NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety

Washington, DC 20594

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Air Traffic Group Factual Report of Investigation

Attachment 9 – Night Flight Studies, 135 pages

Memorandum

U.S. Department of Transportation
Federal Aviation Administration

MAY 12 92

Subject: INFORMATION: Report on the Results of a Safety Analysis Conducted for Aspen-Pitkin County Airport/Sardy Field

Date: MAY 1 1992

From: Director, Flight Standards Service, AFS-1

Reply to Attn. of:

To: Associate Adminstrator for Regulation and Certification, AVR-1

We have attached a copy of the report prepared from the safety analysis conducted by the Northwest Mountain Region at Aspen-Pitkin County Airport/Sardy Field, Colorado. This report was prepared by the General Aviation and Commercial Division, AFS-800, of Flight Standards Service in conjunction with the Technical Programs Division, AFS-400, the Office of the Chief Counsel, AGC-1, and the Office of Airport Safety and Standards AAS-1.

The Flight Standards position, based on the findings of the safety analysis, is that there is no valid safety reason for excluding general aviation night visual flight rules (VFR) operations in visual meteorological conditions (VMC) at Aspen-Pitkin County Airport/Sardy Field. Night VFR flight in VMC at Aspen Airport represents no apparent risk to the appropriately prepared general aviation pilot. This conclusion is based on analysis of accident/incident data, actual flight experience, and topographical information on the area.

Appendix 1 of the attached report contains Flight Standards comments on the November 1991 "Gellman Report."

Thomas C. Accardi

Attachment

REMARKS:

Cancelled by HQ - See ALT Jones 9/10/92

FEDERAL AVIATION ADMINISTRATION

REPORT

ON NIGHT VFR OPERATIONS

IN VISUAL METEOROLOGICAL CONDITIONS

AT ASPEN-PITKIN COUNTY AIRPORT/SARDY FIELD, COLORADO

April 13, 1992

Prepared by the

Flight Standards Service

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FEDERAL AVIATION ADMINISTRATION REPORT ON ASPEN-PITKIN COUNTY AIRPORT/SARDY FIELD, COLORADO

EXECUTIVE SUMMARY

INTRODUCTION

The Northwest Mountain Region, Flight Standards Division, has completed a safety analysis of the Aspen-Pitkin County Airport/Sardy Field, Colorado. The analysis' primary objective was for the Federal Aviation Administration (FAA) to assess the safety of conducting night visual flight rules (VFR) operations by pilots of general aviation aircraft in visual meteorological conditions (VMC). The following report is based on the results of that safety analysis. Appendix 1 to this report contains Flight Standards comments on the Night VFR Safety Study, Sardy Field, Pitkin County Airport. This study was performed and published by Gellman Research Associates, Inc., for the Board of County Commissioners of Pitkin County, Colorado.

BACKGROUND

Currently, all general aviation aircraft are prevented from operating at Aspen-Pitkin County Airport/Sardy Field, Colorado, between the hours of official sunset plus 30 minutes and 0700 the following morning. Aircraft operated by Aspen Airways (United Express), Britt Airways (Continental Express), and Air Wisconsin (United Express) are allowed by the airport authority to conduct night arrivals until 2300 hours. The FAA authorized these carriers to conduct night activities provided they use privately funded instrument approach facilities and special instrument approach procedures. The operations specifications issued by the FAA to these carriers contain this authority. The carrier specially trains its flightcrews and tests their skill and knowledge in operating at the airport annually.

The County of Pitkin, Colorado, Board of Commissioners, which is the airport authority, has used federal funds to improve the airport facilities over the years. The night restriction on general aviation aircraft has never been contested until the Aircraft Owners and Pilots Association (AOPA) and the National Business Aircraft Association (NBAA) filed formal complaints with the FAA. These organizations claim that the airport authority has committed an illegal and discriminatory act against their memberships by permitting unequal access to the airport by the commercial airlines.

For their part, the Commissioners have stated the reason for the restriction is because of their concern for the safety and welfare of persons and property on the surface. The FAA has informed the commissioners that determinations on safety issues are within the exclusive authority of the Federal Government and, in the absence of any information related to a viable safety issue, has demanded that they remove the curfew restrictions on general aviation aircraft. The County has agreed that the Federal Government has the authority on safety matters but is of the opinion that the FAA may not fully realize or appreciate the unusual safety problems associated with VFR flight to and from the airport. The Commissioners proposed to resolve this matter by joining with the FAA in an airport and airspace safety study with the outcome to have a binding effect. They also wanted to delay any action on the curfew until the studies are completed. The estimated time for completion of the studies is 12 to 18 months.

The County Commissioners also expressed concerns about noise from the airport, and the FAA responded by agreeing to join in and partially fund a noise study, provided that the Commissioners aligned the general aviation curfew with that for air carrier operations during the period of the study. The FAA reiterated that the safety issue was solely a Federal decision. To date, the County Commissioners have not taken action to remove the night restriction on general aviation aircraft. Rather, the local ordinance was amended to eliminate aircraft departures on weekends and holidays during the ski season for periods of time up to two and one-half hours after sunset.

THE SAFETY ANALYSIS

The safety analysis consisted of a review and assessment of material generally available to pilots of general aviation aircraft including the *Airman's Information Manual*, the Federal Aviation Regulations (FAR), the *Airport/Facility Directory*, the Standard Instrument Approach Procedures, Accident Prevention Program material on mountain flying, navigation charts for the area, and Notices to Airmen. Safety analysts conducted on-site ground and flight observations, evaluated topography, analyzed obstructions, interviewed local pilots, and considered accident/incident data for the airport. The accident/incident data analysis covered the period 1983 to 1989 and, although FAA did review accident information provided by the Commissioners for several years before 1983, analysis of the Commissioners' record is limited to a background understanding of the opinions and issues expressed. The accident data they provided did not permit the level of study as did National Transportation Safety Board (NTSB) accident files. NTSB accident archives contain full accident records only from 1983. This approach makes it impossible to make a direct comparison with the August 1990 study presented by the Aspen community, since that work presents data based on accidents occurring nearly 20 years earlier than the complete reports available to the FAA.

The accident analysis was limited to accidents occurring on or within 25 nautical miles of the Aspen Airport between 1983 and 1989 and filed in the NTSB archives. Data for

1990 were omitted because investigations were still underway. From the accident analysis, FAA concluded that Aspen Airport does not significantly differ from other airports situated in mountainous terrain, i.e., that there are similar risks at any mountain airport for pilots not familiar with operations unique to mountainous terrain. The navigational aspects associated with these airports require proper preflight planning to ensure terrain clearance during egress and ingress to the airports.

The National Aeronautics and Space Administration's (NASA) Aviation Safety Reporting System was queried for the purpose of reviewing any relevant reports submitted by airmen flying into the area. NASA provided 21 reports involving incidents at Aspen and Eagle Airport. NASA considers the narrative portion of the reports to be more important than the statistical results. The narrative contains statements from pilots who reveal details about what happened and why an incident happened. There were no reports indicating unsafe or hazardous conditions associated with Aspen Airport.

An in-flight review was conducted at airport locations other than Aspen, Colorado for the purpose of comparing the terrain features and airport restrictions, if any, to Aspen. All in-flight evaluations were made under day VFR conditions while simulating the routing and operating practices used by pilots flying with ceilings of 2,000 feet.

An evaluation of the transition to the visual maneuver was made to determine whether a person operating a general aviation aircraft, flying a normal traffic pattern at 1,000 feet above the airport, would require any maneuvering to avoid obstructions. The same procedure was flown using aircraft speeds and bank angles approximating executive-jet class aircraft to determine if any obstructions penetrated the normal pattern while maneuvering from the minimum descent altitude on a circling maneuver to right traffic for runway 33. It was determined that flying a normal traffic pattern (extended 3 miles from the airport) was not possible because of obstructions. A person familiar with the terrain features of the airport could conduct a safe approach straight-in to runway 15 and avoid known features of rapidly rising, high terrain by maneuvering the aircraft before entering those areas. Remaining aligned with the runway 15 centerline at a distance of 4 miles and 1,000 feet above the surface would avoid any obstructions. This maneuvering would not require exceptional piloting skills and the use of the Visual Approach Slope Indicator located on runway 15 would enhance the safety aspects. Obstructions rise to approximately 800 feet above the surface within one-half mile of the runway on the west/southwest side and over 1,000 feet above the surface within one and one-half miles northeast of the runway.

PRINCIPAL CONCLUSIONS

The rapidly rising terrain surrounding the Aspen-Pitkin County Airport requires pilot care because of the high altitude and unlighted obstructions in proximity to the airport. Not all pilots would want to operate in this environment during the day or night.

The accident history for the airport does not reveal any conditions which are unique to the airport. The accidents occurring on the airport seem to be more the product of operational error or mechanical malfunctions. Furthermore, the accidents are not different from those that are common at airports with low field elevations and with no significant surrounding terrain. Evidence from the analysis does not indicate that the airport is inherently unsafe.

Night VFR operations in VMC by pilots of general aviation aircraft can be conducted safely at the airport. With proper planning a person could make a safe journey including a night takeoff or landing without prior experience at the airport; however, the risk of this operation would be higher than for a person who had previously gained familiarity with the airport.

CONCLUSION

The analysis shows no valid safety basis for restricting general aviation aircraft from conducting night VFR operations in VMC.

The body of this report contains additional, specific recommendations.

FAA REPORT ON ASPEN-PITKIN COUNTY AIRPORT/SARDY FIELD

GENERAL INFORMATION

Aspen is located in the west central part of Colorado in a high mountain valley at 7,815 feet above sea level (ASL). The mountains surrounding the City of Aspen range in elevation from 10,000 to over 14,000 feet mean sea level (MSL). The surrounding terrain includes mountain peaks well above 10,000 feet MSL. These peaks are usually obscured during periods of cloudy weather. The airport's coordinates are 39°, 13', 28.5" N Latitude, 106°, 52', 6.6" W Longitude, and the airport is depicted on the Denver Sectional Aeronautical Chart.

The airport consists of a single runway, 7,000 feet long, aligned along a northwest and southeast direction (runway 15/33). The touchdown zone elevation for runway 33 is 7,816 MSL while the runway 15 touchdown zone elevation is 7,675 MSL. This represents an upslope gradient of 1.98 percent when landing on runway 15.

The surface winds at the airport are generally from the north to the northeast quadrants and can produce a considerable downflow of air which may exceed the climb performance of some general aviation aircraft. Winds from the south and southwest produce considerable amounts of turbulence and windshear which spill over the terrain-rise within a half-mile of the airport.

The airport is equipped with Medium Intensity Runway Lighting (MIRL) on runway 15/33, Runway End Identification Lights (REIL), and a Visual Approach Slope Indicator (VASI) located on runway 15. The MIRL have variable intensity controls and are used to outline the edges of runways during periods of darkness or restricted visibility. The REIL are installed to provide positive and rapid identification of the approach end of the runway. They are effective for identification of a runway surrounded by a preponderance of other lighting, identification of a runway which lacks contrast with surrounding terrain, and/or for identification of a runway during reduced visibility. The VASI is a system of lights so arranged to provide visual descent guidance information during the approach to a runway. These lights are visible from 3 to 5 miles during the day and up to 20 miles at night.

The air traffic control tower is open daily until 2200 hours local time. The airport also has secondary beacon radar installed which requires aircraft be equipped with a functioning transponder in order for air traffic to provide any radar services. A VOR/DME (very high frequency omni-directional range with distance measuring equipment) facility is located approximately 12.5 nautical miles northwest of the airport on Red Table Mountain. This is the primary public instrument approach facility for the airport. There are 2 private instrument approach facilities whose use is authorized by the sponsoring air carriers. The minimum sector altitude for all quadrants within 25 nautical miles of the facility is 15,500 feet MSL. The published VOR DME-C instrument approach procedure is not currently authorized at night for air carrier or general aviation aircraft. (A notation on the published instrument approach states, "Procedure not authorized at night." This language, inserted by the Manager of the Denver Flight Standards District Office (FSDO), appeared on the original published instrument approach procedure dated March 13, 1986, and has appeared on each subsequent revision.) The published instrument approach offers only a single option and a single radio navigational reference for a pilot approaching the area in instrument meteorological conditions. Given the surrounding terrain, night VFR approaches in VMC offer many more approach options for the pilot, i.e., more visual cues to supplement radio navigation information. Even the published, charted visual approach procedure is not applicable for VFR pilots operating in VMC because it is the culmination of an instrument procedure by pilots on an instrument flight rules (IFR) flight plan. Pilots conducting night VFR operations in VMC would not be using this charted visual approach procedure because the specific landmarks highlighted in the procedure would not be visible and are, therefore, unusable; however, other landmarks discussed later in this report would be.

Memoranda from the FAA Sacramento, California, Flight Inspection Field Office (FIFO) and the Oklahoma City, Oklahoma, FIFO support continuing the nighttime restriction on the published instrument approach procedure (VOR/DME-C). These documents do not affect the safety study since they both address the safty aspects of the nighttime use of the VOR/DME-C instrument approach procedure. This report, however, addresses nighttime VFR flight in VMC.

REVIEW OF MOUNTAIN AIRPORTS

An in-flight review was conducted at airport locations other than Aspen, Colorado, for the purpose of comparing the terrain features and airport restrictions, if any, to Aspen. These in-flight evaluations were made under day VFR conditions while simulating the routing and operating practices used by pilots flying with ceilings of 2,000 feet. The following airports were selected for having terrain features which were similar to Aspen:

Craig, Colorado	Telluride, Colorado	Gunnison, Colorado
Delta/Blake, Colorado	Hailey, Idaho	
Eagle, Colorado	Oroville, Washington	

Each of the above listed airport environments has unique features and terrain obstructions which would pose a challenge to the skills and judgement of pilots unfamiliar with the specific airport.

The process used in making this review was to evaluate the volume of traffic, predicted lighting effects of a town, areas of maneuvering, normal operating practices, information normally available to the pilot, layout of the airport relative to natural terrain, routing to/from the airport, penetrating obstructions within a normal traffic pattern/flight path, and anticipation of the physiological effects on human performance.

Because of unlighted obstructions, high terrain in all quadrants, and effects of altitude on performance characteristics of typical, light general aviation aircraft, night VFR operations in VMC at Aspen Airport represent a risk typical of any mountain flying operation in unfamiliar terrain for the average pilot regardless of experience. *Gaining exposure to the features and obstructions before operating at night would reduce the risk.*

AIRPORT INFORMATION AVAILABLE TO AIRMEN

The *Airport/Facility Directory* listing for Eagle County, Colorado Airport contains airport remarks which state, "High unmarked terrain all quadrants. Night operations are discouraged to pilots unfamiliar with the airport." This language communicates the message that certain unique terrain features exist and that caution should be exercised by the pilot. These remarks are advisory in nature; the pilot is not required to follow them.

On the other hand, Aspen-Pitkin County Airport has terrain features similar to Eagle. Yet, the *Airport/Facility Directory's* only reference to terrain states ". . . Rwy 15 VASI unusable beyond 4 NM from apch end due to high terrain." Other airports in Colorado have remarks which describe high terrain surrounding the airport or as an obstruction remark for an approach to a specific runway.

ACCIDENT ANALYSIS FOR ASPEN AIRPORT

The NTSB accident archives contain full accident records only from 1983. The analysis included material for the period from 1983 to 1989. Therefore, it is not possible to make a direct comparison with the August 1990 study presented by the Aspen community, since that work presents data based on accidents occurring nearly 20 years earlier than the complete reports available to the FAA.

The Accident Investigation Division, AAI-100, has limited the analysis to accidents occurring on or within 25 nautical miles of the Aspen Airport filed in the NTSB archives from 1983 to 1989. Data for 1990 was omitted because investigations were still underway. The accident information supplied by the County Commissioners cannot be verified because there is no NTSB information available before 1983. The accident analysis data for Aspen Airport do not indicate that it is significantly different from other airports situated in mountainous terrain. Of course, the navigational aspects associated with any airport in mountainous terrain require proper preflight planning to ensure terrain clearance during egress and ingress.

Appendix I of the safety analysis upon which this report is based contains a copy of the accident analysis.

AVIATION SAFETY REPORTING SYSTEM

The NASA's Aviation Safety Reporting System was queried for the purpose of reviewing any relevant reports submitted by airmen flying to the area. NASA provided 21 reports involving incidents at Aspen and Eagle Airports. NASA considers the narrative portion of the reports to be more important than the statistical results. The narrative contains statements from pilots who reveal details about what happened and why an incident happened. There were no reports indicating unsafe or hazardous conditions associated with Aspen Airport.

The reports are included in Appendix II of the safety analysis upon which this report is based.

OBSERVATIONS

There is high mountainous terrain surrounding Aspen Airport. Surrounding the south side of the airport is rising terrain which begins approximately 1 mile and rises rapidly in various directions to over 9,400 feet MSL within 2 miles of the airport. The radar site is located at approximately 8,500 feet MSL and is abeam the threshold of runway 15. Terrain features in the quadrant south of the airport and swinging toward the west rise to over 8,800 feet. From the west to the northwest the terrain is generally below 8,400 feet MSL; however, directly northwest and to the north, the terrain rises sharply with a peak over 9,300 feet MSL within 6 miles of the airport. From the northerly quadrant toward the east southeast the terrain is over 10,000 feet MSL within 3 miles of the airport and rises even higher to over 14,000 feet. An area known as Triangle Peak is located approximately 5.75 miles off the departure end of runway 33 at an elevation of approximately 9,300 feet MSL. Another terrain obstruction known as Williams Peak or Antenna Peak is 8,800 feet MSL within 6 miles west of the airport.

Unlighted obstructions rise above the airport field elevation within 1,000 feet of the runway centerline on the south side. If pilots remain aligned with the centerline they can avoid these obstructions which extend out and beyond the approach end of runway 15.

During periods of unrestricted visibility the distances from the runway end to the obstructions are deceiving and give an illusion of being closer than the actual distance. The vertical rise in the terrain within 1 mile south of the airport is not rapid. However, to the north of the airport the vertical rise is much steeper. To the southeast the terrain rises sufficiently that, at night, it would not be recommended for a VFR departure from runway 15 because of the potential reduction in the aircraft performance and lack of visual cues to determine the location of obstructions. The airport is generally used as a one-way in, one-way out airport because of the terrain features surrounding the airport.

When parked at the end of runway 33, the downslope of the runway increases the margin above the surface when setting the aircraft altimeter to the published field elevation. Conversely, a pilot setting the aircraft altimeter to the published airport elevation, while parked at the end runway 15, would result in the aircraft being lower over the terrain than the indicated altitude. The Aspen Airport runway has an upslope gradient of 1.98 percent when landing on runway 15. Visual illusions from an upsloping runway can cause pilots to flatten out the approach. An upsloping runway, upsloping terrain, or both can create the illusion that the aircraft is at a higher altitude than it actually is. The pilot who does not recognize this illusion will fly a lower approach. A downslope runway, downsloping terrain, or both, can have the opposite effect. Featureless terrain, the absence of ground features, as when landing over darkened areas, water, and terrain obscured by snow, can also create the illusion that the aircraft is at a higher altitude than it actually is. At night, the pilot who does not recognize this illusion will fly a lower approach. The VASI installed on runway 15 assists pilots with descent information during the approach.

For the purpose of monitoring local traffic, aircraft operations were observed over a period of 2 days. Pilots generally use runway 33 for departure. The rising terrain to the east and southeast is one of the reasons for this procedure.

The meteorological conditions during observations were high cirrus, visibility more than 15 miles, with winds out of the south at 5 to 8 miles per hour. Numerous single- and multi-engine aircraft were observed using the airport. Among these were a Cessna 177, a Cessna 182, a Cessna 210, a Cessna 421, a Beech Debonair, a Piper Aztec, and a LearJet. An ultralight was also observed arriving to the airport from the south over the ridgeline. Parked on the ramp were a variety of single engine aircraft including a J-3 Cub, NorthAmerican T-6, Piper Aerostar, Cessna 185, Navion, Stinson 108, and several gliders. Executive class turbojet aircraft which frequent the airport during the year range in size from the Cessna Citation to the Boeing B-727.

The aircraft arrived and departed in an orderly manner, and all used landing lights while in the terminal area. (The *Airport/Facility Directory* contains a remark which encourages pilots to use landing lights because of low visibility in the valley.) None of the arrivals or departures appeared to be other than routine and normal. All aircraft departed to the northwest, then turned toward a westerly heading down the valley in the direction of the Glenwood Springs/Carbondale area. This is the preferred routing out of the Aspen area. None of the aircraft were observed to proceed toward the north or east/southeast.

Arriving aircraft neither required any unusual maneuvering to the airport during daylight hours nor did there appear to be unusual vertical rates of descent. The terminal area flight operations were quite normal in all aspects.

During the review of the Denver Sectional Aeronautical Chart for the Aspen Airport it was observed that the Red Table VOR/DME, 175 degree label overlay, which defines Skier Intersection on Victor 421 airway, obscured meaningful information on the topography. That particular symbol is chart clutter and obscures the topographical features of Triangle Peak.

NIGHT OBSERVATIONS

Flights were conducted into Aspen at night with observations made from the cockpit of a DeHavilland DHC-7 aircraft. The safety analysts, based on their aviation experience, then interpolated what the experience would be like for typical, light general aviation aircraft.

The letdown from the VOR was steep, requiring a rate of descent of approximately 1,500 feet per minute while operating at less than 120 knots indicated airspeed. The air traffic control tower reported the surface winds from the south at 8 knots, and the aircraft experienced light turbulence. Minor drift corrections were made to the flight path to maintain a ground track toward the runway centerline, but no unusual piloting skills were required.

