared imagery (GOES-17 bands 2 and 13) at wavelengths of 0.64 microns (μm) and 10.3 μm, respectively, were retrieved for the period from 0800 MDT through 1200 MDT and reviewed, and the closest images to the time of the accident were documented. Due to sun angle the visible imagery did not provide helpful data.

Figures 7 and 8 present the GOES-17 visible imagery from 1000 and 1010 MDT at 2X magnification with the accident site highlighted with a red square. There was no cloud cover directly above the accident site, but a band of clouds were located from the southwest to the southeast of the accident site. The cloud cover was moving from west to east. It should be noted these figures have not been corrected for any parallax error.

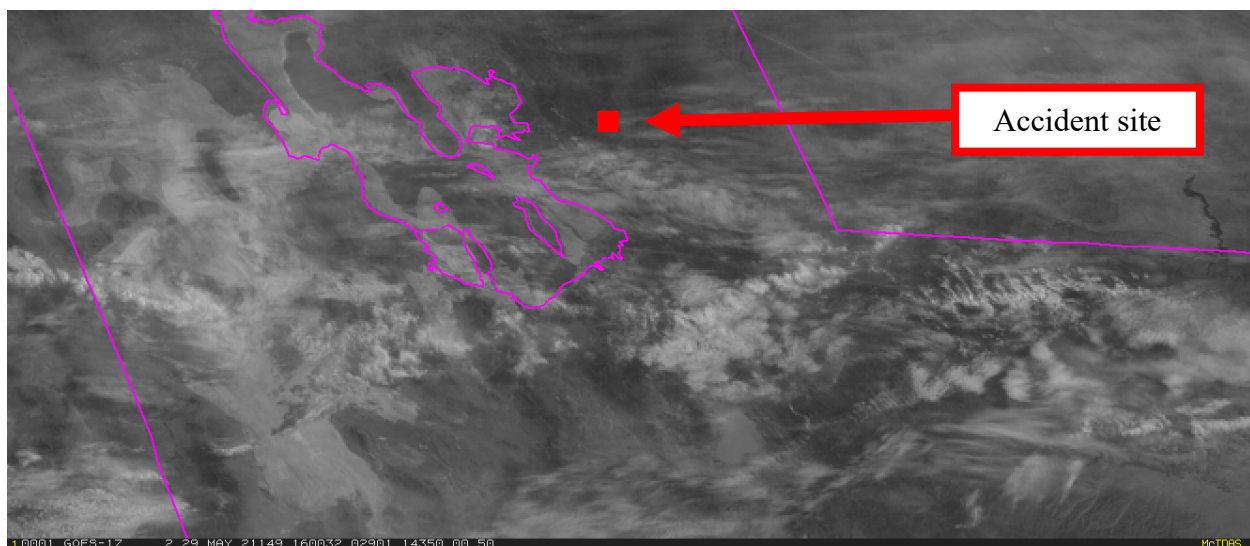


Figure 7 – GOES-17 visible image at 1000 MDT.

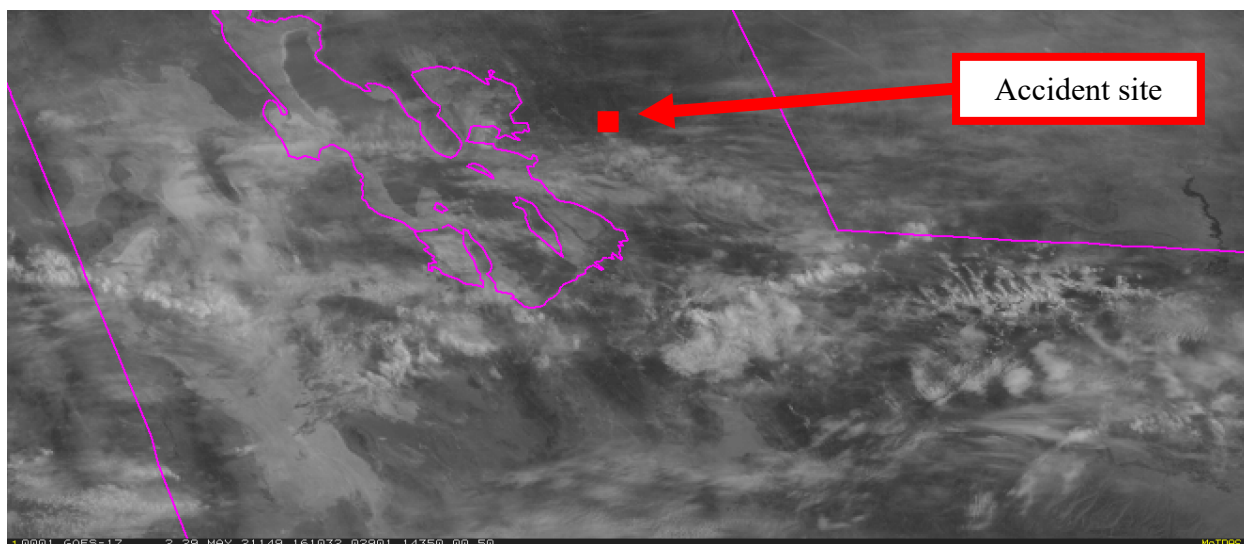


Figure 8 – GOES-17 visible image at 1010 MDT.