The meteorological conditions were clear skies, stars shining, yet not enough terrestrial light to provide any cues for defining the ridges or mountains surrounding the airport. This created an effect where depth perception was difficult, and, unless pilots were familiar with the terrain, they would not be aware of the obstructions which may underlay the flight path. There were no haze patterns nor were the hills or mountains covered with snow, which could enhance the overall lighting effects and aid in the definition of the obstructions. Ridgelines were undefined, with no horizon or mountain definition. This experience demonstrated that Triangle Peak, located northwest from the airport, was not visible. When departing Aspen, a pilot familiar with the local area would likely choose a radial off of the Red Table VOR to make a turn down the valley toward Carbondale/Glenwood Springs or toward the airport when arriving over from the Carbondale area. Night operations in reduced visibility would require familiarity with the terrain features to avoid obstructions. The same terrain and approach paths were observed during daylight conditions to measure the differences in the visual cues available to the pilot.

Triangle Peak, located 6 miles northwest of the airport, while quite noticeable during the day, is virtually unseeable at night. During this night evaluation the vehicle traffic on the surface was sparse yet adequate enough to outline the major road (Highway 82) between Carbondale and Aspen. This highway could be used for night VFR navigation in VMC.

The terrain is high in all quadrants. The approach inbound from Carbondale toward Aspen following the highway is to fly from low terrain to higher terrain. The elevation at Carbondale is approximately 6,000 feet, while the airport elevation at Aspen is 7,800 feet. Glenwood Springs Airport, approximately 9 statute miles northwest of the town of Carbondale, is 5,916 feet.

There was a strobe light system installed at the Aspen Airport as part of a private approach procedure but this was not operating at the time of the evaluation at the direction of the airport management because of environmental reasons.

INTERVIEWS

Note: An aviation safety inspector conducted the interviews in as objective a manner as possible, but the subjective nature of the interviewees comments should be considered when assessing their merit.

A former manager of the Aspen Airport was interviewed. This person claimed to have 4,500 hours total flight time, 2,000 hours of which had been accumulated flying into and out of Aspen as a search and rescue pilot. He indicated that he had personally operated in and out of the airport, at night, and felt it was safe to do so because he was familiar with the surrounding terrain. He indicated he would not fly up the valley but would come over the top of the airport and spiral down overhead, similar to turns about a point. The reason for this type of approach is to avoid the obstructions. He did, however, express the opinion that the airport should be closed at night because of the hazards involved.

Most persons contacted agreed that night operations could be conducted safely but, for the most part, would choose not to do so. Some of the reasons cited for not operating at night were the type of terrain needing to be overflown in a single-engine aircraft, unreported weather, turbulence, effects of high altitude flight on aeronautical judgement (hypoxia), radio navigation interruptions, and darkness. Several local pilots claimed to have operated general aviation aircraft at the airport at night.

REGULATORY ANALYSIS

A review of the various operating regulations was accomplished and deemed applicable to the kinds of operations likely to occur around the airport.

Section 91.103 of Federal Aviation Regulations (FAR) requires each pilot-in-command, before beginning a flight, to become familiar with all available information concerning that flight. This includes aircraft performance relating to values of airport elevation and runway slope, aircraft gross weight, and wind and temperature. The manner in which the pilot becomes familiar with terrain features surrounding the airport is at the discretion of the individual. Normally, use of the sectional chart and the *Airport/Facility Directory* would provide useful information, and consulting them would be considered prudent for any pilot flying to mountain airports.

There are no specific regulatory standards for night VFR operations into mountainous terrain or for what the general aviation pilot is expected to do in such situations. Under FAR § 91.3, the pilot-in-command is responsible for the safe operation of any flight. The pilot has been trained and tested in preflight precautions and in the effects of night and high altitude flight. Student pilots are taught early in the pilot training program to exercise good aeronautical judgement. It is not reasonable to expect all situations to be covered in the flight training curricula; therefore, under the FAR, safe operation depends on the experience and good judgement of the pilot.

There are regulations addressing certain physiological considerations for a pilot before operating at altitudes typically encountered when flying to and from Aspen Airport or any other airport in similar mountainous terrain. The more well-known consideration is called hypoxia. Hypoxia is a state of oxygen deficiency in the body sufficient to impair functions of the brain and other organs. Information relating to the precautions to take to prevent hypoxia and the signs of when it is present are provided to all pilots during the early stages of the flight training program.

Hypoxia can be experienced by pilots of unpressurized aircraft operating at altitudes above 12,500 feet ASL. This is not an absolute figure, and the physical conditioning of the individual plays a important role in determining the true effect. Although a deterioration in night vision occurs at a cabin pressure altitude as low as 5,000 feet, other significant effects of altitude hypoxia usually do not occur in a normally healthy pilot below 12,000 feet. From 12,000 to 15,000 feet of altitude, judgement, memory, alertness, coordination, and ability to make calculations are impaired, and headache, drowsiness, dizziness, and either a sense of well-being or a feeling of belligerence occur. The effects appear following increasingly shorter periods of exposure to increasing altitude. In fact, pilot performance can seriously deteriorate within 15 minutes at 15,000 feet.

Hypoxia at high altitudes is caused only by the reduced barometric pressures encountered at those altitudes, for the concentration of oxygen in the atmosphere remains about 21 percent from the surface out to the outer reaches of space. Therefore, in response to the concern for pilot performance in an atmosphere of reduced pressures, the FAA prescribes in FAR § 91.211 that no person may operate a civil aircraft of United States registry:

1) At a cabin pressure altitude above 12,500 feet mean sea level (MSL) up to and including 14,000 feet (MSL) unless the required minimum flight crew is provided with and uses supplemental oxygen for that part of the flight at those altitudes that is of more than 30 minutes duration;

2) At cabin pressure altitudes above 14,000 feet (MSL) unless the required minimum flight crew is provided with and uses supplemental oxygen during the entire flight time above those altitudes; and

3) At cabin pressure altitudes above 15,000 feet (MSL) unless each occupant of the aircraft is provided with supplemental oxygen.

METEOROLOGICAL FACTORS

As with most mountainous airports, the weather in the valley at Aspen can change rather quickly during the winter months, and blowing snow can reduce visibility to less than 3 miles. The weather patterns are also unpredictable and not usually predicated on other adjacent areas. For example, it can be clear in the Carbondale area and be snowing in Aspen. The Denver area weather CANNOT be used as an indicator of what the weather will be in the Aspen area. Likewise, Eagle County Regional Airport weather, located within 25 miles of Aspen, could be significantly different. The turbulence throughout the area picks up considerably with an increase in wind velocity.

Density altitude is a measure of air density. It is not to be confused with pressure altitude. When the temperature becomes higher than standard for a particular location, the density of the air is reduced. This, in turn, aerodynamically affects aircraft performance. On a typical general aviation aircraft with a carbureted engine, the horsepower output is reduced and the propeller loses some efficiency from the loss of power and because the blades, being airfoils, do not obtain as much thrust from a bite of the less dense air. Since the propeller cannot develop its maximum force, it will take longer for the aircraft to obtain necessary forward speed to produce the required lift for takeoff. Thus, the takeoff distance will be increased. The loss of horsepower and the propeller efficiency will also result in a decrease of the climb performance. For example, at Aspen Airport with an outside air temperature of 80 degrees and pressure altitude of 7,800 feet, the takeoff distance would be increased by over 260 percent and the rate of climb reduced by 80 percent. Assuming the aircraft would climb at 700 feet per minute at sea level, this rate of climb would be reduced to 140 feet per minute while covering the ground at approximately 90 miles per hour. In 4 minutes, the aircraft would be able to climb to an indicated altitude of approximately 8,400 feet MSL while covering a distance of 6 miles from the airport. The terrain within 6 miles of the airport rises higher than the expected climb performance of the aircraft. Therefore, flight planning and route selection for the VFR pilot becomes very important.

Although this is generally more of a daytime problem--air cooling sublimates the effect --density altitude is only a serious nighttime problem in areas of high altitude.

AIRPORT TRAFFIC VOLUME

A review of the traffic flow to the airport was made to determine the volume and to measure that volume against other airports within the region which had similar numbers of takeoffs and landings. The following is a traffic count for the facility:

Fiscal Year	Total Operations	Air Carrier 121/135	General Aviation	Instrument Operations
1985	40,916	11,568	29,229	9,214
1986	43,267	10,917	32,330	9,362
1987	47,217	11,645	35,691	10,601
1988	49,566	10,789	38,719	10,832

Fiscal Year	Total Operations	Air Carrier 121/135	General Aviation	Instrument Operations
1989	49,904	11,227	37,616	11,768
1990	51,409	14,108	37,182	22,293*

* Radar installed and improved instrument approach procedure increased the acceptance rate of aircraft to the airport

During 1989 July was the peak month with 6,146 operations, including 365 air carrier, 487 air taxi, 3,063 itinerant general aviation, 57 military, and 2,174 local takeoff and landings. The peak number of operators for a day during the summer was 566; during the winter it was 280 operations. The monthly totals were:

January	4,960	February	5,078	March	5,619
April	2,632	May	2,404	June	4,143
July	6,146	August	6,083	September	4,195
October	2,991	November	2,993	December	4,165

The traffic volume for the following airports of comparable operational levels as of calendar-year 1989 was:

Aspen, Colorado	51,243	Lewiston, Oregon	58,585
Boise, Idaho	50,938	Missoula, Montana	61,101
Olympia, Wash.	48,954	Grand Junction,Co.	81,844
Pocatello, Idaho	49,887	Great Falls, Mont.	67,670
Twin Falls, Idaho	45,879	Helena, Montana	62,016
Walla Walla, Wa.	51,550	Troutdale, Oregon	60,418
Idaho Falls, Idaho	45,071	Hailey, Idaho	54,360*

* Projected data

NOTE: The traffic counts for Aspen in the above presentations are different because the report reflects the fiscal year versus the calendar year.

AIRPORT REMARKS

A complete review of airport remarks for those airports located within the boundaries of the Northwest Mountain Region was conducted to determine the kind of information available to the pilot on terrain features surrounding the airport. Remarks contained in the *Airport/Facility Directory* which are deemed to be pertinent and appropriate for the area come from a number of sources. The airport manager, the FAA, and the general public may submit information to be included in the *Airport/Facility Directory.* Several airports have few remarks listed while others have information which is direct and communicative.

Below are selected comments of those airports appearing in the *Airport/Facility Directory.* The comments on the terrain features surrounding an airport are listed alphabetically by state.

COLORADO:

Aspen-Pitkin County/ Sardy Field	General Aviation Arrival authorized until 30 minutes after official sunset only. Takeoff not authorized runway 15 without written permission. Due to poor visibility in valley, use landing light in traffic pattern. Runway 15 VASI unusable beyond 4NM from approach end due to high terrain.
Eagle Co. Regional	High unmarked terrain all quadrants. Night operations discouraged to pilots unfamiliar with airport.
Granby-Grand Co.	Recommended traffic to east only by experienced pilots. High terrain rises quickly to the east.
Gunnison	High terrain all quadrants.

IDAHO:

Hailey/Friedman Mem.	Not recommended at night for users unfamiliar with area mountains.
Ketchum/Twin Bridges	Airport located in high mountain valley surrounded by high mountains.

MONTANA:

Butte/Bert Mooney	Runway 33: do not use VASI beyond 1.5 miles due to high terrain. Do not use VASI beyond 2.5 miles from approach end of runway 29 due to high terrain.

ACCIDENT PREVENTION PROGRAM AND OTHER FAA INFORMATION

The Accident Prevention Program distributes a publication entitled "Tips on Mountain Flying," which contains certain ideas, graphs, and possible courses of action for the pilot to keep in mind while flying in mountainous country. It is intended to be neither original nor all inclusive. It is presented as an educational publication to be used by pilots as a reference for those seeking information on mountain flying.

A discussion of aircraft performance verses density altitude is included in this publication as a refresher to most pilots. This information is usually presented as part of the basic knowledge requirement in *ab initio* training leading toward a private pilot certificate and is a subject well covered in other grades of pilot and ground/flight instructor certificates.

The FAA Northwest Mountain Region, Denver Air Route Traffic Control Center, publishes a document entitled, "High Mountain Flying in Ski Country, USA." The information contained in the publication is intended to assist the pilot when flying to the high country of Colorado. Information has been extracted from Advisory Circular (AC) 91-15, "Terrain Flying," which lists some do's and don't's about mountain flying and contains other information about winter flying, mountain weather, and airport notes. The remarks for special notes for the Aspen-Pitkin Airport are to use caution because of high terrain in all quadrants.

CONCLUSION

The terrain surrounding the Aspen-Pitkin County airport is sharply rising and at a high altitude, and there are unlighted obstructions close to the airport. Not all pilots would want to operate in this environment during the day or night. Likewise, not all pilots who are qualified in the airplane single-engine class of aircraft would operate a high-performance single-engine aircraft or tailwheel-type of aircraft without the benefit of additional training, experience, and proficiency flying.

Night VFR operations in VMC by pilots of general aviation aircraft can be conducted safely at the airport. A person could, with careful planning, make a safe journey and night takeoff or landing without prior experience; however, the risk would be higher than for a person who had previously gained familiarity with the airport.

It would be appropriate, at the earliest possible revision cycle, for the *Airport/Facility Directory* to contain a remark to the effect, "Night operations not recommended for persons unfamiliar with the airport." Also, Airport Terminal Information Services (ATIS) could provide traffic pattern information and advisories for night operation including go-around instructions.

The accident history for the airport does not reveal any conditions which are unique to the airport. The accidents occurring on the airport seem to be more the product of operational error or mechanical malfunctions. The accidents are not different from those that are common at airports with low field elevations and no significant surrounding terrain. There is no evidence to conclude that the airport itself cannot be used safely at night in VFR VMC operations by properly prepared pilots.

RECOMMENDATIONS

It is recommended the FAA initiate action to implement the following recommendations:

1. Reaffirm the inappropriateness of a night restriction for general aviation aircraft at the Aspen-Pitkin County Airport/Sardy Field, Aspen, Colorado, based on safety considerations and urge the Aspen Airport Manager to cease the attempt to regulate in areas that encompass FAA's safety responsibility.

2. Prescribe in the *Airport/Facility Directory* entry for Aspen an airport remark which states, "Night operations not recommended to those unfamiliar with the airport."

3. In addition to recommendation 2, the Airport Manager should be encouraged to propose for FAA approval and eventual inclusion in the *Airport/Facility Directory* a complete and detailed description of the recommended traffic pattern to be used by pilots arriving and departing the airport. Included in this description should be the preferred runway for use during day/night operations, the pattern altitudes, direction of traffic flow to each runway, and suggested altitudes for maneuvering an aircraft within the valley immediately surrounding the airport.

4. Encourage the airport management to consider recommissioning a lead-in strobe light approach system to Runway 15 at Aspen-Pitkin County Airport to be used by all operators. The use of a lead-in strobe light system would enhance the operational aspects of night flight and should be installed for use by pilots. Approach lights provide the basic means to transition from visual or instrument flight for landings. The lead-in system would provide a pilot operating an aircraft during day or night conditions with a sequence of flashing lights which would appear to travel towards the runway. During hours when the

air traffic control tower is not in service to the public, the lights should be operable by the pilot from the air through VHF radio activation.

5. If the lead-in lights are recommissioned, ensure steps have been taken to publicize the availability of the lead-in light system to airmen by placing this information in the *Airport/Facility Directory*.

6. Remove the 175 degree label overlay from the Denver Sectional Aeronautical Chart which defines the Skier intersection on V421 airway off of the Red Table VOR (DBL) and place it in another location on the chart.

7. Encourage the county to determine the feasibility of locating an obstruction light, pulsating light, or beacon on Triangle Peak and Williams Peak (Antenna Peak) to assist the pilot in determining their location when operating in the enroute/terminal area west/southwest of the airport. Lighting of Triangle Peak and Williams Peak with beacon, pulsating light, or obstruction light should enhance the detection of these natural obstructions by pilots operating to and from the airport.

8. Request ANM-500 take steps to use the Airport Terminal Information Service (ATIS) to provide arrival/departure information and advisories for visual traffic and for pilots performing go-around or missed approach procedures at Aspen Airport. If the lead-in light system is returned to operation, use the ATIS to announce the availability of the lead-in approach light system to pilots upon their request.

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APPENDIX 1: COMMENTS ON NIGHT VISUAL FLIGHT RULES (VFR) SAFETY STUDY, SARDY FIELD, PITKIN COUNTY AIRPORT (GELLMAN REPORT, HEREAFTER REFERRED TO AS "THE STUDY")

In general, we find the study to be unscientific, illogical, subjective, and biased. Its premises rely on much irrelevant material, and as a consequence, the study will lead an uninformed reader to many erroneous conclusions. First, we will comment on the Executive Summary; then we will comment on the frontispieces for each of the seven parts of the study.

Executive Summary Rebuttal

The second paragraph on page 1 of the Executive Summary states that the prohibition on night VFR general aviation operations at Sardy Field appears to be "...rationally based upon valid FAA-based safety considerations as well as empirical data." The "FAA-based safety considerations" upon which the author bases his/her argument seems to be related to the pilot qualifications for special area/routes and airports as required by Sections 121.443 and 121.445 of the Federal Aviation Administration (FAR) and Advisory Circular (AC) 121.445-1D. AC 121.445-1D states that the operating rules governing domestic and flag air carriers have for some time required pilots to be qualified over the routes and intc airports where scheduled operations are conducted. The operations review program Notice No.8 issued May 5, 1978, proposed, among other things, to eliminate the airport and route qualifications provisions for pilots operating under the domestic and flag rules. Further, it was proposed to amend Section 121.445 of the FAR to require pilots of all Part 121 certificate holders to meet special qualifications for certain airports and *special types of navigation qualifications for certain areas or routes,* or both, where the Administrator determines such qualifications are necessary. Amendment 121-159, which contains this regulatory change, became effective on August 31, 1980. AC 121.445-1D provides industry with information necessary to meet the requirements of amended Section 121.445 of the FAR by identifying those areas/routes and airports where special pilot qualifications or *special navigation qualifications are required.*

Interestingly, although the study continually points to the mountainous terrain at Sardy Field as a major issue, and AC 121.445-D describes 64 special airports as being located in mountainous terrain, thereby requiring special qualifications for Part 121 pilots, *Sardy Field is not one of the 64 airports so listed.* Sardy Field is listed as having "high terrain; special procedures" that require special pilot qualification for Part 121 operators. "High terrain" and "mountainous terrain" are not necessarily the same physical phenomena.

It is our opinion that the special qualifications required by the AC and Section 121.445 of the FAR relate more importantly to the unique, non-standard type of navigational aid employed by the scheduled air carriers at Sardy Field, a TALAR interim-standard MLS, as opposed to the high terrain. The issue of high terrain more accurately means high density altitude and has nothing to do with mountainous terrain. High density altitude conditions can be experienced almost anywhere, even at Death Valley, California in July, even though Death Valley is below sea level.

Concerning the "empirical accident data" as described on pages 3 through 6 of the Executive Summary, we refer to an objective, statistically sound analysis of accident data prepared by the FAA's Office of Accident Investigation (AAI) and which was part of the safety analysis upon which the body of this report has been based.

The AAI analysis indicates that there is no practical way to compare directly the rates contained in the study. The study apparently is based on accidents occurring within a 50-mile radius of the airports studied and apparently is based on all accidents, whether or not the flights involved the specified airports. On the other hand, the analysis of the issue completed by AAI was based on accidents within a 25 mile radius of the airports and involving flights which clearly were either departing or destined for the particular airports. Consequently, this empirical data has a higher degree of specificity and reliability.

The study is subjectively directed toward a hypothetical night rate for Aspen, which is based on a "what if" hypothesis converting Aspen's daytime rate to a night rate by the factor of night vs. day experience at other mountain airports. The AAI analysis made no such calculation, and, indeed, such a conclusion is difficult, if not impossible, to reach based on the FAA data.

The AAI analysis was objectively directed toward answering this question: How does Aspen compare in accident experience relative to 10 mountain airports considered to have reasonably similar hazards? The study includes ***all*** 30 "towered" mountain airports as described in AC 121.445-1D, many of which could not be considered anywhere close to presenting the hazards of the high mountain airports. The study includes such airports as Roanoke, VA, Wilkes-Barre, PA, Huntington, WV, airports which certainly have unique hazards but not of the same type of the high mountain airports.

If Aspen's accident experience is measured using the 5 accidents the AAI analysis included for the years 1983-1990 (against the total (not annual) 304,497 operations (33,833 average annual operations X 9 years) for that period, the AAI analysis calculates an overall rate of about 1.64 accidents per 100,000 hours. The study arrives at an accident rate of 2.53/100,000 hrs for the same number of accidents. The difference is that the study's rate includes operations for the 6 years (1983-1988) while the AAI analysis used operations through 1990; the AAI analysis rate is lower because ***no accidents meeting the AAI criteria occurred in 1989 and 1990.*** The fact that the study conveniently does not consider 1989 and 1990 in its statistical analysis--2 whole years in which there were no accidents involving flight operations to or from Aspen--is indicative of the subjective nature of the study. It is also suggestive of the fact that the rise and fall of the accident rate within the area around Aspen, or any other area, is somewhat reliant on serendipity.

The study, in its *Summary of Findings* (page 3-2), states that the mountain airport accident rate "...is significantly higher than at non-mountain airports. The observed rates are respectively 1.34 and 0.79 accidents per 100,000 operations." It is presumed these are overall rates, day and night. The study states in the next finding, "The night accident rate at mountain airports is 2.05 and is significantly higher (68 percent higher) than the day accident rate of 1.22 at these airports", and finally, "The estimated night accident rate at Aspen if operating hour restrictions are eliminated would be approximately 4.25." Using the same subjective formulae the AAI analysis used to calculate a day rate of 1.64, the rate for night operations at Aspen would be 2.76, only slightly higher than the ***average*** of 2.05 average accident rate for night mountain airport operations.

In conclusion, of the 30 mountain airports considered by the study, at least four (BGM, FLG, JNU, and TVL) show significantly worse accident experience per 100,000 operations than Aspen. Although the universe of airports is different in the AAI analysis, the Aspen accident experience is shown to be considerably less severe than some other mountain airports in both the AAI analysis and the study.

Many of the "facts" stated in the last three pages of the Executive Summary of the study are either completely false, statistically biased, or emotionally charged and misleading. For example, "Airplane crashes are an important public health problem. They are the eighth leading cause of unintentional injury in the United States." Statistically, a person is more likely to be struck by lightning than to be in an airplane accident. To state that airplane crashes are the eighth leading cause of unintentional injury without qualifying that with the first through the seventh causes is unscientific and untrustworthy. If an uninformed reader were given an opportunity to evaluate the complete ranking of causes of unintentional injury there may be a few other more common activities that require serious consideration. For example, what is the rate of unintentional injury within a 50-mile radius of Aspen caused by downhill skiing? If the accident statistics were taken out of context, as the aviation accident statistics have been, the downhill skiing accident rate would appear precipitous as well.

The study further states that "...80% of the deaths from this cause nationally occurred in the general aviation category, and 12% involved unscheduled air taxis. Scheduled carriers accounted for only 8%." The Administrator's Fact book for January 1992 indicates that there are 5,660 aircraft actively employed in air carrier operations (domestic, flag, supplemental, scheduled cargo and commercial operators, commuter and on-demand air taxis) and 210,000 active general aviation aircraft. This produces a total of 215,660 aircraft. Simple, objective mathematics inform us that all air carrier aircraft only comprise 2.6% of the total fleet, yet the study indicates, based on its statistical manipulation, that they account for 20% of the deaths nationally. The numbers simply do not "add up."

A clear example of the overall nature of the study is the use of a "frontispiece" displayed at the beginning of each of the seven parts. They are irrelevant, emotionally charged, misleading, and, in many instances, actually detrimental to the Board of County Commissioners' position concerning general aviation.

Frontisplece Rebuttal

The frontispiece in part 1 of the study alleges "23 Die In Air Accidents In Area In 15 Months". However, a review of the accidents described shows some were committed by air carriers, albeit non-scheduled air carriers. No probable cause of the subject accidents was mentioned, thereby eliminating any possibility of taking *appropriate* action to prevent future accidents, the ultimate goal of accident investigations. In AAI's more objective accident analysis, probable causes of the subject accidents show that the majority had nothing to do with Aspen's terrain or location. To wit, they were operational or mechanical errors that could occur at any airport or during any phase of flight regardless of geographical location. Again, citing such unrelated accidents without citing probable cause--which is a matter of public record--indicates either a serious flaw in research technique or a deliberate attempt to exclude pertinent data.

For example, the frontispiece in part 2 cites a November 1991 accident at Sardy Field wherein the aircraft was 93 pounds over maximum gross weight. Such a pilot error has nothing to do with the airports geographic location and the alleged unsuitability of this location for general aviation night VFR operations.

The part 3 frontispiece states that the Federal Aviation Administration's (FAA) "Go Team" will "check out a recent rash of fatal crashes". The results of the "check out" are not mentioned, nor is it mentioned that the "Go Team" routinely investigates fatal crashes; i.e., its "checking out fatal air crashes" is part of its functional statement. As previously mentioned, the analysis of accidents at and around airports in mountainous areas completed by AAI ("Go Team") shows that the data associated with Sardy Field does not reveal that is significantly different from other airports situated in mountainous areas. Additionally, the AAI analysis has determined that accidents at Sardy Field and 9 other mountainous area airports are typical of operational errors and mechanical malfunctions that occur at any airport regardless of terrain. Again, the AAI analysis shows no accident within 25 nautical miles of Aspen for all of 1989 and 1990.

The part four frontispiece describes a fatal *daylight* accident involving a "chartered Lear Jet" operated by a certificated air carrier (air taxi) operator, not a general aviation operator conducting night VFR operations. There is no relevancy, and the inescapable conclusion is that, in citing such irrelevancies, the study's only purpose is to be inflammatory.

The part five frontispiece describes a daytime accident involving a Cessna 210 that made a forced-landing in a meadow near an area used to dump sludge from a local sewage treatment plant. The accident occurred in a sparsely populated area 5 miles west of Aspen. The conclusion drawn illogically by the article is that if the accident had happened at night the pilot might not have been able to avoid hitting homes. Such a conclusion does not follow since, depending upon altitude and reason for the forced landing, the pilot may not have been able to avoid homes during the day.

The part six frontispiece describes the difficulties encountered by an accident rescue team caused by bad weather. Again, this in no way relates to general aviation nighttime flight operations at Pitkin County Airport. Bad weather, as well as many other factors, can hamper any accident investigation and is not dependent upon the physical terrain.

Finally, the seventh frontispiece states that the emergency services in Aspen are unable to handle an accident involving a 85-seat BAE-164 aircraft. These aircraft are almost exclusively operated by major, scheduled air carriers, not general aviation operators, the overwhelming majority of which operate aircraft with 8 or fewer seats. Clearly, the study's authors have not discovered the regulatory differences between air carrier and general aviation operations. This "lumping" of two diverse types of flight operations detracts from the study's credibility and inexcusably provides inaccurate information to the public.

In our opinion, the illogical and irrelevant use of these articles as frontispieces is consistent with the contents of the entire study and the subjective, biased information that the author irrationally draws upon to support the position of the Board of County Commissioners of Pitkin County, Colorado.

Conclusion

With the exception of restricted areas, so designated to protect aircraft from unseen in-flight hazards in accordance with Part 73 of the Federal Aviation Regulations (FAR), it is our position that a competent airman who exercises good judgement, who operates an airworthy aircraft, who meets all applicable certification and recency of experience requirements pertinent to Part 61 of the FAR, and who complies with all pertinent operating requirements of Part 91 of the FAR, can operate aircraft safely anywhere in the National Airspace System, and that includes general aviation VFR night operations at Aspen, Colorado.

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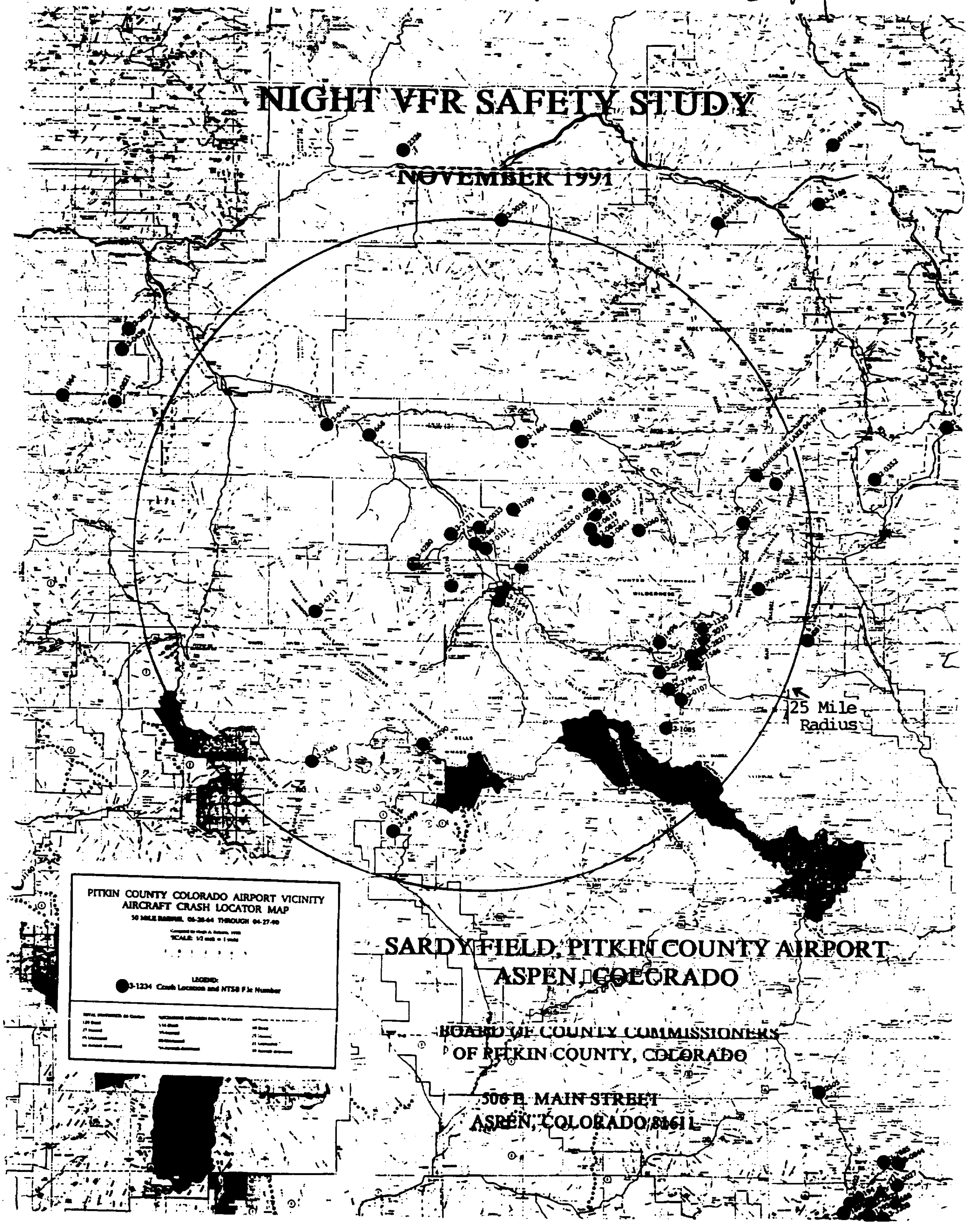
NIGHT VFR SAFETY STUDY

NOVEMBER 1991



SARDY FIELD, PITKIN COUNTY AIRPORT
ASPEN, COLORADO

BOARD OF COUNTY COMMISSIONERS
OF PITKIN COUNTY, COLORADO

506 E. MAIN STREET
ASPEN, COLORADO 81611

NIGHT VFR SAFETY STUDY
SARDY FIELD, PITKIN COUNTY AIRPORT
ASPEN, COLORADO
NOVEMBER 1991

BOARD OF COUNTY COMMISSIONERS
OF PITKIN COUNTY, COLORADO
506 E. MAIN STREET
ASPEN, COLORADO 81611

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PART 1.00
EXECUTIVE SUMMARY

ASPEN NEWS, Thursday

FROM PAGE 1

23 Die In Air Accidents In Area In 15 Months

ACCIDENTS from page 1

instructor to learn the intricacies of alpine air currents, wind patterns and air densities.

Christopher noted "airplanes like thick air. They fly better in it," which leads to more problems in the summer than winter. Warm air is less dense than cool air, so planes have less lift in the warm weather and "need more runway."

The air accidents in the region don't reflex on Sardy Field, he said. "I can't see any of the previous accidents having to do with the airport itself."

Recent air accidents include:

■ A Snowmass pilot and his brother were killed Nov. 24, 1989 when their homemade airplane disintegrated on impact near the Pitkin County Airport. Initial reports from the National Transportation and Safety Board say the plane ran out of fuel.

■ A Piper Cherokee crashed in a raging snowstorm northeast of Hagerman Pass on April 28, 1990. Six people headed to a singing competition in Salt Lake City were killed. Severe weather and a dangerous crash site hampered rescue efforts for several days.

■ Two charter pilots were killed Oct. 25, 1990 when their single-engine turbo-prop plane crashed near Carbondale.

■ A Cessna 210 dropped out of a calm, blue sky Nov. 12, 1990 and

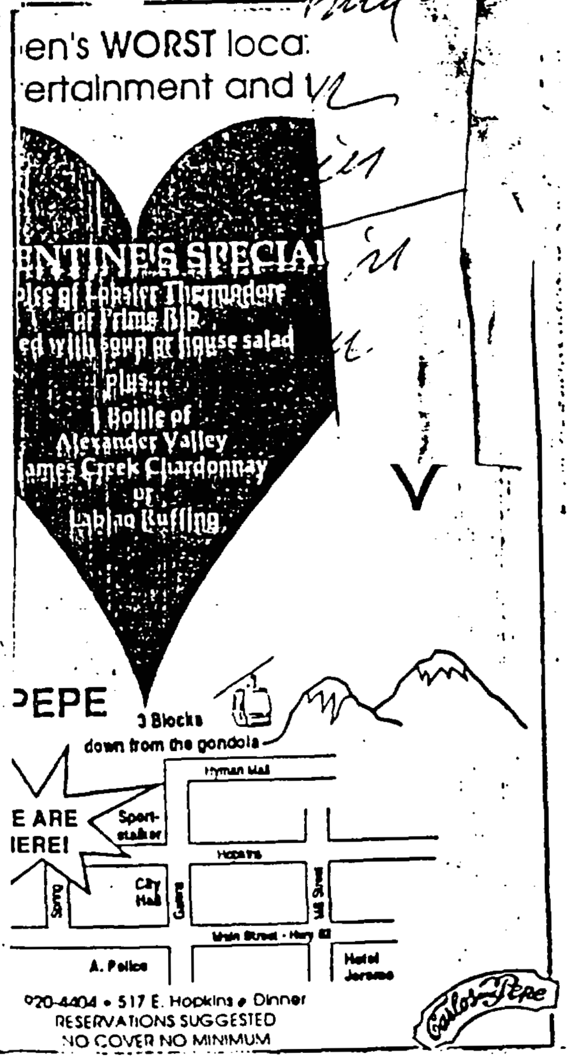
> "It's commonly known and accepted that mountain flying carries with it a few more risks than flatland flying."
>
> Brad Christopher
> Airport Manager

slammed into a mountainside within sight of the Aspen airport. All four people aboard were killed.

■ A Piper Comanche plane crashed in the East Snowmass Creek area late Feb. 7 during a short sight-seeing flight from Aspen airport. Two USAir pilots survived the crash, but died before rescuers could locate the wreckage. No flight plan was filed and the plane's emergency locator transmitter malfunctioned, delaying discovery of the plane.

■ Four people aboard a Cessna that left the Eagle County Airport were found dead Feb. 12 after the plane went down in the Flat Tops Wilderness Area.

■ A Lear Jet crashed yesterday ½ mile from the Aspen airport, killing three people aboard. Cause of the crash is unknown.



1.00 EXECUTIVE SUMMARY

The historical record and the empirical study data suggest that Pitkin County's night operational extension for IFR operations by scheduled air carriers is not "unjustly" discriminatory to night VFR operational requests of general aviation. This is so because:

- The conditions implicit in FAA Certification (of carriers that are competent to conduct night operations at Aspen airport) have the effect of reducing the night time airport related responsibilities of the County by closing the airport to classes of operations which do not necessarily have the required (or readily determinable) capabilities to operate in an extremely hazardous Aspen Airport night environment.

- At the same time, FAA certification provides an FAA-based determination which justifies limited night access to an FAA-identified class of air carriers that have achieved an exemplary safety record in the same uniquely hazardous environment. By comparison, national and local statistical evidence discloses that general aviation is itself a hazardous form of travel.

- The standards imposed upon these scheduled carriers at the Aspen Airport cannot currently be imposed upon, or certified by FAA, with respect to, general aviation night VFR users at the Aspen airport.

The current night extension regulation therefore appears to be rationally based upon valid FAA-recognized safety considerations as well as empirical accident data. As such, the regulation appears to support the County's interest in the safe and efficient operation of its airport. This County interest was recognized by express FAA Grant Assurance language, and other FAA policies. Current Pitkin County night extension policies have existed since the 1970's. They were well known to the FAA before numerous Grant Assurances were signed. These practices were supported by FAA because of the very real safety concerns which are discussed in detail throughout this Night VFR Safety Study Report.[1]

[1] See Historical Overview, Part 2.00, commencing at page 2-1 of this Night VFR Safety Study report.

at Aspen. High levels of crew proficiency and local knowledge and experience also required by AC 121.445-1D, and by the FAA-approved operating certificates heduled air carriers who are the sole night users.

nposed special airport standards (which are implicitly incorporated into County on regulations) are consistent with extreme night operational risks. There quite ar set of standards or provisions which may be made applicable to, or enforceable l aviation night VFR users as a class. As a result, there can be no assurance night time VFR users are "similarly situated", in the safety sense, to the approved rriers who are subject to the special procedures of AC 121.445-1D and the current tension regulations.

al data analysis was conducted by Gellman Research Associates, Inc. for the purpose FR Safety Study. Gellman Research analyzed NTSB and other accident data tributed only to "airport operations" nationally, i.e.: accidents attributed to take off a specific airport. The results of this analysis were compared with the "airport" rience for 30 FAA-designated "Special" towered airports which were so designated untain airport" characteristics similar to those present at the Aspen airport. The arch analysis supports the following conclusions:[5]

The accident rate at mountain airports is significantly higher than that at non-mountain airports. The observed rates are respectively 1.34 and 0.79 accidents per 100.000 operations. (Note that all accident rates mentioned in this analysis are

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ings summarized in this section 3, a. through f. are found in *Rate Analysis,* Gellman Research Associates, Inc., *September 27,* ch is Part 3.00, commencing at page 3-1 of this Night VFR Safety t.

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a. 80% of the deaths from this cause nationally occurred in the general aviation category, and 12% involved unscheduled air taxis. Scheduled carriers accounted for only 8%.

b. Since 1983 the annual death rate for pilots in airplane crashes rivals the death rates of 18 year old males killed in motorcycle accidents.

8. The cost of airplane crashes in mountainous states is staggering, whether measured in human losses or dollars.[11]

a. Using very conservative values of $500,000 per life, the aggregate cost of lives lost in the small study area (50 mile radius of Aspen Airport) would be $100 million.

b. Non fatal injuries, airplane loss or damage and the costs of search and rescue operations add additional millions to societal cost.

c. Baker and Lamb estimated that airplane crashes for the small study area wasted more than $4 million annually in an area that comprises only one-tenth of Colorado.

9. General aviation is a hazardous form of travel. The death rate per million person-miles for people in private planes is more than 6 times as high as for people traveling by private car. The likelihood of a fatal crash per 100,000 departures is 11 times as high for general aviation as for

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[11] The source for findings summarized in this section 8, and its subparts is Baker, SP and Lamb, MW, *Hazards of Mountain Flying: Crashes in the Colorado Rockies, Aviation, Space & Environmental Medicine, Vol 60, Number 6 (June 1989)*. This is included as Part 5.00, commencing at page 5-1 of this report.

scheduled commuters and 43 times the rate for airlines. Of all deaths in civilian aviation, 81% occurred in general aviation. This provides further compelling substantiation for the reasonableness of granting night operating extensions only to air carrier's whose IFR operations have achieved exemplary safety records, but not to general aviation night VFR operations.[12]

[12] The source for findings summarized in this section 9 is Sunshine Aviation Safety Studies (Lamb and Baker), *"Aspen Airport and the Risks of Mountain Flying", October, 1991, p. 2.* This is included as Part 4.00, commencing at page 4-1 of this report.

PART 2.00
HISTORICAL OVERVIEW

ASPEN DAILY NEWS, Monday, November 25, 1991, Page 3

LOCAL

Plane In Fatal Sardy Field Crash Overloaded, NTSB Report Says

Daily News Staff Report

When a Cessna 210 took off on a fatal flight from Sardy Field on Nov. 12, 1991, the plane was loaded 93 pounds over its certified maximum weight, federal investigators report.

Moments later, the aircraft slammed into a hillside just west of the runway, killing all four aboard. An air traffic controller reported the propeller appeared to be faltering, but a subsequent investigation revealed no evident engine failure.

A recently released National Transportation Safety Board report on the crash makes no attempt to name a cause for the accident, which happened in clear weather.

The tragic Nov. 12 flight totaled the plane and killed pilot Lawrence Barrett, 43; Karolyn Barrett, 45, Russell Lind, 52; and Jimoh Ade Unka Yussuf, 34. All the victims hailed from Southern California.

Aspen Daily News file photo

Investigators considered the role of weight and of a fuel valve in this 1990 crash, which killed four Californians.

THE NTSB report quotes Aspen air traffic controller Lee Beavers as saying he saw the plane take a "tight, slipping left bank" just west of the runway moments after it lifted off. "The sun reflected off the airplane's propeller and it appeared to (Beavers) that it was 'flickering' and 'not turning very fast.' " the report says.

Beavers believed the pilot was trying to turn back to the airport, according to the report. The pilot had told Beavers by radio prior to takeoff on Runway 33 he intended to make a sweeping turn over Snowmass and depart to the southwest.

However, NTSB investigators report they found "no evidence of preimpact airframe, propeller or flight control malfunction/failure." The plane gas tank had been filled up moments before takeoff, according to the report. With a full load of fuel, four passengers and substantial baggage, the plane was 93 pounds over its maximum certified takeoff weight of 3,800 pounds, according to the NTSB.

"The sun reflected off the airplane's propeller and it appeared to (Beavers) that it was 'flickering' and 'not turning very fast.' "

NTSB Report

INVESTIGATORS gave some attention to analyzing the fuel selector valve in the Cessna 210, which allows the pilot to select fuel flow from the left tank, right tank or both, or turn the fuel off. The valve was in the "Left" position on the indicator, although it was nearly closed when it was taken to the Cessna manufacturing plant and disassembled. On-site inspection did find fuel in the fuel line leading to the engine, however.

An autopsy performed on Lawrence Barrett found he died "instantaneously of head and chest injuries." No drugs or alcohol were found in his system.