5.0 Pilot Reports

The longline-disseminated pilot reports¹³ (PIREPs) distributed into the national airspace (NAS) were reviewed from about three hours prior to the accident time to three hours after the accident time within 100 miles of the accident site and no PIREPs were recorded during that period.

6.0 Significant Meteorological Information

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

7.0 Center Weather Service Unit Advisories

The Salt Lake City (ZLC) Air Route Traffic Control Center (ARTCC) Center Weather Service Unit (CWSU) was responsible for the accident region. There were no Center Weather Advisories (CWA) valid at the accident time.

8.0 Airmen's Meteorological Information

There were no Airmen's Meteorological Information (AIRMET) advisories valid for the accident site at the accident time.

¹³ Only pilot reports with the World Meteorological Organization headers UBUT**, UBID**, and UBWY** were considered. These do not include pilot reports only broadcast via radio.

9.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) products issued before the accident flight and valid at 0900 MDT are shown in attachment 1. The GFA surface forecast valid for departure for around the accident time indicated VFR conditions and a variable surface wind at 5 knots. The GFA cloud forecast valid before departure for around the accident time indicated only cirrus clouds with scattered to broken skies along the Utah and Wyoming border. For more information, please see attachment 1.

10.0 Terminal Aerodrome Forecast

KOGD was the closest airport to the accident site with an NWS¹⁴ Terminal Aerodrome Forecast (TAF). The KOGD TAF valid at the time of the accident was issued at 0520 MDT and was valid for a 24-hour period beginning at 0600 MDT. The 0520 MDT TAF for KOGD was as follows:

TAF KOGD 291120Z 2912/3012 32007KT P6SM SCT120

After 0600 MDT, the forecast expected a wind from 320° at 7 knots, greater than 6 miles visibility, and scattered clouds at 12,000 ft agl.

11.0 NWS Area Forecast Discussion

The NWS office in Salt Lake City, Utah, (WFO SLC) issued the following Area Forecast Discussion (AFD) at 0513 MDT:

FXUS65 KSLC 291113
AFDSLC

Area Forecast Discussion
National Weather Service Salt Lake City UT
512 AM MDT Sat May 29 2021

.SYNOPSIS...A dry cold front will stall across central Utah today. A weak low pressure system will cross the region later through Monday, before high pressure becomes established through much of next week.

&&

.SHORT TERM (THROUGH 12Z TUESDAY)...A diffuse shortwave trough over the California coast will continue to slowly amplify and move across the desert southwest through Monday. Ahead of this trough, a shallow cold front has moved into central Utah, and is currently situated just south of I-70. This front is expected to remain largely in place through the day. North of the front, a bit of an increase in midlevel moisture is noted, with PWAT in the 0.5-0.6 inch range.

¹⁴ According to NWS Instruction 10-813: "A NWS TAF consists of the expected meteorological conditions significant to aviation at an airport for a specified time period. For the U.S., this is the area within five (5) statute miles (SM) of the center of an airport's runway complex." www.nws.noaa.gov/directives/sym/pd01008013curr.pdf

Expect temperatures across northern Utah to be slightly cooler today behind the front. Some weak returns are already noted on KMTX, although this should be mostly virga as they are not as evident on the lowest tilt. Some high-based showers and virga and perhaps a couple of isolated thunderstorm will be possible over and near the northern and central mountains as instability increases with daytime heating. The greatest threat from these would be gusty outflow winds, as little rainfall will be expected. Otherwise, the northerly gradient in place behind the cold front will lead to enhanced northerly winds across portions of northern and central Utah today, but should not be especially windy as winds aloft remain relatively light. However, models do indicate easterly winds from the surface trough around 700mb late tonight into tomorrow morning across northern Utah and southwest Wyoming. This could bring some localized breezy canyon winds to the northern Wasatch Front, but should remain subadvisory as the support is relatively weak.

The cold front will sag farther south tomorrow, allowing the slightly cooler temperatures and moisture to spread into southern Utah. Showers and thunderstorms should be a bit more widespread, with a better chance of measurable but not significant rain, mainly over the mountains and southern/eastern valleys. Canyon winds may again be enhanced across the northern Wasatch Front tomorrow night as easterly flow returns.