2.00 HISTORICAL OVERVIEW

"Our primary concern [about possible Pitkin County ownership of runway lights] from a safety standpoint is to see that no lighting system or night operation approval will open the door to night VFR[1] operations by either the flying public or passenger carrying operators, since in our opinion the scarcity of lighting in the surrounding mountains and valleys would make such operations hazardous." *FAA internal Flight Standards memorandum, September 22, 1978*, by Richard L. Devereaux, Director.

This FAA internal Flight Standards memorandum is only a part of the large, and growing, body of evidence in the public record, or in the public domain, of the Aspen Airport's unique hazards generally, including the significant night operational concern that scarcity of lighting in the surrounding mountains and valleys would make night VFR operations hazardous. These and other well-documented safety concerns are the reasons why Pitkin County and FAA have never heretofore permitted such "night VFR operations by either the flying public of passenger carrying operators".[2]

This historical overview reviews the materials in this record which document (1) the unique combination and gravity of the risks of night VFR operations at the Aspen Airport, (2) the FAA's past knowledge and support of County closure of its airport to night VFR operations, and (3) the other authoritative sources which suggest that recent FAA demands to open the Aspen Airport to night VFR operations are inappropriate.

[1] VFR means Visual Flight Rules promulgated by the FAA. In general these rules require pilots to comply with minimum visibility distances and ceilings, and also to "see and avoid" terrain, obstructions, weather and other aircraft by visual reference.

[2] This class of presently prohibited operations is hereafter referred to as "night VFR general aviation" operations.

(1) The Record of the Combination and Gravity of the Risks

In 1974 and 1975 the FAA requested cooperation of Pitkin County for installation of a 100% FAA funded lead-in light system in the valley adjacent to the airport. Board of County Commissioners (BOCC) minutes reflect local public concern about the use of these lights by general aviation for flights in marginal weather and at night. The FAA representative, Mr. Hoover, was asked the question: "If at some time in the future the tower were open until 10 p.m., would the lead-in lights then encourage more night flights?" Mr. Hoover stated that "It won't ever be a night airport here." He also stated that there "isn't a prayer" of "lighting this whole valley," which would be required if the tower was open until 10 p.m. He also stated that he didn't see any real possibility of the tower being open to 10 p.m. His comments included the statement that "they had the worst safety record in here of any place in the mountains."[3]

Night VFR operations by general aviation have never been permitted by either the County or the FAA at the Pitkin County Airport (Sardy Field), Aspen, Colorado since it opened in 1946.

However, Pitkin County's Regulations have historically permitted a night IFR[4] operational "extension" (to 11:00 p.m. currently) for a limited class of FAA certificated users.[5] This class is defined by Pitkin County regulations as "FAA Part 121 and 135 Certificated Scheduled Air

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[3] 1/6/75 Pitkin County Board of County Commissioners (BOCC) Minutes - FAA lead-in light proposal.

[4] IFR means Instrument Flight Rules promulgated by the FAA. Generally, these rules specify navigational instrumentation and procedures approved by the FAA to assure safe navigation, including avoidance of terrain, other obstructions and other aircraft through the use of such instrumentation and procedures, which do not necessarily require visual observation and avoidance of such hazards.

[5] Pitkin County Ordinance 89-3, October 24, 1989. This Ordinance was amended in other particulars by Ordinance 90-12, November 27, 1990. A predecessor of current regulations was an initiated question approved by the electorate November 7, 1978. At that time, Rocky Mountain Airways and Aspen Airways (now Continental Airlines and United Express) had been approved for night operations by FAA pursuant to operational plans substantially like those now in effect.

Carriers" that have access to "an on-site instrument landing system", and which use FAA Part 36 Stage III (quiet) aircraft.[6] This is a readily determinable class. It is composed of FAA certificated users who are subject to FAA imposed operating standards, including those which are specific to each user's operation at Aspen. County use of existing FAA-defined air carrier classifications also imposes important additional local crew operational experience requirements because of Aspen's designation by FAA as a "Special" airport.[7]

This is so because FAA's Federal Air Regulation (FAR) 121.445 requires special air crew qualifications for Part 121 air carriers operating at Special Airports. Aspen Airport has been so designated for some time. The most current FAA designation appears in Advisory Circular (AC) 121.445-1D. Aspen Airport is listed as such a Special Airport, expressly because of "high terrain, special procedures" which apply to it. The comments of FAA's Director of Flight Standards, D.C. Beaudette, state that the purpose of the Advisory Circular is to:

> "...provide information...concerning those areas/routes and airports where the Administrator has determined that special qualifications are required of pilots in command as provided in FAR Section 121.445.
>
> "These qualifications are also to be met within the preceding 12 calendar months for those airports determined to be unique due to surrounding terrain, obstructions, or complex approach and departure procedures. Pilot in command qualification requirements for special airports are applicable to all airports listed in Appendix 1.

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[6] Pitkin County Ordinance 89-3, October 24, 1989. This ordinance also conditioned nighttime operations extension use to operations by aircraft that "comply with or are exempt from FAR Part 36 'Stage III' Noise Regulations", and other conditions which are not within the scope of this particular study. However, it is noted parenthetically that a 1991 noise study indicates that daytime operations are contributing to higher than desirable cumulative average (Ldn) and single event (SEL) noise levels in residential areas (60 Ldn and >100 Dba respectively) and that night operations by general aviation will dramatically increase night noise levels. See *October 2, 1991 letter from Bernard Dunkelberg & Company to Pitkin County Special Counsel Dwight K. Shellman, Jr.* summarizing a recent Mestre Greve Associates, Analysis of Existing Noise Environment, Pitkin County Airport (September 1991).

[7] *FAA Advisory Circular 122.445-1D, "Pilot in Command Qualifications for Special Area/Routes and Airports, Federal Aviation Regulations (FAR) Section 121.445, DC Beaudette, Director, Flight Standards Service, 6/20/90.* This document's significance is discussed at length throughout this report.

"...(A)ppendix 1 contains a listing of airports, by regions, where it has been determined that pilots require special airport qualifications. ...(Airports...such as John F. Kennedy...and O'Hare...which do not have te⁻⁻ain problems, are not included.)"

Extended (nighttime) operations at the Aspen Airport which result from FAA certification are in fact "full IFR procedures for both ingress and egress...(including) vertical navigation from the final approach fix to the runway threshold."[8] Steep descent, climb and maneuverability demands imposed by Aspen's terrain, and FAA's IFR and other certification requirements have the effect of requiring use of high performance aircraft far more suited to this operating environment than a large number of general aviation aircraft.[9]

VFR operations (day or night) by general aviation or others, by definition, presuppose the pilot's ability to "see and avoid" all terrain and other hazards, so as to enable the pilot and the aircraft to either outclimb or outmaneuver the terrain. As will be seen, even in daytime VFR situations, the capabilities of many general aviation aircraft and their pilots are known to be seriously taxed by the unique combination of hazards recognized to exist around the Aspen Airport.

The following description from an FAA publication is an accurate summary of Aspen's daytime VFR hazards:

> "The FAA operates a Tower and Radar Approach Control at Aspen from 0700 until 2200 local time. The radar is a beacon-only system. It does not display aircraft without operating transponders. It does not display terrain or weather.

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[8] Wachs, EH, *VFR Bedtime in Aspen*, Aviation Safety Monitor, December 1989. This is part of Wachs, 12/22/89 letter to FAA Administrator Adm. James Busey. These were included as attachment 15 to BOCC 8/7/90 Hearing Record.

[9] The substantially limited performance capabilities of general aviation aircraft involved in analyzed accidents in the Aspen region is one of the findings of a recent independent study:

> "Airplanes with three or four occupants and low powered four-seat aircraft were over-represented among crashes involving failure to outclimb rising terrain." *Baker, SP and Lamb, MW, Hazards of Mountain Flying: Crashes in the Colorado Rockies, Aviation, Space & Environmental Medicine, Vol 60, Number 8, Synopsis, page 531. (June 1990).* The full text of this paper is included as Part 5.00, commencing at page 5-1 of this Night VFR Safety Study Report.

* * *

"Use of landing lights is highly recommended at all altitudes when inbound to Aspen as sighting traffic when the aircraft is below terrain is extremely difficult.

* * *

"The Aspen Airport is normally configured as an opposite direction airport. Pilots should be particularly alert for opposite direction aircraft when flying on or near the runway centerline.

* * *

"Airport operating hours for general aviation are from 0700 to 30 minutes past official sunset, local time.

* * *

"Runway 15 has a Visual Approach Slope Indicator (VASI) but it is not usable beyond 4 miles due to high terrain.

* * *

"Use caution due to high terrain in all quadrants. To the west the terrain rises 780 feet within 1/2 mile of the runway, and other terrain within 8 miles of the airport rises more than 3.500 feet. To the east and southeast, the terrain exceeds 1.000 feet within 1-1/2 miles of the runway and 3.500 feet within 5 miles. Updrafts, downdrafts, and wind shear may be present when the Aspen Airport winds exceed 10 knots." ***High Mountain Flying In Ski Country U.S.A.*** FAA, Northwest Mtn Reg, Denver Air Route Traffic Control Center, 1991 pp. 14-15.

More vivid, unpublished, internal FAA descriptions of the Aspen Airport's day VFR hazards include the following:

"Sardy Field is situated in the southern end of a narrow doglegged (Roaring Fork) valley at an elevation of 7,793' MSL. This valley is bounded on the east, south and west by high mountain ranges extending up to 14,000' MSL and the valley narrows to the southeast toward Sardy Field. Terrain rises sharply south, west and east of Sardy Field and prevents arrival/departure procedures in these areas. Consequently, nearly all arrival and departure procedures are conducted within the narrow confines of the Roaring Fork Valley north of Sardy Field, resulting in a head-on "one in" or "one out" traffic situation.

* * *

"It seems reasonable that if...higher than basic VFR weather minimums are necessary to assure flight safety for air carrier operations at Sardy Field, then similar or more restrictive measures should be applied for the normally less proficient general aviation pilot who often operates less sophisticated aircraft to this airport.

* * *

"This...(is) an area notorious for its rapidly changing weather conditions. * * * Although pilots [of general aviation aircraft] can normally be expected to exercise their Part 91 weather responsibilities, these regulations are not appropriate for the unique conditions of Aspen. The Roaring Fork Valley comes to an abrupt end at Sardy Field. If a pilot is unable to execute a successful landing, his ability to safely exit from the canyon depends upon the cloud ceiling, the flight visibility, and the turning radius required for the aircraft. More specifically, during periods of lowered ceilings the mountain walls on each side of the valley become obscured and any lowering of the ceiling tends to narrow the visible area between the valley walls. Since the slope of the adjacent terrain controls available turning radius for each ceiling condition, the pilot must make a 180 degree turn prior to the time he reaches a point where the canyon becomes too narrow for such a maneuver. Pilots who are inexperienced or unfamiliar with the Aspen area can thus become trapped in an area where a landing must be made to avoid terrain which rises faster than the climb rate of the aircraft, even though they are complying with flight visibility requirements.

"Although reported Sardy Field weather may be above basic VFR minimums at the time a pilot commences his transition from the Carbondale area, pilots often become trapped in rapidly deteriorating weather prior to their arrival at the airport. * * * Sardy Field is also subject to rapidly changing weather conditions, and pilots tend to gamble on the weather ... These situations compromise safety, disrupt air traffic, and often require emergency-type handling...to adjust or delay IFR air carrier traffic to accommodate the general aviation aircraft."[10]

These local VFR hazards obviously increase when the VFR pilot's ability to see and avoid the mountains is further reduced by darkness:

> "Pitkin County Airport, Aspen, Colorado is, like many mountain airports, surrounded by unidentified and unlit obstacles. These obstructions are an extreme hazard to aircraft in non-visual conditions. As an active pilot, I have flown out of Aspen Airport for approximately 20 years.
>
> "On two or three occasions in the recent past I have made an approach into Aspen after dark, operating air rescue missions with clearance to land after dark. I can assure you that--even knowing every conceivable approach to the airport--there is absolutely no way (other than the centerline of the runway) to identify obstructions on a dark night. * * *
>
> "The Aircraft Owners and Pilots Association (AOPA) is lobbying for and is prepared to take legal action to force Pitkin County Airport to remain open after dark for use by general aviation. These general aviation aircraft will in most cases have no IFR capabilities or compliance requirements. Such aircraft will be required to perform a circling descent into the Aspen Airport. This is insane." Edward H. Wachs, *"VFR Bedtime in Aspen". The Aviation Safety Monitor, December 1989, attached to Wachs' December 22, 1989 letter to Adm. James Busey, FAA Administrator.*[11]

These observations were mirrored by findings of participants in the current study, who concluded:

> "Except in full moonlight, at night the pilot has no outside image of the terrain. It is eerie and ofttimes frightening to navigate in the blackness among mountains, too low to be in range of VORs, trying to use pilotage and memory and imagination to avoid giant rocky peaks and ridges in the flight path. * * * In Colorado's turbulent skies, it can be a nightmare to fly across mountain ranges in pitch black darkness, fighting downdrafts, scrambling to maintain altitude at the best angle of climb airspeed and full power, with no place to go if the engine fails.

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[10] FAA internal Memo 2/21/75, from Chief, Air Traffic Division ARM-500 to Chief, Airspace and AT Rules Division, AAT-200 re *"Proposed establishment of special AT Rules-FAR Part 93 for Sardy Field, Aspen Colorado."*

[11] Item 15, BOCC 8/7/90 Hearing Record.

"The proposal to open Aspen to night VFR would permit access by single engine aircraft. which our study indicated have special problems in the mountains. Trying to land. VFR. at night at Aspen would involve hurtling down into a black hole punctuated by the small blaze of lights of the town and faint beams of headlights moving along nearby roads. Avoiding vertigo and controlling necessary high rates of descent take experience and mental discipline. Many of Aspen's visitors have never needed the qualities necessary for night mountain flying. A night pleasure flight to Aspen is not an appropriate learning opportunity.[12]

* * *

"Night departures pose additional problems. Even the easiest climb profile northwest along the darkness of the Roaring Fork Valley requires avoiding unseen hills. Other than turboprops and jets. few general aviation aircraft sport the climb rate necessary to clear. without circling, the massive peaks embracing Aspen to the northeast. east and south.

* * *

"Night flying in this environment is. for all practical purposes. instrument flying: and the non-instrument-rated aviator. legally traversing mountains VFR in the dark. will find his or her skills harshly tested."[13]

The inside title page of this Night VFR Safety Study Report graphically shows the rising terrain which intrudes into the airspace within a three mile radius around the Aspen Airport.[14]

Extended night IFR operations. under FAA-approved operational plans. by scheduled air carriers have resulted in no accidents, no serious injuries and no deaths. This is persuasive empirical evidence that the high performance aircraft, special IFR procedures, airline operated navigation

[12] *Lamb, W.W. and Baker S.P., Aspen Airport and the Risks of Mountain Flying,* October, 1991, Sunshine Aviation Safety Studies, p. 4-3.

[13] *Lamb, W.W. and Baker S.P., Aspen Airport and the Risks of Mountain Flying,* October, 1991, Sunshine Aviation Safety Studies, p. 4-4.

[14] The source of the inside front title page graphic is "Table Mountain VOR Approach", Item 27, discussed at page 37, BOCC 8/7/90 curfew hearing record.

aids at Aspen, and crew recurrency requirements--imposed by this FAA certification process and the Special Airport standards of FAR 121.445-1D--actually do create effective safety standards. However, these standards are not now imposed by FAA upon, and cannot be met by, general aviation VFR night users as a class.

In contrast, the empirical history of accidents, injuries and deaths attributable to general aviation VFR day operations at Aspen - and day and night operations in the 50 mile high mountainous "region" surrounding Aspen - have been sufficiently dramatic to prompt independent, third party analysis.

In 1986 attorney Margaret W. Lamb, J.D., an ex-air taxi pilot and mountain flying instructor,[15] had discovered evidence of mountain drainage windshear in three Aspen-related crashes and wrote a first article about the phenomenon, which was published in FLYING.[16]

In 1989 epidemiologist Susan P. Baker was a professor of Health Policy and Management and Head of the Division of Public Health, and the Director of the Injury Prevention Center of Johns Hopkins University School of Public Health. Professor Baker is also a private pilot.[17]

Prompted by their joint concern about the apparently large numbers of aircraft accidents in the Aspen region of Colorado, Professor Baker and Ms. Lamb initiated a study of NTSB aircraft crash data within 50 miles of Aspen.

Baker and Lamb's 1989 work constitutes the seminal research concerning the Aspen region's

[15] Margaret Lamb is an attorney who specializes in aviation law. In addition to being an ex-air taxi pilot and mountain flying instructor, she is a frequent writer and lecturer on aviation safety.

[16] *Rocky Mountain High Flying*, FLYING, May 1986, 998. Copy included as Appendix Item 4.

[17] Professor Baker's lengthy list of professional credentials, publication and expertise in this and related areas of research for Prof. Baker appears at Appendix Item 5.

uniquely dangerous flying environment. They reported:

> "Between 1964 and 1987, 232 airplanes crashed within 50 nautical miles of Aspen. CO; 90% were general aviation crashes. A total of 202 people died and 69 were seriously injured. The societal cost averaged more than $4 million annually. Most pilots were experienced and many were flight instructors, but 44% had flown less than 100 hours in the type of plane in which they crashed. Forty-one percent of the pilots were out-of-state residents. Crashes in the study area were more likely to be fatal than in the rest of Colorado. Airplanes with three or four occupants and low powered four-seat aircraft were over-represented among crashes involving failure to outclimb rising terrain." Baker, SP and Lamb, MW, ***"Hazards of Mountain Flying: Crashes in the Colorado Rockies". Aviation, Space & Environmental Medicine, Vol 60, Number 8, page 531*** (June 1989). The quotation is from the article synopsis, p. 531. The full text of this article is included as a Part 5.00 of this report, commencing at page 5-1.[18]

Baker and Lamb's data reflect that of 230 crashes studied, 88 (or 38%) were specifically identified as Aspen Airport related, i.e.: arriving or departing. Of the 88 crashes, 27 were fatal and 87 lives were lost.[19]

The outside front cover of this Night VFR Safety Study Report contains a graphic representation of more than half of the crash groupings in the approximately 10,000 square miles of mountainous terrain within the 100 mile by 100 mile Aspen region which was studied by Accident Investigator Roberts in 1990. The source of this graphic was Roberts' 1990 analysis of NTSB closed and pending accident files.[20] This graphic also shows the heavy concentrations of aircraft accidents

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[18] Further reports by the authors concerning this study can be found in AOPA Pilot, July 1989 p 100, and *"Colorado Mountain Flying: Crashes and Weather"*, a private paper published by American Institute of Aeronautics and Astronautics, Inc. (1989), all of which are included in full text as a Part 6.00, commencing at page 6-1 of this report.

[19] Sunshine Aviation Safety Studies (Lamb and Baker), *"Aspen airport and the risks of Mountain Flying", October, 1991, p. 4-2.*

[20] Roberts, Hugh. His compilations and mapping of NTSB closed and in process NTSB accident records were included in the BOCC 8/7/90 hearing record, as Item 9 (Map, Aircraft Crash Locator, which include portion used for cover of this report), and Item 10 (Map Legend and tabulation).

in the canyons and ridges within the 25 mile radius circle drawn around the Aspen Airport.[21] The 39 crashes within that smaller 25 mile radius reviewed by Roberts were substantially all general aviation, VFR operations. This subgroup produced 89 dead, 29 injured and 39 aircraft destroyed.[22]

This Night VFR Safety Study Report contains or summarizes all of the other published materials which are known to be in the public domain or in the public record as to the character and seriousness of the night VFR aviation risks at the Aspen Airport.[23] The Aspen Airport risks acknowledged by the above referenced FAA documentation and the earlier investigations of Baker and Lamb are further corroborated by the following published materials:

- The August 7, 1990 hearing of the Pitkin County Board of County Commissioners relating to VFR night safety and noise concerns. This hearing record - parts of which are referred to throughout this report - contains extensive lay and expert testimony confirming the validity of the same safety concerns which are documented in the preceding portions of this historical overview.[24]

- The Supplemental report of Sunshine Aviation Safety Studies (Lamb and Baker) of October 1991 entitled "Aspen Airport and the Risks of Mountain Flying". Parts of this

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[21] Almost all of the accidents occurring within 25 miles of any airport in the area studied by Baker and Lamb occurred in the Aspen airport vicinity, according to private communications with Baker and Lamb.

[22] Roberts, Hugh. Compilations and mapping of NTSB closed and in process NTSB accident record were included in the BOCC 8/7/90 hearing record, as Items 9 (Map, Aircraft Crash Locator, which include portion used for cover of this report), 10 (Map Legend and tabulation).

[23] Note that other FAA internal materials on the subject may exist. FAA has never responded to Pitkin County's requests to provide such materials. The FAA materials referred to in this Historical Overview are limited to those which were found in Pitkin County files. See p. 2-22 through 2-23.

[24] The full text of this hearing, and hearing documents, were published by Pitkin County in a separate volume entitled "*Minutes, The Pitkin County Board of County Commissioners Special Meeting Re: Ordinance Setting Hours of Operation At the Aspen Pitkin County Airport, Tuesday, August 7, 1990*". Copies were provided to the FAA shortly after publication, and was the subject of FAA County attorney's meeting discussed in subsection (3)(e) of this Historical Overview, page 2-21.

report have also been referred to above. The full text is included as part 4.00. commencing at page 4-1 of this Report.

• Gellman Research Associates report entitled "Accident Rate Analysis," September 27. 1991. This analysis compared the NTSB accident rate experience of airport operations of 30 AC 121.445-1D Special "mountain" airports similar to Aspen and also 526 other "non-mountain" airports. It also compared the Aspen Airport accident rate with other mountain and non-mountain airports. The full text of this report is included as Part 3.00, commencing at page 3-1 of this Report. The Gellman Research analysis supports the following conclusions:

(1) The accident rate for Special mountain airports (1.34) was almost twice as high as non-mountain airports (0.79).

(2) The day accident rate for the Aspen Airport (2.53) is significantly higher than (more than double) the day accident rate (1.22) for the special mountain airports as a class.

(3) Night accident rate of special mountain airport group (2.05) was 68% higher than the day accident rate (1.22).

(4) If night VFR operations were permitted at the Aspen Airport, the statistically estimated accident rate would be 4.25. Therefore:

• The Aspen general aviation night accident rate (4.25) will be more than double the night accident rate of mountain airports generally (2.05). The 4.25 Aspen night accident rate will be approximately 68% higher than the day accident rate which Aspen Airport is already experiencing (2.53).

• The Aspen night VFR accident rates (4.35) would be more than three times the day/night average accident rate for the 30 mountain airports (1.22); twice the average night accident rate of those airports (2.05), and more than 5 times the average rates experienced at non-mountain airports (.79).

(5) These conclusions were based upon statistically significant differences in accident rates at airports operating in similar circumstances.

(2) The Record of FAA support of Airport closure to Night VFR

On February 2, 1990 the FAA demanded (at the request of AOPA and other national aviation special interest groups) that Pitkin County open the Aspen Airport for night VFR use by the flying public and passenger carrying operators generally --without regard to the ability of these users to meet the night operational standards applicable to the FAA-approved Scheduled Carriers.

The FAA's historic knowledge of County night access and safety policies was expressly admitted, but was re-characterized as a "past pattern of exclusion of night general aviation" which the FAA had "not opposed". At the same time, however, the FAA change of position was conceded to be the result of a "fresh look". *2/9/90 letter, Alan Wiechmann of FAA to Pitkin County Board of County Commissioners.*

The following is a summary of what the available[25] historical record reflects as to these recent FAA re-characterizations. Pitkin County believes that it reflects that the nighttime operational extension for FAA certificated air carrier IFR operations --and the consequent closure to other less safe night VFR operations -- has long been known to, developed under, and supported by FAA policies and practices which recognized that such differential treatment was justified by relative safety, passenger carrying capabilities, or legitimate local environmental considerations. This extensive record is summarized below in small type to conserve space:

> 1973. "In the interests of flight safety, the airport owner may impose reasonable rules and regulations (see paragraph 54b [reserved]) which restrict use. These may prohibit aircraft not equipped with a reasonable minimum of communications equipment from using the airport. They may restrict or deny use of the airport for student training, ...or for some other purpose deemed

[25] FAA internal documents referred to in this Night VFR Safety Study are those found in County files. FAA has never responded to Pitkin County's repeated requests to provide other internal FAA documentation which may refer to the topics addressed in this study.

incompatible with safety under local conditions peculiar to the airport." *8/24/73 FAA Order 5190.6, Airports Compliance Requirements.* This Order recommended that in establishing reasonableness of such restrictions, the assistance of local FAA Flight Standards representatives should be obtained. As noted below, Flight Standards concerns about "safety under local conditions peculiar to" the Aspen Airport are in fact documented in the historical record.

January, 1975. The comments of FAA's Hoover at the County lead-in light hearing have been quoted previously (to the effect that Aspen Airport "won't ever be a night airport" because "they had the worst safety record in here of any place in the mountains"). See page 2-2.

February, 1975. FAA Flight Standards' February 21, 1975 internal Special Minimum Memo represents such a Flight Standards recognition of general aviation's special VFR risks at Aspen Airport. This memo was also quoted extensively at pages 2-5 through 2-7 above. This memo documents FAA's awareness that, because of

> "...[F]light safety factors associated with high terrain, adverse weather, limited navaids and tight maneuvering space around the airport, the agency has imposed higher than basic VFR minimums on the operating certificates of all of the carriers serving" (Aspen). "It seems reasonable that if these higher...minimums are necessary to assure flight safety for air carrier operations..., then similar or more restrictive measures should be applied for the normally less proficient general aviation pilot who often operates less sophisticated aircraft at this airport."

1976. "Actions an airport proprietor can establish, after providing an opportunity to airport users, the general public and to FAA to review and advise: (1) Restrictions on the use of or operations at the airport in a particular time or by aircraft type, such as...(b) prohibiting operations at certain hours -curfews; (c) Prohibiting operation by a particular type or class of aircraft; and (2) any combination of the above." See Par e.1.b and c., and Par f.. *11/18/76 FAA handout "SUMMARY OF SUGGESTED METHODS FOR DEALING WITH AIRPORT NOISE DESCRIBED IN DOT NOISE ABATEMENT POLICY ISSUED ON November 18, 1976"*.

May-June, 1977. Airport manager Doug McCoy, John Young and County Attorney Stuller met with multiple FAA officials in Denver to discuss 23 specific written questions which had been submitted by letter of May 23, 1977 by Attorney Stuller at the suggestion of FAA's James Houghton. These included questions as to how the County could discourage use of the airport by general aviation at times when lighting or control tower operations would otherwise make it possible for general aviation to do so.

The reported FAA answer was that preference could be given to commercial carriers because of the public service aspects of their operations.

It was also noted that night use by general aviation could in FAA's opinion be "discouraged by shutting off runway and taxi lights when not needed for commercial users." *County staff reports of the responses of FAA at 6/8/77 Night flight Meeting with FAA in Denver.*

November, 1977. County attorney Stuller expressed the "great concern of the Board...with respect to night flying by carriers is the potential for increased illegal use by general aviation." Ms. Stuller noted the Board's concern that: "FAA proposes to maintain its tower open until 9 pm and to control the runway lighting system"..."and [the Board] expressed concern that your mandate will not permit you to withhold lighting and tower assistance to general aviation even though an operation may be prohibited by our curfew." The County Attorney solicited FAA's opinion as to whether it would close the tower 1/2 hour after sunset and permit the carriers [rather than FAA] to operate their own landing systems, to "help in the enforcement of our curfew."

The FAA response was to "offer no objection" to the proposed procedure "if this would be the Board's desire." *11/18/77 County Attorney letter to FAA, and FAA's MM Martin's Response of 11/23/77.*

1978. The FAA Flight Standards memo (runway lighting concerns) of September 22, 1978 was quoted in part at page 2-1. At that time the Aspen Airport was closed to all night operations because of a dispute between Rocky Mountain Airways (RMA) and Aspen Airways concerning, among other things, use of RMA-owned runway lights. This Memorandum commented about a County AIP application to purchase runway lights, which had been withdrawn. As already noted, Flight Standards' observations were:

> "Our primary concern from a safety standpoint is to see that no lighting system or night operation approval will open the door to night VFR operations

> by either the flying public or passenger carrying operators since in our opinion the scarcity of lighting in the surrounding mountains and valleys would make such operations hazardous."

Subsequent night operational requests by both carriers resulted in FAA approval, conditioned upon compliance with IFR standards, the airlines' proprietary landing systems and the other conditions referred to above.

<u>1979.</u> On April 11, 1979 FAA's Max Bard wrote a letter to airport manager Doug McCoy confirming that the County could close the airport to general aviation operations which conflicted with the need to serve large numbers of scheduled carrier passengers. This letter notes that County airport IFR capacity is limited to 6-8 landings and departures per hour under stated visibility minimums, and that no IFR equipment "could be installed that would increase the critical IFR capacity." The letter goes on to state:

> "As previously discussed with you, in our opinion, you may close the airport to general aviation when you have conflicts with moving large numbers of scheduled passengers."

<u>1983.</u> In March, 1983 George Madsen, as Chairman of the Board, wrote to FAA's Walter Barbo. The purpose of the letter was to confirm the inclusion of runway lighting in the County/FAA AIP project 3-08-003-02. It confirmed that the clear purpose of the lights was for use by scheduled carrier night operations, but not general aviation.

> "The new system will be used for providing bad weather/poor visibility runway delineation, runway lighting from sunset until 30 minutes past sunset (airport general aviation closing time), scheduled night time operations, and night emergency evacuation flights."

This communication and the resulting grant clearly document that the County's night operational restrictions were not only (1) well known to FAA, but also (2) were consistent with the non-discrimination grant assurances which FAA was required to receive and the County was required to give. It also establishes that with all facts disclosed, these non-discrimination assurances were known and accepted by both the County and FAA to be true when they were made. These grant assurances are discussed in more detail in subsection (3) of this Historical

Overview, below.

1977-1988. Aspen Airport Managers' knowledge of FAA support for the present type of night regulations was documented by their testimony at the Board's August 7, 1990 night VFR public hearing.

Doug McCoy, manager from 1977 to 1984-5, stated that he had numerous contacts with the FAA field personnel. Based on that, he stated that "(T)he FAA was not in favor of general aviation accessing the airport after dark ...: for safety reasons", and because "they didn't have any instrument capability at the airport." He also stated that "when the VOR issue initially came up, the FAA at least indicated to me that the VOR would not be used as an approach mechanism for the Aspen Airport, that it would only be used as a homing device or locator device for holding patterns and such as that. The VOR wouldn't be used for approaches to the airport."

McCoy was asked about FAA's stated positions during his tenure as to the issue of alleged nighttime operational discrimination between scheduled carriers and general aviation. He responded that during his tenure there had also been a complaint by NBAA or AOPA "to equalize night flights" and that he had asked FAA's office to clarify FAA's position. He testified that FAA had responded that Pitkin County could discriminate between the two types of operations because "they were two completely, entirely different entities, and operating under entirely different regulations." 8/7/90 BOCC hearing record, pp. 43-5.

McCoy's successor as airport manager was Richard Arnold, now manager of the Telluride Airport. Arnold was not able to attend the 8/7/90 hearing, but supplemented the 8/7/90 Hearing Record during the period allowed by the Board for such purpose.

Arnold's letter of 8/27/90 appears as item 44 of the 8/7/90 Hearing Record. It discloses his extensive local knowledge and crash experience. Arnold opined that:

> "I do not believe that there can be general aviation parity with night operations conducted by scheduled airlines under the special exception ... to closing time for the airport.
>
> "These airline operations are conducted by crews which have 'recurrency' through frequent requalification with this airport; are conducted with high performance aircraft capable of descending and climbing within the severely constrained

airspace; employ special instrument approaches or precision instrument approaches which are proprietary to each airline and are conducted by extremely quiet aircraft. These special conditions to scheduled airline operations have evolved over the years through a constant process of improvement required by various boards of County Commissioners, the airlines and FAA." 8/7/90 BOCC hearing record, Arnold 8/27/90 letter, attachment 44.

Mr. McCoy's testimony is at odds with Mr. Weichmann's 2/9/90 letter suggestion that FAA's change of position in 1990 resulted from a recent complaint, and that FAA's prior action was only that it had just "not objected".

Mr. Arnold's letter supports McCoy, and also notes that similar complaints recurred during Arnold's tenure as well, and that he received the same responses thereto that McCoy had received:

> "Like my predecessor, Doug McCoy, I received repeated confirmations from FAA representatives who worked closely with me to the effect that FAA supported the general aviation curfew at 1/2 hour after sunset on safety grounds, and also supported the special exception and conditions imposed on and for the benefit of the scheduled airlines and their passengers. Whenever suggestions were made that differential treatment was unlawfully discriminatory, I was advised by appropriate FAA representatives that Pitkin County was permitted to discriminate or distinguish between different classes of users, but not within the same class. This was explained to mean that Pitkin County could enforce different operational times between general aviation on the one hand and the two specially qualified scheduled airlines on the other hand, but could not discriminate between users in the same class, namely that we could not discriminate between the two airlines, or between users who were within the general aviation class." Arnold letter 8/27/90, attachment 44 to 8/7/90 BOCC hearing record.

1988. A proposed Radar facility at the Aspen Airport resulted in a NEPA-required Environmental Assessment (EA). This assessment involved, among other functions, responses to concerns raised by the public about the potential effects of the proposed Radar installation.

The FAA EA responses included statements that Radar installation would only permit FAA to better manage existing operational patterns, and that a "change in total numbers of operations" was not anticipated. This process resulted in an FAA Finding Of No Significant Impact (FONSI). These responses stand in contrast with FAA's February 2, 1990 demand that general aviation VFR night operations should now be permitted, and FAA's reliance upon recent VOR/DME and Radar installations as facility changes which justified a "new look".[26]

(3) Other Matters which Suggest FAA Actions are Inappropriate.

In addition to the above historic documentation and the referenced studies, a variety of other authoritative sources exist in the record which support Pitkin County's position that FAA's demand for general aviation VFR night operations at the Aspen Airport is inappropriate.

(a) Prior DOT Secretary's Pronouncements. FAA's present position conflicts with its parent Department of Transportation's (DOT) Secretary's prior public representations of "zero tolerance" for any compromises of safety[27]. This is so because the historical record and the empirical data show that night general aviation VFR operations will demonstrably degrade the exemplary safety record and high standards historically applicable to night operations at the Aspen airport.

(b) Grant Assurance Language. Pitkin County has received Airport Improvement Program (AIP) grants from FAA. Typical AIP grant assurances promulgated by FAA have been signed by the County. AOPA and FAA assert that Pitkin County's refusal to open the airport to general

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[26] Compare the above testimony of McCoy (that the VOR/DME would not support landing approaches, and the above FAA EA responses resulting in the 9/30/88 FAA Radar ATCRBS FONSI, with the 2/2/90 FAA Letter to Pitkin County demanding night VFR operations.

[27] See the Abstract of former Transportation Secretary Elizabeth Dole's Meet the Press interview 12/19/83 regarding Air Illinois safety deficiency reports and the effects of deregulation on the safety of the nation's carriers:

> "I will in no way tolerate a diminution of safety in any way in any of our modes of transportation," Mrs. Dole said.
>
> * * *
>
> "I am working very hard with all my modal administrators, those who head various transportation modes . . . to insure that safety is in no way compromised, especially in this period of changes in our society, technological changes, deregulation."

Full abstract at Appendix, Item 1.

aviation night VFR operations would result in FAA enforcement actions and future grant disqualification actions, based upon these assurances.

However, a review of these assurances discloses language which expressly refutes those AOPA and FAA assertions. Typical grant assurances between the County (as Sponsor) and FAA provided that:

> "a. (Sponsor will) ... make its airport available as an airport for public use on fair and reasonable terms and without unjust discrimination to all types, kinds and classes of aeronautical uses."

but also states that:

> "h. Sponsor may establish such fair, equal and not unjustly discriminatory conditions to be met by all users of the airport as may be necessary for the safe and efficient operation of the airport."[28]

<u>(c) FAA/NEPA Regulations.</u> Since FAA's current demands are a significant reversal of the above-summarized well-established local and federal policy, Pitkin County asserts that FAA (and other federal) regulations require an Environmental Assessment (EA) or Environmental Impact Statement (EIS) before such changes can be imposed - even if they are legal.[29]

<u>(d) Congress' Conference Report.</u> In response to concerns that the FAA would initiate action against Pitkin County before current noise and safety studies could be initiated, Congress was

[28]See "Economic Assurances" Paragraph 22, a. and h of typical Pitkin County FAA Grant Assurance.

[29]The *National Environmental Policy Act, 42 U.S.C Section 4321* <u>et seq.</u> See also: *FAA Order 1050.1D, 12/5/86, "Policies and Procedures for Considering Environmental Impacts," and FAA order 5050.4A,* and *Council on Environmental Quality (CEQ) Regulations,* attached thereto, and also FAA *"Airport Environment Handbook" 10/10/85.*

requested to. and did intervene. The Conference report of October 20. 1990[30] recited the factual background of the dispute with substantial accuracy.

The Conference Report noted among other matters that:

> "In exchange ... and to insure safe operations. commercial operators installed private navigation aids, and agreed to require certain aircraft performance standards, as well as special pilot training and experience, to perform after dark operations at Sardy Field." ***Conference Report H 10884, re "Pitkin County Airport", October 20, 1990.***

Congress' Conference Report concluded with this direction:

> It is believed that the interest of the people of Pitkin County and the Federal Government would be best served by a negotiated settlement. rather than litigation by the Department of Justice, at the request of the Federal Aviation Administration." ***Conference Report H 10884, re "Pitkin County Airport", October 20, 1990.***

Prior to that Conference Report, Pitkin County had forwarded to FAA a copy of the record of the Board's August 7, 1990 hearing, and had already initiated efforts to attempt to initiate a factually-based negotiated resolution. On September 13, 1990, County Attorney Whitsitt and Special Counsel Shellman met in Washington DC with FAA's Leonard Griggs and others. The history, the 8/7/90 hearing record and the other matters presented at this Washington DC meeting were summarized by a Pitkin County meeting memorandum[31]. The following County requests were made:

> (1) That FAA provide its administrative record of the safety or other determinations supporting Mr. Weichmann's 2/9/90 FAA position that the curfew was "unjustly discriminatory" and that general aviation night access until 11 pm was safe. (Mr. Danforth of FAA had advised Mr. Shellman that the safety question had been reviewed

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[30] Verbatim copy of the entire section of the Conference report relating to this matter appears at Appendix Item 2.

[31] FAA Meeting Summary, Washington DC September 13, 1990, Appendix Item 3.

by the Region at the time the Weichmann letter of 2/2/90 was being drafted):

(2) That FAA conduct NEPA EA or EIS procedures regarding the subject general aviation night VFR operational use demand;

(3) That FAA participate with Pitkin County in County noise and safety studies to address, among other things, the implications of the FAA demands.

The FAA made no effort to pursue a negotiated settlement, as directed by the Conference Report. FAA's response to Pitkin County's negotiating overtures was limited to a demand that general aviation be permitted immediate night VFR access until 11 p.m. This was accompanied by statements of FAA's unwillingness to participate in Part 150 noise study funding, unless and until FAA's night VFR demand was met before the studies began. FAA's Griggs stated that FAA would do its own safety studies.[32]

No FAA response has ever been received to the County attorneys' requests for the administrative record, or the safety review supporting the 2/9/90 Weichmann letter.

Pitkin County therefore commenced its own limited studies in these areas without FAA participation or funding, while continuing to repeat its requests for FAA disclosure and discussions. The County efforts along these lines were recently summarized as follows:

"While I am pleased to respond to FAA requests to us for documentation in our possession, I would like to note that this process continues to be a one way street.

"We have outstanding, unanswered Pitkin County requests to FAA for FAA documentation of alleged FAA safety determinations that go back to Brad Christopher's July 13, 1990 letter to Preston Gardner ANM-20, and Tim Whitsitt and my requests for the same information at our meeting with Leonard Griggs and others at FAA headquarters on September 13, 1990. This FAA documentation and all other relevant FAA documentation

[32]See FAA Meeting Summary memorandum, Washington, D.C., December 13, 1990, Appendix Item 3.

was again requested in Chairman Ethridge's letter to Alan Weichmann and Whitsitt and my letter to Weichmann, both of which were dated August 14, 1991. Copies of all three of the above letters are enclosed, without copies of the attachments. (The 8/14/91 Ethridge letter copy also contains my notations correcting 1991 references that should have been 1990, at pp 8 and 9.)

"The August 14, 1991 letters to Mr. Weichmann also requested an 'end of August 1991' (or thereabouts) meeting between County counsel and FAA. It was our hope that this would permit a joint review [of] FAA's documentation and responses to County requests. We had also hoped to review the status of our own noise, safety and utilization reviews, as well as the further FAA safety study which we [were] told by FAA's Griggs would be initiated after our 9/13/90 meeting with FAA. We continue to hear that FAA study was in process, but have never been advised of what was reviewed or the results. Since our own studies are now nearly complete, such a meeting could still be productive." ***Fax transmittal Special Counsel Shellman to FAA regional Assistant Counsel Carl Lewis, 10/28/91.*** [Matters in brackets are inserted to supply omissions from the original text.]

PART 3.00
ACCIDENT RATE ANALYSIS
09/27/91
GELLMAN RESEARCH ASSOCIATES, INC.
AND
ADVANCED AVIATION CONCEPTS

Friday, February 15, 1991 Times Daily 3

Special team to probe Aspen air crashes

By SCOTT CONDON
Times Daily Staff Writer

A special team of aircraft accident investigators known as a "Go Team" will check out a recent rash of fatal crashes in the Aspen area, according to local officials.

Pitkin County Sheriff's Office Patrol Director Tom Stephenson said he was told by a Federal Aviation Administration inspector that a special team of investigators had been summoned here from Washington, DC.

"The FAA out of Washington, DC. is concerned about the number of accidents in this area," Stephenson said.

Aspen Airport Manager Brad Christopher said he also heard that a special team of investigators was headed to Aspen, but he wasn't sure if the "Go Team" would be sent by the FAA or the National Transportation Safety Board.

Both federal agencies study aircraft crashes.

Stephenson said the FAA inspector told him Wednesday's crash prompted the agency to send the special investigators.

Three men, Aspenite Harold Goldsmith and two pilots from Denver, were killed Wednesday when their Learjet crashed near Woody Creek.

"I got the impression from this FAA inspector that this accident was the straw that broke the camel's back," Stephenson said.

There have been at least six fatal accidents in Pitkin County during the last 15 months — since Nov 29, 1969. Those accidents have killed 19 people.

Two USAir pilots were killed last week when their small plane crashed while they were sightseeing near the Snowmass Ski Area.

Christopher said he was also told the number of crashes — not an individual event — has promoted the FAA or NTSB to send a special team to Aspen. The investigators apparently will be looking at the series of local crashes, he said.

> "The FAA out of Washington, DC, is concerned about the number of accidents in this area."
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Christopher said he saw a plane at the airport Thursday that led him to believe investigators may already be here. But he has not received official word that a special team is here, he said.

A spokesman for the FAA's regional office in Seattle said no team was at the Aspen crash site on Thursday, but he didn't know if one was headed to the area.