Monday should start to trend a bit drier as the trough axis shifts into Colorado and high pressure nudges into northwest Utah. Temperatures should begin a warming trend that is expected to persist through midweek.

.LONG TERM (After 12Z Tuesday)...At the start of the long term period, a broad ridge will be building just off the California coast. This feature will track east through much of the week, with the ridge axis moving over Utah and southwest Wyoming on Thursday. Guidance remains in exceptionally good agreement about the ridge through Wednesday, with the various ensemble members only showing minor differences in the strength of the ridge. Under the influence of high pressure, the forecast area will stay dry with a steady warming trend in temperatures.

Starting to see a bit more spread in the guidance beginning Thursday where the exceptional agreement previously continued. While still in good agreement, seeing some differences in the precise strength of the ridge Thursday afternoon, with EPS members generally favoring a stronger ridge than the GEFS and Canadian. Regardless, with the ridge overhead or just east of the area anticipating that to be the warmest day of the period, with some record breaking high temperatures likely, particularly over northern Utah.

By Friday spread increases considerably as the various ensemble members have a few different ideas about the influence of a Pacific Northwest trough on the ridge. EPS members favor a solution where the ridge stays in place but flattens, resulting in some minor cooling. Meanwhile, most GEFS members are now favoring a solution where the trough completely displaces the ridge, bringing the

potential for a bit more cooling as well as some precip. Tend to favor the flat ridge solution for now as guidance has been more consistent in showing this solution.

&&

.AVIATION...KSLC...The SLC terminal will see VFR conditions throughout the day with some high clouds. Northwest winds are anticipated through the daytime hours.

Rest of Utah and southwest Wyoming...VFR conditions are expected throughout the day across the area. A weak frontal boundary stalled over central Utah will act as the focus for the development of scattered cumulus this afternoon, with a few showers possible. For areas behind this boundary, west to northwest winds will prevail, with the usual diurnal winds anticipated for areas south of the boundary.

&&

.FIRE WEATHER...A weak trough slowly crossing the area through Monday has pushed a cold front into the area. This cold front will stall across central Utah today, then sag a bit farther south tomorrow. A few showers will develop near and north of the front today, mostly high-based producing some gusty outflow winds but little in the way of rainfall. Temperatures will be slightly cooler across northern Utah behind the front today. Showers and thunderstorms will increase in coverage and spread farther south tomorrow, with a slightly better, albeit still low, chance of wetting rain. Temperatures across the south are expected to be slightly cooler tomorrow but may warm a couple of degrees across the north as the airmass modifies. The airmass will start trending drier on Monday as the trough exits the area and high pressure starts to build into the area. A more significant warming trend will then take place through the middle of next week with dry conditions.

&&

.SLC WATCHES/WARNINGS/ADVISORIES...

UT...None.

WY...None.

&&

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12.0 Winds and Temperature Aloft Forecast

The NWS 0757 MDT Winds and Temperature Aloft forecast valid for the closest point to the accident site is included below:

FBUS31 KWNO 291357

FD1US1

DATA BASED ON 291200Z

VALID 291800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
SLC	9900	3605+09	2607+02	2620-15	2628-26	263743	254053	264262	

The closest forecast point to the accident site was Salt Lake City, Utah (SLC). The 0757 MDT SLC forecast for use between 0800 MDT and 1500 MDT indicated a calm wind at 6,000, a wind at 9,000 ft from 360° at 5 knots with a temperature of 9°C, and a wind at 12,000 ft from 260° at 7 knots with a temperature of 2°C.

13.0 Pilot Weather Briefing

The accident pilot did not receive weather information¹⁵ from Leidos Flight Service. A search of archived ForeFlight information indicated that the accident pilot did not request and receive weather information from ForeFlight before the accident flight. There is no record of the accident pilot receiving or retrieving any other weather information before or during the accident flight.

14.0 Astronomical Data

The astronomical data obtained for the accident site on May 29, 2021, indicated the following:

SUN	
Begin civil twilight	0524 MDT
Sunrise	0557 MDT
Accident time	1000 MDT¹⁶
Sun transit	1325 MDT
Sunset	2052 MDT
End civil twilight	2125 MDT

At the time of the accident the Sun was located at an altitude of 43.03° and azimuth of 98.45°.

E. LIST OF ATTACHMENTS

Attachment 1 – GFA valid for the accident site at accident time

Submitted by:

Paul Suffern
Senior Meteorologist

¹⁵ https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_91-92.pdf

¹⁶ Inserted accident time for reference and context.