The public affairs office for the FAA's Washington, DC, office couldn't be reached by the Times Daily before 6 pm EST Thursday.

The NTSB sent an investigator from Denver to the Aspen crash site Wednesday. The FAA has a team assisting with the investigation — which is standard procedure, according to agency spokesman Dave Duff.

Duff said Go Teams are on-call investigators with special expertise. He said they are more common to the NTSB than the FAA.

Column

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Duff said Go Teams are on-call investigators with special expertise. He said they are more common to the NTSB than the FAA.

Column

3.00 ACCIDENT RATE ANALYSIS

ACCIDENT RATE ANALYSIS

September 27, 1991

Prepared for:

Aspen-Pitkin County Airport

by

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and

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ACCIDENT RATE ANALYSIS

Introduction

The objective of this study is to estimate the general aviation accident rate that would prevail at night if operating hour restrictions were removed at Pitkin County (Aspen) Airport. Currently, Aspen's airport is open to the public for air operations from 7:00 A.M. until 30 minutes after sunset. However, there are commercial Part 121 operations using a privately-owned landing aid until as late as 11:00 P.M. These commercial operations must take place in accordance with Pitkin County Ordinances 89-3 and 90-12 which specify certain criteria which carriers must meet to take advantage of the curfew extension.

Because there is no experience with general aviation night operations at Aspen, projecting accident rates resulting from such operations should be based on experience in similar circumstances. To define those circumstances, it is important to note that Aspen has been designated an AC121.445D "Special Airport" by the FAA. Under FAR Section 121.445, a pilot-in-command of a Part 121 operation must meet special qualifications in order to operate at a designated airport. These qualifications relate to familiarity with the special nature of the airports designated; the FAA classified Aspen as being characterized by "high terrain" requiring "special procedures." Twenty-nine other airports located in mountainous regions have also been designated under Section 121.445; the night accident experience at their airports is used to project the expected accident rate at Aspen.

The analysis is based on reported accidents involving fixed-wing general aviation airplanes at towered airports and the numbers of general aviation operations at these airports over the years 1983 through 1988. To facilitate the analysis, two towered airport categories are defined:

- Other, non-mountain airports (526 airports);
- Part 121.445 mountain airports (30 airports);

The mountain airports are identified in Table 1.

The analysis addresses the following questions:

- (1) Is the overall accident rate at mountain airports significantly higher than that at non-mountain airports?
- (2) Is the night accident rate at mountain airports significantly higher than the day rate at these airports?
- (3) What is the estimated night accident rate that would be experienced at Aspen if operating hour restrictions were removed?

Summary of Findings

This analysis shows that:

- (1) The accident rate at mountain airports is significantly higher than that at non-mountain airports. The observed rates are respectively 1.34 and 0.79 accidents per 100,000 operations. (Note that all accident rates mentioned in this analysis are per 100,000 operations.)
- (2) The night accident rate at mountain airports is 2.05 and is significantly higher (68 percent higher) than the day accident rate of 1.22 at these airports.
- (3) The estimated night accident rate at Aspen if operating hour restrictions are eliminated would be approximately 4.25.

Data

The data for the analysis are:

- Total general aviation airplane operations at towered airports in the years 1983 through 1988 as published by the FAA;
- Fixed-wing general aviation accidents over the same years identified by the National Transportation Safety Board (NTSB) as having occurred at towered airports.

The analysis excludes any general aviation accidents that occurred in areas not specifically identified by NTSB as having occurred at a towered airport. These data are summarized in Table 2 together with the corresponding accident rates; a complete listing of data used in the analysis is contained in Appendix A-1.

Table 1

MOUNTAIN AIRPORTS WITH TOWERS

LOCID	City	State
ADQ	Kodiak	AK
ASE	Aspen	CO
AVL	Asheville	NC
AVP	Wilkes-Barre	PA
BGM	Binghamton	NY
BHM	Birmingham	AL
BTV	Burlington	VT
BUR	Burbank	CA
CRW	Charleston	WV
ELM	Elmira	NY
FLG	Flagstaff	AZ
HTS	Huntington	WV
ITO	Hilo	HI
JNU	Juneau	AK
LEB	Lebanon	NH
LIH	Lihue	HI
LMT	Klamath Falls	OR
MDT	Harrisburg	PA
MSO	Missoula	MT
OGG	Kahului	HI
ONT	Ontario	CA
PPG	Pago Pago	Samoa
PSP	Palm Springs	CA
RNO	Reno	NV
ROA	Roanoke	VA
SAN	San Diego	CA
SBA	Santa Barbara	CA
STT	St. Thomas	VI
TVL	S. Lake Tahoe	CA
VDZ	Valdez	AK

Source: FAA Air Traffic Activity 1989

Analysis of Mountain Versus Non-Mountain Flying

Also shown in Table 2 is the calculated value of the Z statistic used to test the hypothesis that accident rates do not differ among non-mountain and mountain airports. Z is the relevant normally distributed statistic for testing the hypothesis that the two accidents rates are the same against a one sided alternative hypothesis and p is the probability of observing a value of z at least as large as the computed value if the accident rates are in fact identical. The probability of observing a Z-value as large as the one calculated, if the accident rates were the same for the two airport categories, is less than 0.0000003, and implies that the accident rates differ substantially among airport categories.

Night and Day Flying at Mountainous Airports

Table 3 shows the number of accidents occurring at mountain airports during the Day and at Night respectively. Day is defined in terms of the Aspen Airport operating hours, which are from 0700 to 30 minutes after sunset. The closing hours in the middle of each month are shown in Table 4. On an annual basis, Aspen operations occur on average from 0700 to 1845. Night is the period from closing to 0700. The allocation of total operations to Day and Night was based on the distribution of General Aviation traffic by hour of day as reported in the "General Aviation Pilot and Aircraft Survey" conducted by the FAA in 1985. The traffic distributions for towered airports are shown in Table 5.

Analysis of the data in Table 3 indicates that the Night rate at mountain airports is 1.68 times greater than the Day accident rate and that the difference in rates is significant at the 99% level; that is, the probability that day and night accident rates at mountain airports are the same is about 0.01.

Table 2

OVERALL ACCIDENT RATES
BY TYPE OF AIRPORT

EVENT	AIRPORT TYPE MTN	NONMTN	TOTAL
ACCIDENTS	125	1,876	2,001
OPERATIONS	9,323,600	237,666,090	246,989,690
ACC RATE	1.34	0.79	0.81

$z = 5.74$
$p = 0.0000003$

Table 3

ACCIDENT RATES AT MOUNTAIN
AIRPORTS BY TIME OF DAY

EVENT	TIME OF DAY NIGHT	DAY	TOTAL
ACCIDENTS	28	97	125
OPERATIONS	1,366,244	7,957,356	9,323,600
ACC RATE	2.05	1.22	1.34

$z = 2.32$
$p = 0.010$

TABLE 4

CLOSING HOURS AT
ASPEN AIRPORT

MONTH	CLOSING
January	1738
February	1813
March	1844
April	1914
May	2043
June	2105
July	2103
August	2033
September	1946
October	1859
November	1723
December	1719

Table 5

SEASONALY ADJUSTED MEAN HOURLY GENERAL AVIATION OPERATIONS AT TOWERED AIRPORTS

HOUR	WEEKDAY	WEEKEND	COMBINED
0600 – 0659	1.9	0.8	1.59
0700 – 0759	5.1	5.7	5.27
0800 – 0859	13.0	12.9	12.97
900 – 0959	23.2	21.3	22.66
1000 – 1059	33.0	28.5	31.71
1100 – 1159	25.9	26	25.93
1200 – 1259	17.5	24.7	19.56
1300 – 1359	19.9	26	21.64
1400 – 1459	24.4	22.8	23.94
1500 – 1559	27.0	19.7	24.91
1600 – 1659	22.1	15.1	20.10
1700 – 1759	24.6	12.7	21.20
1800 – 1859	18.0	11.1	16.03
1900 – 1959	14.2	6.2	11.91
2000 – 2059	6.4	3.2	5.49
TOTAL	276.4	236.8	264.91

Source:
General Aviation Pilot and Aircraft Activity Survey, Federal Aviation Administration, September 1985

Estimated Day and Night Traffic Shares

Total operations 0600–2100:	264.91
Est operations 2100–0599: 7% of 264.91	18.54 *
Est total operations:	283.46
Est flights 1845–0700:	41.54
Percent of operations 1845 – 0700:	14.65
Percent of operations 0700 – 1845:	85.35

* In the same publication, FAA estimates that seven percent (7%) of operations occur between 2100 and 0559. This same percentage was applied to mountain airports even though such late night operations are less frequent. As a consequence, the calculated night accident rate at mountain airports in probably conservative.

Application to Aspen

The Day accident rate at the Aspen airport over the years 1983 through 1988 was 2.53 accidents per 100,000 operations (5 accidents in 197,247 operations). Experience at other mountainous airports suggests that if operating hour restrictions were eliminated, the estimated general aviation accident rate at night at Aspen would be 4.25 (2.53 times 1.68).

Conclusion

Based on experience at towered mountain airports subject to Part 121.445, the general aviation accident rate at Aspen Airport at night would be 68 percent higher than the rate during current operating hours. This conclusion is based on findings of statistically-significant differences in accident rates at airports operating in similar circumstances.

APPENDIX A-1

DISTRIBUTION OF GENERAL AVIATION ACCIDENTS AND OPERATIONS BY LOCID, TERRAIN AND TIME OF DAY

NONMOUNTAIN					MOUNTAIN				
LOCID	OPERS	DAY	NGT	TOTAL	LOCID	OPERS	DAY	NGT	TOTAL
2I4	342,367	2		2					
31J	120,295	1		1					
ABE	466,862	2		2					
ABI	451,922	1	1	2					
ABQ	511,349	6		6					
ABY	290,896	1		1					
ACK	430,303	2	3	5					
ACT	286,927	1	4	5					
ACY	302,631		2	2					
ADM	92,499	1		1					
ADS	953,436	6	4	10					
ADW	137,175	1		1					
AGC	782,385	4	1	5					
AGS	219,185	2	1	3					
AID	154,404	2	1	3					
AIY	277,010	4	2	6					
AKN	98,359	4	1	5					
ALN	384,505	3	1	4					
ALO	239,443	1	3	4					
AMA	240,834	2		2					
ANC	443,593	12	1	13					
ANE	1,140,234	3	4	7					
APA	2,122,791	26	1	27					
APC	796,699	4		4					
APF	502,632	4		4					
APG	0		1	1					
APN	43,363	1	1	2					
ARB	552,654	3	1	4					
ARR	828,539	2	1	3					
					ASE	197,247	5		5
ASH	758,000	2	1	3					
ATL	203,224		1	1					
ATW	284,194	1	2	3					
AUS	789,042	4	1	5					
					AVL	328,691		2	2
					AVP	241,699	1		1
AZO	459,068	2	1	3					
BAF	643,119	4	1	5					
BAK	162,424	1		1					
BDR	865,884	5	3	8					
BEC	167,420	1		1					
BED	1,292,645	4		4					
BET	119,177	2		2					
BFI	2,217,201	8	2	10					
BFL	581,137	2	1	3					
					BGM	185,141	5	2	7

DISTRIBUTION OF GENERAL AVIATION ACCIDENTS AND OPERATIONS BY LOCID, TERRAIN AND TIME OF DAY

NONMOUNTAIN					MOUNTAIN				
LOCID	OPERS	DAY	NGT	TOTAL	LOCID	OPERS	DAY	NGT	TOTAL
BGR	312,107	1	2	3					
					BHM	738,668	6	4	10
BIL	472,882	10		10					
BIS	289,682	4		4					
BJC	861,843	8	1	9					
BLI	292,583	3		3					
BMG	197,283	6	1	7					
BMI	334,148	1	4	5					
BNA	650,959	6	2	8					
BOI	491,217	7		7					
BOS	281,062	2	1	3					
BOW	328,992	2		2					
BPT	253,890	1	4	5					
BRO	297,985	2	1	3					
BTL	192,946		1	1					
BTR	690,642	1	1	2					
					BTV	492,526	4	1	5
BUF	298,913		1	1					
					BUR	817,476	8	2	10
BVI	566,338	2	1	3					
BVY	790,377	5	1	6					
BWI	425,422	5	1	6					
CAE	442,839	5	2	7					
CAK	505,097		3	3					
CCR	1,348,212	11	4	15					
CDW	1,383,662	3	2	5					
CGF	439,845	1	2	3					
CGI	186,136	1		1					
CGX	332,285	1		1					
CHA	529,519	3	2	5					
CHD	0		2	2					
CHO	229,882	4		4					
CHS	262,136	7		7					
CIC	247,910	1	1	2					
CID	371,071	2	2	4					
CKB	274,004	1	2	3					
CLE	360,229	1		1					
CLL	411,335	4	2	6					
CLT	522,843	5		5					
CMH	744,564	7	1	8					
CMI	712,914	4	1	5					
CNO	1,191,500	17	1	18					
COE	453,637	1		1					
COS	549,628	6	1	7					
COU	209,111	1	1	2					
CPR	294,856	3		3					

DISTRIBUTION OF GENERAL AVIATION ACCIDENTS AND OPERATIONS
BY LOCID, TERRAIN AND TIME OF DAY

NONMOUNTAIN					MOUNTAIN				
LOCID	OPERS	DAY	NGT	TOTAL	LOCID	OPERS	DAY	NGT	TOTAL
CPS	778,211	3	1	4					
CRE	531,792	6		6					
CRG	688,862	6	2	8					
CRP	359,378	2		2					
CRQ	1,103,594	3	1	4					
					CRW	405,485	2	2	4
CSG	287,596	2	1	3					
CVG	192,690		1	1					
CXY	417,398	3	1	4					
CYS	277,092	8	1	9					
DAB	1,111,116	13		13					
DAL	878,621	2	1	3					
DAY	305,367	2		2					
DBQ	278,639	1	1	2					
DCA	476,433	2	3	5					
DEC	358,867	3		3					
DEN	335,719	2		2					
DET	783,362	5	1	6					
DFW	136,786	1		1					
DHN	260,131	1	1	2					
DLH	148,834	1		1					
DPA	1,202,271	13	1	14					
DSM	599,568	5	1	6					
DTW	381,612	1		1					
DVT	1,400,290	8		8					
DWH	951,226	8	1	9					
DXR	733,200	8	2	10					
EDF	48,813	1		1					
EKM	233,418	1		1					
					ELM	285,621	2		2
ELP	785,934	15		15					
EMT	1,119,853	12		12					
ENA	205,803	7	1	8					
ERI	299,924	3		3					
ESF	167,507	1	1	2					
EVV	365,169	5	2	7					
EWB	503,887	2		2					
EYW	254,236	3	2	5					
FAI	527,384	8	1	9					
FAR	372,921	4	1	5					
FAT	821,653	8		8					
FAY	245,036	2	1	3					
FBG	0		3	3					
FCM	1,085,854	10	3	13					
FFZ	765,486	4	3	7					
					FLG	191,038	7	2	9

DISTRIBUTION OF GENERAL AVIATION ACCIDENTS AND OPERATIONS BY LOCID, TERRAIN AND TIME OF DAY

NONMOUNTAIN					MOUNTAIN				
LOCID	OPERS	DAY	NGT	TOTAL	LOCID	OPERS	DAY	NGT	TOTAL
FLL	611,806	3	3	6					
FLO	160,727	2	1	3					
FLV	57,890	1		1					
FMN	294,874	1	1	2					
FMY	645,494	6	1	7					
FNT	593,612	3		3					
FOE	174,318	3		3					
FOK	717,065	1	1	2					
FRG	967,494	14	1	15					
FSD	367,843		1	1					
FSM	294,358	1	1	2					
FTW	1,819,317	5	2	7					
FTY	869,182	2	5	7					
FUL	987,588	13	1	14					
FWA	418,087	1		1					
FXE	1,156,268	10	1	11					
FYV	196,103	2	1	3					
GCC	166,340	4	2	6					
GCN	72,076	4	1	5					
GEU	743,365	1		1					
GFK	1,197,420	4		4					
GGG	473,045	1		1					
GJT	390,210	3		3					
GMU	82,336	4	2	6					
GNV	430,005	6	2	8					
GON	517,796	2	1	3					
GPT	187,878	2		2					
GRB	319,457	2		2					
GRF	0	1		1					
GRI	110,519	2		2					
GRR	559,914	1		1					
GSO	517,373	4		4					
GSP	215,507	2	2	4					
GTF	207,179	2	2	4					
GVT	455,900	1		1					
GYR	900,920	5		5					
GYY	556,798		1	1					
HFD	880,069	3	1	4					
HGR	324,953	1		1					
HHR	709,185	6	1	7					
HIO	951,050	2	1	3					
HKS	258,532	1	1	2					
HLG	155,743	1	3	4					
HLN	198,092		1	1					
HNL	503,683	1	2	3					
HOU	992,816	8		8					

DISTRIBUTION OF GENERAL AVIATION ACCIDENTS AND OPERATIONS BY LOCID, TERRAIN AND TIME OF DAY

NONMOUNTAIN					MOUNTAIN				
LOCID	OPERS	DAY	NGT	TOTAL	LOCID	OPERS	DAY	NGT	TOTAL
HPN	1,036,258	6	3	9					
HRL	291,981	3		3					
HSV	303,021	2		2					
					HTS	257,784	1		1
HUF	336,611	3		3					
HUM	288,828	2		2					
HUT	344,968	2		2					
HVN	629,322	1	2	3					
HWD	1,502,278	11	1	12					
HWO	1,137,183	11	3	14					
HYA	596,113	2		2					
IAD	508,739	4		4					
IAH	337,039	1	1	2					
ICT	725,400	4		4					
IDA	196,468	2		2					
ILG	906,314	1	3	4					
ILM	308,808	1		1					
IND	441,803	2	2	4					
INT	533,596	4	3	7					
IPT	219,555	2	1	3					
ISP	1,149,227	4	1	5					
ITH	420,089	1	2	3					
IXD	357,814	3		3					
JAN	200,688		3	3					
JAX	290,091	3	1	4					
JEF	194,750		2	2					
JFK	170,527		2	2					
JLN	101,411	3		3					
					JNU	248,640	8		8
JVL	476,334	1		1					
JXN	367,316	3		3					
LAF	625,767	3		3					
LAL	835,368	7	4	11					
LAN	675,978	5	1	6					
LAS	667,493	13		13					
LAW	144,207	1		1					
LAX	378,665		3	3					
LBB	467,252	7	1	8					
LBE	291,431	6		6					
LCH	272,682	2	1	3					
					LEB	294,332	2		2
LEX	490,935	3	1	4					
LGA	196,899	1		1					
LGB	2,409,019	10	3	13					
LHD	457,941	7	2	9					
LIT	617,557	5		5					

DISTRIBUTION OF GENERAL AVIATION ACCIDENTS AND OPERATIONS BY LOCID, TERRAIN AND TIME OF DAY

NONMOUNTAIN					MOUNTAIN				
LOCID	OPERS	DAY	NGT	TOTAL	LOCID	OPERS	DAY	NGT	TOTAL
LNK	466,849		1	1	LMT	239,401	4		4
LNN	285,506	1	1	2					
LNS	752,725	1		1					
LOU	1,122,750	3	3	6					
LRD	243,936		1	1					
LSE	258,791	2		2					
LTS	0		4	4					
LUK	0	3		3					
LVK	1,083,498	2	1	3					
LWB	76,145	1		1					
LWM	801,143	8	3	11					
LYH	310,513	3	1	4					
MAF	468,765	2		2					
MCE	274,003	5		5					
MCI	87,599	2		2					
MDH	588,961	4	2	6					
MDW	750,289	6	2	8	MDT	494,018	1		1
MEI	134,949	1		1					
MEM	592,808	3	1	4					
MFD	245,621	2	1	3					
MFE	394,978	5	1	6					
MFR	478,625	2	1	3					
MGE	0	1		1					
MGM	277,856	4		4					
MGW	273,972	1		1					
MHT	758,548	2		2					
MIA	357,914		1	1					
MIC	884,161	8	2	10					
MIE	265,459	2		2					
MKC	829,701	6	2	8					
MKE	472,589	1	1	2					
MKG	278,540	1	1	2					
MKK	57,489	1		1					
MLB	1,284,972	6		6					
MLI	335,945	1		1					
MLU	449,140	3		3					
MMU	1,229,836	4	1	5					
MOB	288,212	2	2	4					
MOD	587,475	5	9	14					
MOT	248,004	1		1					
MRB	126,014	2		2					
MRI	1,794,048	35	2	37					
MRY	464,954	7	1	8					
MSN	631,728	6		6					

DISTRIBUTION OF GENERAL AVIATION ACCIDENTS AND OPERATIONS BY LOCID, TERRAIN AND TIME OF DAY

NONMOUNTAIN					MOUNTAIN				
LOCID	OPERS	DAY	NGT	TOTAL	LOCID	OPERS	DAY	NGT	TOTAL
					MSO	285,696	6		6
MSP	451,530		1	1					
MSY	245,148	1	2	3					
MTN	781,417		1	1					
MTO	295,490	2		2					
MWA	268,092	1		1					
MWC	559,872	4	3	7					
MWH	760,790	1		1					
MYF	1,373,671	6	3	9					
MYR	0	1		1					
NEW	1,398,134	5	1	6					
NKX	0	1		1					
NMM	0		1	1					
NZJ	0	2		2					
OAK	1,607,921	4	3	7					
OGD	490,511	9		9					
					OGG	178,303	1		1
OJC	638,800	7	2	9					
OKC	424,495	2	1	3					
OLM	342,771	1	1	2					
OMA	516,508	1		1					
					ONT	258,542	1	1	2
OPF	1,078,354	15	2	17					
OQU	88,680	1		1					
ORF	503,680	3		3					
ORH	552,827	1	2	3					
ORL	970,264	7	2	9					
OSH	704,688	15	1	16					
OSU	835,728	2	1	3					
OUN	543,705	2		2					
OWB	283,282	2		2					
OWD	830,578	3		3					
OXR	677,436	2	2	4					
PAE	787,955	3	4	7					
PAH	173,904	1		1					
PAO	1,173,891	19	2	21					
PBI	875,838	5	4	9					
PDK	1,337,462	4	1	5					
PDT	138,454	1		1					
PFN	638,799	4	1	5					
PHF	526,795	2		2					
PHL	415,687	1		1					
PHX	768,706	5		5					
PIA	343,250	1	1	2					
PIE	895,020	5	3	8					
PIH	204,342	3		3					

DISTRIBUTION OF GENERAL AVIATION ACCIDENTS AND OPERATIONS BY LOCID, TERRAIN AND TIME OF DAY

NONMOUNTAIN					MOUNTAIN				
LOCID	OPERS	DAY	NGT	TOTAL	LOCID	OPERS	DAY	NGT	TOTAL
PIT	208,054	1		1					
PKB	355,328		3	3					
PMD	82,295	1		1					
PMP	857,340	5		5					
PNE	965,480	1		1					
PNS	457,236	3		3					
POC	1,185,674	4		4					
POU	697,555	4		4					
PRC	1,012,393	6	1	7					
PSC	329,372	1	4	5					
					PSP	385,702	6	1	7
PTK	1,972,091	12	3	15					
PUB	330,802	2		2					
PVD	908,032	2		2					
PWA	854,361	1		1					
PWK	1,262,037	11	3	14					
RAL	784,890	2	1	3					
RAP	247,300	2		2					
RBD	744,577	2		2					
RDD	513,427	5	2	7					
RDG	558,252	2		2					
RDU	591,274	3	1	4					
RFD	653,131	3	5	8					
RHV	1,186,020	14	1	15					
RIC	417,993	1		1					
					RNO	542,990	8	1	9
RNT	927,105	2		2					
					ROA	534,584	6	3	9
ROC	881,601	4	2	6					
ROW	224,221	3	1	4					
RST	318,281	1		1					
RVS	1,253,263	5	1	6					
SAC	825,747	3		3					
SAF	336,936	4		4					
					SAN	183,807		1	1
SAT	706,156	3		3					
SAV	376,480	5	1	6					
					SBA	917,918	3	2	5
SBN	393,965	1		1					
SBP	496,371	3	2	5					
SCH	320,790	1		1					
SCK	607,340	1	1	2					
SDF	243,911		2	2					
SDL	1,009,481	9	2	11					
SDM	731,150	2	1	3					
SEA	115,628	1		1					

DISTRIBUTION OF GENERAL AVIATION ACCIDENTS AND OPERATIONS
BY LOCID, TERRAIN AND TIME OF DAY

NONMOUNTAIN					MOUNTAIN				
LOCID	OPERS	DAY	NGT	TOTAL	LOCID	OPERS	DAY	NGT	TOTAL
SEE	1,156,709	6		6					
SFB	656,393	3	1	4					
SFF	494,559	5		5					
SFO	268,003	2		2					
SGF	365,999	4		4					
SGH	265,147	2		2					
SHV	243,244	2		2					
SIG	375,801	6		6					
SJC	1,542,151	7	1	8					
SJT	342,425	3	2	5					
SLC	565,615	6	1	7					
SLN	236,665	2		2					
SMF	318,051		1	1					
SMO	1,107,296	6		6					
SMX	365,616	4	4	8					
SNA	2,652,646	7	1	8					
SNS	489,488	4	2	6					
SPG	428,331	9	1	10					
SPI	463,431	3	2	5					
SQL	1,020,331	6		6					
SRQ	736,984	6		6					
SSC	0	1		1					
SSF	268,238	2		2					
STJ	104,359	2		2					
STL	304,224	1	1	2					
STP	628,646	3		3					
STS	721,124	3	2	5					
					STT	157,817	2	1	3
SUA	396,481	2	2	4					
SUS	928,342	6	1	7					
SWF	495,072	1	1	2					
SYR	349,683		2	2					
TCL	201,262	3		3					
TEB	1,357,964	4	1	5					
TIW	543,944	6		6					
TIX	709,718	6	1	7					
TLH	409,230	5	1	6					
TMB	1,820,991	8	2	10					
TOA	1,515,930	5		5					
TOL	390,252		1	1					
TOP	393,610	1		1					
TPA	454,916	2	1	3					
TRI	397,987		1	1					
TTD	306,784	1		1					
TTN	913,727	1		1					
TUL	640,526	3	1	4					

DISTRIBUTION OF GENERAL AVIATION ACCIDENTS AND OPERATIONS BY LOCID, TERRAIN AND TIME OF DAY

NONMOUNTAIN					MOUNTAIN				
LOCID	OPERS	DAY	NGT	TOTAL	LOCID	OPERS	DAY	NGT	TOTAL
TUS	973,621	7		7					
TVC	455,710	3	2	5					
					TVL	202,761	8	3	11
TWF	226,808	5	2	7					
TXK	233,124	1	1	2					
TYR	387,859	1		1					
TYS	485,243	2	1	3					
UCA	308,162	1		1					
UES	421,385	2		2					
UGN	872,965	5		5					
VGT	710,376	7		7					
VLD	243,964	3	1	4					
VNY	2,968,457	15	3	18					
VRB	1,000,449	9	2	11					
WDG	277,828	1	1	2					
WHP	832,639	8	2	10					
WJF	645,707	5	1	6					
WRB	0	1		1					
YIP	691,214	2	2	4					
YKM	353,683	3		3					
YNG	501,058	3		3					
YUM	333,255	2		2					
OTHER	11,747,891	0	0	0	OTHER	257,729	0	0	0
TOTAL	237,665,878	1472	404	1876	TOTAL	9,323,616	97	28	125

PART 4.00
ASPEN AIRPORT AND THE RISKS OF MOUNTAIN FLYING

VALENTINE'S DAY

Aspen Daily News

"Printed on Recycled Paper."

February 14, 1991

Lear Jet Crashes 'In Fireball' Across From Shale Bluffs

Aspen Local Believed To Be One Of Three Killed In Jet Accident

By EVE O'BRIEN and GREG TRINKER
Aspen Daily News Staff Writers

An Aspen resident was one of three people killed at dusk Wednesday when a chartered Lear jet operated by Tailwinds/Richmoore Aviation crashed into an empty field one-half mile short of Aspen's Sardy Field runway.

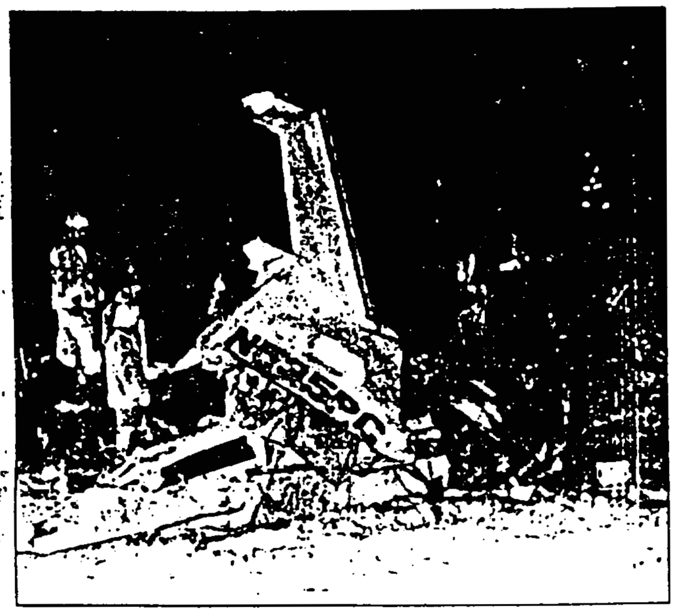
The Gates Lear Jet was based in Denver and flown by two Denver-based pilots at the time of the crash, according to an Aspen pilot familiar with the ill-fated flight, which took off from Las Vegas about 3:30 Wednesday afternoon.

Witness said the sleek jet appeared to dip its wings several times while coming in at a high speed before crashing in "a fireball" in an open area across from Shale Bluffs.

PITKIN COUNTY CORONER Steve Ayers said the bodies were "completely unrecognizable" and were just "charred remains. We'll have to use dental records to identify the bodies, he added.

Although some early reports, includ-

Please see CRASH on page 18



Aspen Daily News / Eve O'Brien

Only the tail section remained intact on this Gates Lear Jet that crashed about 5 30 p.m. Wednesday less than a mile away from the Aspen airport. An Aspen resident and two Denver pilots are believed to have been on board the plane, which was attempting to land when the accident occurred. None of the three survived.

Lear Jet Tragedy Is Seventh Crash Within 15 Months

By GREG TRINKER
Aspen Daily News Staff Writer

Although Aspen's alpine airport isn't considered dangerous by local pilots, the greater Aspen area has had three fatal aircraft crashes in the past six days, with nine deaths, and seven wrecks in the past 15 months. A total of 23 people have died from those aircraft tragedies.

Located at 8,000 feet, the airport is surrounded by imposing peaks. The th mountain air and tricky currents can fc pilots accustomed to sea-level flyir

"It is not a dangerous airport, but o that requires a lot more attention" th airports at lower elevations, according Aspen airport manager Brad Christ pher. "It's commonly known a accepted that mountain flying carr with it a few more risks than flatlar flying."

IT IS NOT federally required, bu many pilots get "mountain check outs" before flying in Aspen or other alpine areas, Christopher said. In a mountain check out, a pilot will fly with a local

Please see ACCIDENTS on page 19

Aspen Airport And The Risks of Mountain Flying

--Night VFR Study Report, Frontispiece

4.00
ASPEN AIRPORT AND THE RISKS OF MOUNTAIN FLYING

MARGARET W. LAMB, J.D.
SUSAN P. BAKER, M.P.H.

SUNSHINE AVIATION SAFETY STUDIES
QUESTA, NEW MEXICO 87556-0650

OCTOBER 1991

ASPEN AIRPORT AND THE RISKS OF MOUNTAIN FLYING

INTRODUCTION

Our recent study of crashes in the Colorado Rockies (1,4) was the first epidemiologic examination of this serious problem. The research entailed careful analysis of NTSB records of 230 crashes. We also flew Lamb's Navion over the passes, above many of the crash sites and into Aspen's airport. Wearing crash helmets against the unpredictable sudden downdrafts, equipped with emergency survival gear that could keep us alive for several weeks, we picked routes and altitudes that would allow us to coast miles to a safe landing in the event of an engine failure.

Because of ignorance or overconfidence, few pilots take such precautions. Too many ended up as statistics in our study, taking with them passengers whose lives had been placed in their hands.

To our great concern, it has now been suggested that Aspen's Sardy Airport be opened to general aviation at night. In addition to providing a copy of our study, we present the following overview of mountain flying and of basic injury prevention strategies, in support of arguments against allowing nighttime general aviation flights to or from Sardy.

OVERVIEW

General aviation (private flying) is a hazardous form of travel. The death rate per million person-miles for people in private planes is more than 6 times as high as for people traveling by private car (8 versus 1.2) (2). The likelihood of a fatal crash per 100,000 departures is 11 times as high for general aviation as for scheduled commuters and 43 times the rate for airlines (Table 1). Of all deaths in civilian aircraft, 81% are in general aviation.

Table 1. FATAL ACCIDENTS PER 100,000 DEPARTURES, 1985-1989, U.S.

GENERAL AVIATION	2.15
COMMUTERS, SCHEDULED	0.19
AIRLINES, SCHEDULED	0.05

Source: NTSB, Annual Report to Congress, plus estimate that a general aviation flight is 1.4 hours, based on FAA's General Aviation Activity and Avionics Survey for 1989.

In mountainous areas, the risks to the public traveling by general aviation are even greater than elsewhere. A review of all aircraft crashes in Colorado from 1982-1986 revealed that mountainous terrain was a factor in 30% of the fatal crashes compared with 7 percent of the nonfatal crashes (5). In addition to the mountains themselves, unpredictable weather, confusing terrain, and the effects of altitude on the pilot and on aircraft performance contribute to potentially lethal situations -- which are then compounded by the absence of level areas for emergency landings and the extreme difficulty of search and rescue operations.

As a result, the Rocky Mountain states and Alaska have the highest aviation death rates in the nation (Figure 1). For Colorado residents, the death rate is more than twice the national average: 1.4 versus 0.6 per 100,000 population (2).

Colorado is unique in having 54 mountains of 14,000 feet or higher, and Aspen is located near the middle of these peaks. It is the only airport in the United States where virtually all approaches require a pilot to fly for 50 to 100 miles above high mountains, most of them 10,000 feet or higher. During the 24 year period from 1964-1987, 88 crashes (more than three per year) within 50 nm of Aspen were of planes flying to or from the Aspen airport, not merely traversing the area. Of the 88 crashes, 27 were fatal and 87 lives were lost.

NIGHT FLYING NEAR ASPEN

Colorado mountain flying is fraught with perils. Violent atmospheric conditions challenge pilots threading their way across the peaks. Vision -- including the pilot's perception of aircraft position and attitude relative to terrain -- is the surest safety factor. And in a mechanical emergency, being able to see a landing spot amid the sea of peaks is vital.

Human vision is not good at night and the effects of hypoxia make night vision worse. Night vision deteriorates at altitudes as low as 5,000 feet. For optimum protection the FAA recommends that pilots use supplemental oxygen (a rare commodity in general aviation aircraft) above 10,000 feet during daytime and above 5,000 feet at night (Airman's Information Manual, Para. 601, "Effects of Altitude").

Furthermore, when crashes occur at night, they are 2 1/2 times as likely to be fatal as crashes during daytime hours (Table 2).

TABLE 2: PERCENT OF GENERAL AVIATION CRASHES THAT ARE FATAL AT NIGHT COMPARED TO DAYTIME; U.S. 1983-1987, FIXED WING AIRPLANES

	TIME	
	1900-0669	0700-1859
NUMBER OF FATAL CRASHES	853	1491
TOTAL NUMBER OF CRASHES	2337	10309
PERCENT FATAL	36%	14%

Source: Unpublished analysis by S.P. Baker of NTSB data tapes for 1983-1987

Except in full moonlight, at night the pilot has no outside image of the terrain. It is eerie and ofttimes frightening to navigate in the blackness among mountains, too low to be in range of VORs, trying to use pilotage and memory and imagination to avoid giant rocky peaks and ridges in the flight path. One of the authors (Lamb) nearly twenty years ago was snatched by a 3500-fpm downdraft, at night, near one of Colorado's highest peaks, and in daytime has since encountered many downdrafts approaching this magnitude. In Colorado's turbulent skies, it can be a nightmare to fly across mountain ranges in the pitch black darkness, fighting downdrafts, scrambling to maintain altitude at best angle of climb airspeed and full power, with no place to go if the engine fails.

The proposal to open Aspen for night VFR would permit access by single engine aircraft, which our study indicated have special problems in the mountains. Trying to land, VFR, at night in Aspen would involve hurtling down into a black hole punctuated by the small blaze of lights of the town and faint beams of headlights moving along nearby roads. Avoiding vertigo and controlling necessary high rates of descent take experience and mental discipline. Many of Aspen's visitors have never needed the qualities necessary for night mountain flying. A night pleasure flight to Aspen is not an appropriate learning opportunity.

VFR AND ASPEN

Relative to day VFR, in a publication issued by the FAA in 1976, the only VFR recommended arrival and departure route was through the Roaring Fork River Valley, via Carbondale (Figure 2) (3). Although the Red Table VOR and Aspen radar have since been installed, the terrain and vagaries of weather have not changed since then, yet airplanes now pour in and out of Aspen from all directions -- and three per year don't make it.

A VFR private pilot, who may carry passengers, can legally fly in the vicinity of Aspen with a 1,000 foot ceiling and three miles visibility.

In contrast, instrument-rated pilots, entering the Aspen area on the instrument flight plan Roaring Fork Visual Approach, are restricted to a 6,000-foot ceiling and ten miles visibility. Isn't there some message in this fact? Here are advanced aviators, utilizing sophisticated equipment, under radar guidance from Air Traffic Control, and their minimums are three to six times as stringent. And these are daylight procedures. Is it rational to make available a dangerous nighttime mountain environment for all grades of passenger-carrying pilot, from airline captains to private pilots? Yet this is what is proposed by opening Sardy Field to general aviation VFR and IFR night operations.

SOME COMMENTS ABOUT VFR APPROACHES INTO ASPEN

The least hazardous route to Aspen is up the Roaring Fork Valley, whose floor near Glenwood Springs is about 6,000 feet above sea level. The valley rises gradually to Aspen's elevation. There are good emergency landing sites along the way. Approaching Sardy Field from any other direction, pilots must make precipitous descents at rates calculated from 800 fpm to 1500 fpm or more. Many experts consider such descent rates unstabilized, and in less rugged parts of the country such steep profiles would never be planned or used.

Trying to stay ahead of an unusually high descent rate and keep the engine from shock cooling, while looking for traffic, is hard enough in the daytime when one can see what is out there. At night, with loss of visual references, the average pilot will be at severe risk.

Night departures pose additional problems. Even the easiest climb profile northwest along the darkness of the Roaring Fork Valley requires avoiding unseen hills. Other than turboprops and jets, few general aviation aircraft sport the climb rate necessary to clear, without circling, the massive peaks embracing Aspen to the northeast, east, and south.

Imagine a pilot exhilarated by Aspen area skiing and self-confident after meeting the challenges of landing at Sardy Airport. How easy to yield to the temptation to ski until the lifts close, grab a quick dinner, and take off in darkness in order to meet the next morning's business deadlines. Compounding the hazards of nighttime navigation in the mountains, his exuberance may mask judgment-clouding fatigue.

Night flying in this environment is, for all practical purposes, instrument flying; and the non-instrument-rated aviator, legally traversing mountains VFR in the dark, will find his or her skills harshly tested.

During hours of darkness when the tower is open, Aspen Approach presumably could provide radar advisories to VFR traffic, workload permitting. But does the FAA want to undertake the risk of navigating for the pilot when the pilot, flying along in mountain blackness, cannot see the hazards for himself?

PREVENTIVE MEASURES

"You be careful!" and "Use good judgment!" are ineffective prevention measures. NTSB records give ample evidence that experience and local familiarity do not protect pilots and their passengers from the hazards of mountain terrain. Of the pilots who crashed within 50 nm of Aspen, the majority had more than 1000 hours of flight time, almost 60% were Colorado residents, and 17% were instructors. One instructor was teaching an AOPA-sponsored mountain flying course at the time of his fatal crash.

A new study of work-related aviation deaths in Colorado found that 93% of the non-military personnel were in general aviation aircraft and most of the pilots had extensive experience. One general aviation pilot, a western Colorado dentist who often flew his dental crew to work in a remote location, took off to return home after a day's work and flew into a cloud-obscured mountain, killing himself and 4 employees (5). Although he was a pilot with more than 2,200 hours, there was no record that he received a weather briefing or filed a flight plan. Thus, even experienced pilots cannot always be relied upon to use sufficiently good judgement.

Airplane crashes do not occur at random. In illustration, rates are higher at night and in mountainous areas, and certain types of aircraft are especially likely to be involved in specific types of crashes. The fact that airplane crashes are not random implies that much can be done to prevent them, often by reducing exposure to specific high-risk situations.

In recent years, research in virtually all types of transportation crashes and other accidents has made it clear that because of human fallibility, injuries and deaths are bound to occur if we have to rely on the expertise, cooperation, and eternal vigilance of everyone at risk of injury. Effective prevention of accidents and injuries entails measures that minimize the opportunities for disaster. This is reflected in many examples of effective prevention measures, including:

- requiring nighttime currency for pilots carrying passengers
- requiring instrument ratings before pilots may fly in clouds
- restricting some categories of tractor-trailers to the types of roads that can accommodate them most safely
- closing ski slopes at times of greatest danger from avalanches.

These strategies exemplify reasonable regulations that effectively protect the public. In contrast, warning signs, high school driver training courses, and many similar educational approaches have been shown to have little or no effect -- especially on the people who are most likely to place themselves and others at risk. Tragically, the individuals who are least susceptible to warnings often exhibit a constellation of hazardous behaviors. For example, the drivers who are least likely to wear seat belts are those who have been drinking or are following other vehicles too closely, running red lights, or otherwise driving foolishly -- and therefore most apt to crash and to need the seat belts.

Our review of crashes in the Aspen area, as well as a great deal of scientific research in injury prevention, suggests that many pilots cannot be relied upon to protect themselves and their passengers by avoiding flights that are beyond their competence or the capabilities of their aircraft. Many FARs reflect this fact. For example, the FAA has designated more than 60 airports as requiring special qualifications of Part 121 pilots, typically because of mountainous terrain. These "special" airports are discussed elsewhere. Of particular relevance to this report is the fact that Aspen, in the eyes of many pilots, is unique among all towered airports in the degree to which it challenges pilots. If this is true in the daytime, then surely the public should not be placed in jeopardy by allowing nighttime operations.

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Susan P. Baker is an internationally recognized epidemiologist who founded the Johns Hopkins Injury Prevention Center. After many years of work in highway safety, she obtained a pilot's license and now focusses her efforts on aviation safety, studying mountain flying, pilot fatigue, aviation occupational injuries, and human factors in Part 135 crashes. Author of the Injury Fact Book, she has written scores of articles as well as many textbook chapters. Professor Baker holds joint appointments at The Johns Hopkins Medical Institutions in Health Policy and Management, Pediatrics, Environmental Health Sciences, and Emergency Medicine.

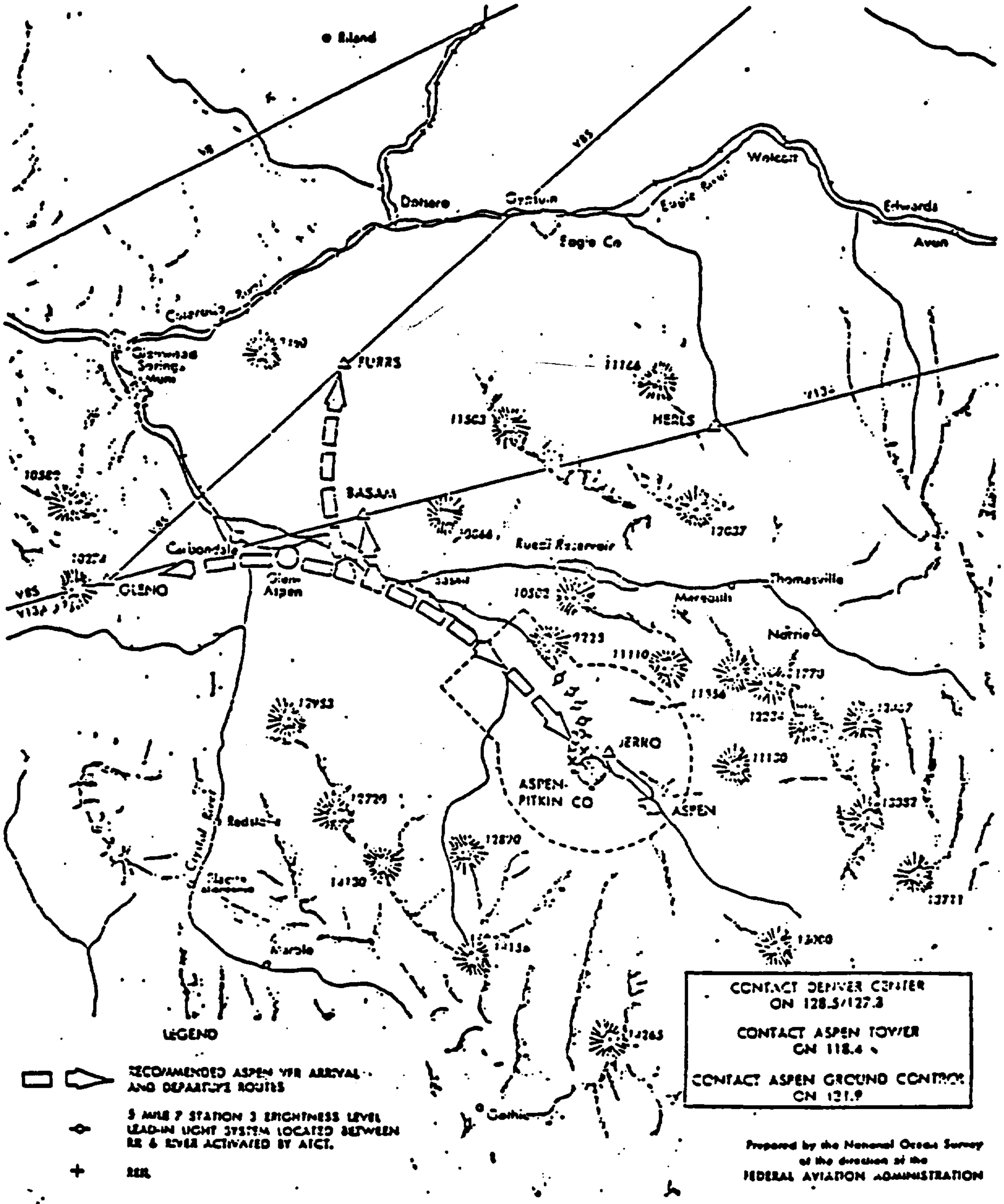


FIGURE 2. TERMINAL AREA GRAPHIC NOTICE, ASPEN, COLORADO, ASPEN, PITKIN COMPANY

(DEPARTMENT OF TRANSPORTATION (1976). <u>FLYING TO ASPEN</u>? DENVER CENTER: FAA ROCKY MOUNTAIN REGION, DENVER FSS)

PART 5.00
HAZARDS OF MOUNTAIN FLYING: CRASHES IN THE COLORADO ROCKIES

Susan P. Baker and Margaret W. Lamb

Aviation, Space and Environmental Medicine
June, 1989

NEW YEAR'S EVE

Aspen Daily News

"Printed on Recycled Paper."

5?? E. HOPKINS, ASPEN, COLORADO 81611 — MONDAY, DECEMBER 31, 1990 — VOL 13 #156 FREE

Two Survive Skillful Crash Landing At W/J

Engine Dies Mysteriously; Neighbor Cites Incident As Reason To Keep Night Curfew On Private Aircraft

Daily News Staff Report

A pilot narrowly avoided smashing his plane into employee housing at the W/J Ranch when the engine of his Cessna 210 stopped miles short of the Pitkin [illegible] Airport, forcing him to land in [illegible] meadow near the Rio Grande Trail Saturday.

The pilot, Steven Dolezal, 42, of Basalt and his 17-year-old stepson Jeff Lehman walked away from the wreck with minor cuts and bruises, but the incident is evidence that safety concerns justify the Pitkin County Airport's after-dark curfew for private pilots, according one curfew supporter.

Deep snow in the meadow on the "lower bench" of the ranch softened the landing of the plane. However, it was destroyed when it hit a large boulder before coming to a stop in the meadow, according to Pitkin County Sheriff's Deputy Joe DiSalvo.

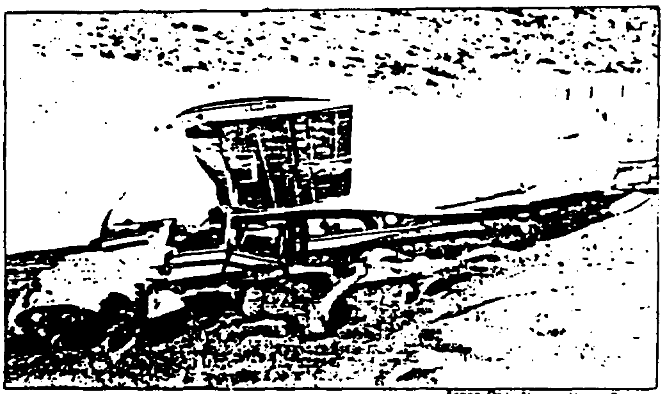
"IT WAS crunched," DiSalvo said of the light plane, which landed near an area used to dump sludge from the Snowmass Sanitation District.

The plane came down about one-tenth of a mile from the nearest house at the W/J Ranch, which is located about five miles west of downtown Aspen.

If the accident had happened at night, the pilot might not have been able to avoid the homes and choose a safe lan[ding] spot because of darkness, accord[ing] to Wink Jaffe, who owns the employ[ee] housing near the crash site.

"I guarantee you, if this had happene[d] at night he (the pilot) would be dead as well as maybe some other people in the houses," Jaffee said. "With visibility there's a much better chance that everybody's going to be OK."

Please see CRASH on page 18



Aspen Daily News / Nicole Rimpel

CRASH LANDING: Boulders stopped a Cessna 210 that crash landed near the W/J ranch. The pilot and his passenger received minor injuries.

> "I guarantee you, if this had happened at night, he (the pilot) would be dead as well as maybe some other people in the houses."
>
> Wink Jaff[e]

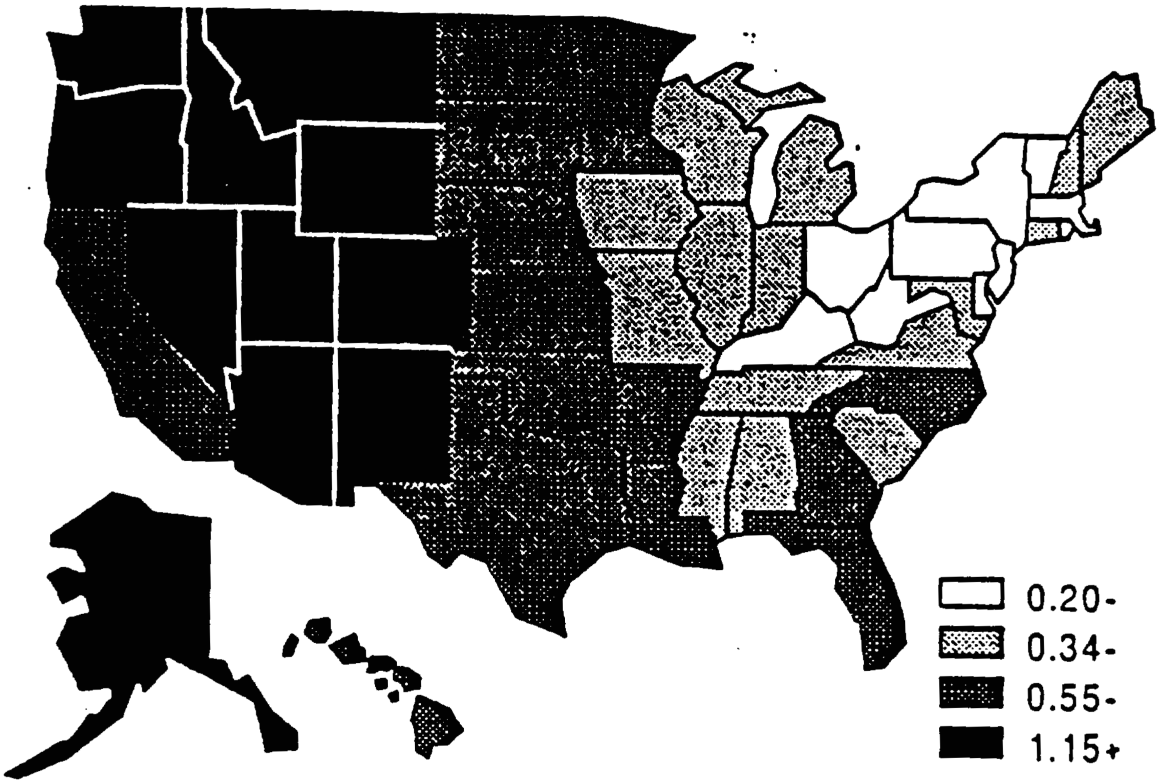


FIGURE 1. DEATH RATES FROM AIRCRAFT CRASHES BY STATE, PER 100,000 POPULATION, 1980-1986

(BAKER, S.P., ET AL. <u>THE INJURY FACT BOOK, 2ND EDITION</u> (1991). NEW YORK, NEW YORK: OXFORD UNIVERSITY PRESS)

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JUNE, 1989

AVIATION, SPACE & ENVIRONMENTAL MEDICINE

Hazards of Mountain Flying: Crashes in the Colorado Rockies

SUSAN P. BAKER, M.P.H., and MARGARET W. LAMB, LL.B.

BAKER SP, LAMB MW. *Hazards of mountain flying: crashes in the Colorado Rockies.* Aviat Space Environ. Med. 1989; 60:531–6.

Between 1964 and 1987, 232 airplanes crashed within 50 nautical miles of Aspen, CO; 90% were general aviation crashes. A total of 202 people died and 69 were seriously injured. The societal cost averaged more than $4 million annually. Most pilots were experienced and many were flight instructors, but 44% had flown less than 100 hours in the type of plane in which they crashed. Forty-one percent of the pilots were out-of-state residents. Crashes in the study area were more likely to be fatal than in the rest of Colorado. Airplanes with three or four occupants and low-powered four-seater aircraft were over-represented among crashes involving failure to outclimb rising terrain. In a subset of crashes examined for restraint use, 50% of the front seat occupants using only lap belts were killed, compared to 13% of those who also wore shoulder restraints. Preventive recommendations include shoulder restraint use and better training in mountain flying, with incentives provided by the FAA and insurance companies.

We dedicate this article to W. R. Lovelace II, M.D., a pioneer in aerospace medicine who perished in a crash in the Colorado Rockies.

AIRPLANE CRASHES are the eighth leading cause of fatal unintentional injury in the United States (2). In the decade from 1976 to 1985, 15,360 Americans lost their lives in airplane crashes. Only 8% of those killed were on air carriers or scheduled commuter flights; 80% of the deaths involved general aviation (private aircraft, including planes owned by private companies) and 12% involved unscheduled air taxi operations (19).

In the mountain states, aviation death rates are at least twice the rate for the United States as a whole (2). To better understand the size and nature of the problem, we reviewed a 24-year series of crashes in a mountainous area where news reports suggested that a large number of crashes had occurred in recent years (5). The selected area surrounds Aspen, CO and includes the Leadville airport (9,927 ft above sea level, the highest public airport in the United States) and nine other public airports. A 70-mi section of the Continental Divide crosses the area; major general aviation routes include Independence Pass, at 12,094 ft, and Monarch Pass, at 11,312 ft—far higher than most commonly used mountain passes in other states.

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This manuscript was received for review in September 1988 and accepted for publication in November 1988.

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METHODS

The National Transportation Safety Board (NTSB), which collects data on all civilian airplane crashes in the United States, listed the locations of crashes in Colorado between 1964 and 1987. We identified all crashes within a radius of 50 nautical miles (93 km) of Aspen, CO, using the Denver Sectional Aeronautical Chart (16). The NTSB supplied a brief report for each with information on place, date, time, characteristics of aircraft, pilot, and circumstances, as well as number of occupants and whether they were killed or injured. Detailed written reports of NTSB investigations provided data on shoulder restraint use and alcohol for the subgroup of 22 cases since 1979 in which pilots crashed in mountain terrain under visual conditions. NTSB computer tapes for 1983–86 provided data on pilots' place of residence and occupation.

Comparison data were obtained from NTSB tapes for other crashes in Colorado, from Federal Aviation Administration (FAA) publications for trends in aviation activity (6), and from NTSB national data on general aviation crashes (18).

RESULTS

A total of 202 people were killed and 69 seriously injured* in the 232 airplanes that crashed in the study area between 1964 and 1987. Thirty percent of the crashes were fatal to one or more occupants. Crashes

* "Serious injury" is defined by the NTSB as any injury which: 1) requires hospitalization for more than 48 hours; 2) results in a fracture, except simple fractures of fingers, toes, or nose; 3) causes severe hemorrhage, nerve, muscle, or tendon damage; 4) involves any internal organ; or 5) involves second- or third-degree burns.

were more likely to be fatal in the study area than elsewhere in Colorado: for the period 1983–86, 32% were fatal in the study area versus 19% in the rest of Colorado ($X^2 = 3.3$, $p = 0.07$).

The majority of the flights (59%) were personal flights (Table I). Only two aircraft were scheduled commuters: both made hard landings—in one instance, the pilot had not lowered the landing gear. On-demand air taxis were involved in 17 crashes, killing 37% of their occupants. Business or corporate airplanes were involved in 42 crashes and 32% of their occupants were killed.

Categories of Crashes

We divided the crashes into nine groups, based on the circumstances and major contributing factors.

1. Mountain terrain: Of the 57 airplanes in this category, 37 were unable to outclimb rising terrain and the pilots could not successfully turn back; 9 struck terrain while flying level or descending under conditions in which the pilot was not accurately aware of location; 5 were snared by windshears and unexpected downdrafts on the windward side of a ridge (mountain drainage winds); and 6 were caught in lee side downdrafts or rotors under mountain wave conditions.

2. VFR into IMC—flight into instrument meteorological conditions (IMC) from weather in which visual flight rules (VFR) applied: These 24 flights also ended when the airplanes struck mountain terrain, but unlike the crashes in the first group, they took place under conditions of greatly reduced or zero visibility in clouds or precipitation.

3. High winds, crosswinds, or turbulence at the airport: Placed in this category were three pilot-loss-of-control crashes in surface winds greater than 30 knots or in moderate to severe turbulence close to the ground.

4. Airport conditions: The 45 crashes in this category (46 airplanes) involved one or more of the following: water, snow, slush, ice, or asphalt chips on the runway; pavement holes or soft runways; deer on the runway; fences, rocks, dirtbanks, snowbanks or ditches near the runway; tailwinds at airports with runways used for opposite-direction takeoff and landing; and sloping runways or those of non-standard width.

5. Ice or frost on the airframe: This is a condition which causes reduction of lift: seven pilots departed without removing airframe ice or frost.

6. Improper operation of the powerplant: Ten crashes involved incorrect adjustment of the mixture control; using the wrong weight oil; running out of gas; or fuel starvation because the fuel tank selector valve was in the wrong position.

7. Improper operation of the flight controls (rudder, ailerons, elevator, and flaps): Fifty crashes included pilot loss of control on takeoff (thirteen), landing (thirty-six), or in flight (one). This category differentiates between airport objective conditions (Category 4), and improper piloting techniques resulting in stalls, ground loops, gear-up landings, hard landings, and runway undershoots and overshoots.

8. Mechanical failure: There were 21 crashes caused by malfunctions such as propeller blade separation, throttle control arm separation, engine failures and fires, power losses, electrical and brake failures, loose magneto parts, lint in the fuel selector valve, sugar in an auxiliary tank, eroded fuel pump liner, nose gear collar failure, loose seat screws, and tire tread separation.

9. Miscellaneous: A further 13 crashes (14 aircraft) involved wire strikes, acrobatics, precautionary landings to avoid IMC, a low pass, or a midair collision.

TABLE I. PURPOSE OF FLIGHT BY NUMBER OF OCCUPANTS AND DEATHS.

Purpose	Flights	Occupants	Deaths No.	Deaths %
*Personal Flights	136	415	109	26%
*Business/Corporate	42	131	48	37%
Air Taxi	17	76	24	32%
*Instruction	16	43	7	16%
*Student Solo	6	6	0	0%
Ferry	4	7	4	57%
Scheduled Commuter	2	47	0	0%
*Other**	9	20	10	50%
TOTAL	232	745	202	27%

* These are considered "general aviation."
** Includes search and rescue, agricultural spraying, aerial survey, airplane test flight, air show, and one stolen airplane in which all 8 occupants were killed.

Density Altitude

Many crashes occurred at density altitudes of 13,000 to 15,000 feet. Density altitude was a factor in most categories of crashes and was not isolated as a single cause. Decreased aircraft performance was influential in takeoff and departure incidents and in crashes involving failure to outclimb rising terrain; 30% of crashes in the latter category occurred in July when density altitude is often very high. In contrast, only 11% of other crashes occurred in July ($p < 0.01$) (Fig. 1). For all categories combined, the largest number of crashes occurred in July and the second largest in March.

Mountain Weather

Mountain weather was a factor in all categories of crashes: atmospheric phenomena, including mountain waves, downdrafts, rotors, valley and drainage winds, whiteout, icing, instrument conditions, thunderstorms, lightning, windshears, turbulence, gusty winds, crosswinds or tailwinds upon landing, and density altitude (and combinations of these) were documented in 113 cases (49%).

Occupants

All the aircraft involved had a total of 745 occupants, of whom 27% were killed. Three-fourths of all deaths occurred in crashes related to mountain terrain or IMC, in which 47% and 83%, respectively, of the occupants were killed (Table II). No deaths were related to equipment malfunction or airport conditions.

The median number of occupants was 2.1 for all airplanes. Aircraft that were unable to outclimb rising terrain had more occupants (median = 2.6), reflecting the importance of the weight of occupants in determining crash likelihood in mountainous areas. The percentage of crashes involving inability to outclimb rising terrain

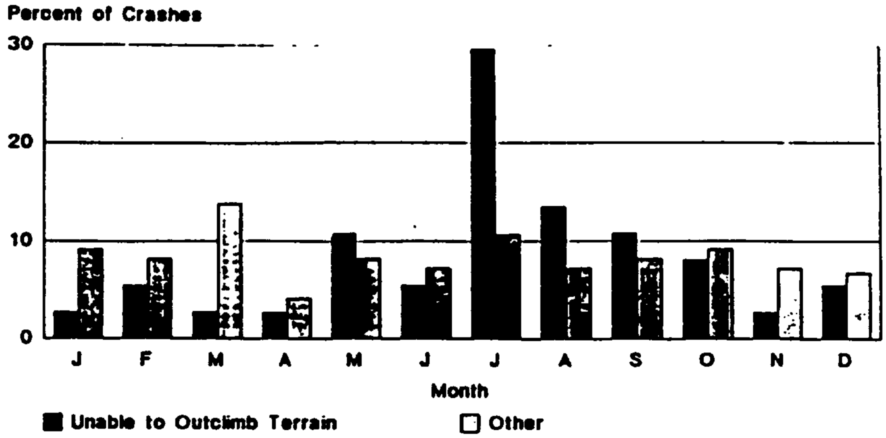

Fig. 1. Percent of crashes by month of the year and circumstances.

increased from 6% for airplanes with one occupant to 30% of those with four occupants (Fig. 2). Also overrepresented in this group of crashes were relatively low-powered four-seaters (≤180 horsepower), which comprised 49% of airplanes unable to outclimb terrain, but only 14% of airplanes in other categories (X^2 = 24, $p < .001$).

Pilots

The median age of the pilots was 37 years, with a range of 19 to 73 years. The majority (52%) had more than 1,000 hours of total flight time and only 9% had less than 100 hours. Forty-six percent had an airline transport license and/or a commercial license. Only 5% were student pilots flying without an instructor. Of the pilots-in-command 37 (17%) were instructors; 1 was teaching a mountain flying course when he crashed.

Many pilots had little experience in the type of airplane flown at the time of the crash (Fig. 3): 16% had less than 20 hours in type and 44% had less than 100 hours. Pilots with air transport ratings were as likely to have low time in type as other pilots.

Place of residence was available from NTSB computer tapes for crashes during 1983–1986: 15 of the 37 pilots (41%) who crashed in the study area during that period did not live in Colorado. Of those 15, 1 came from a nearby mountain state; the rest were "flatlanders." In other parts of Colorado, only 25% of pilots involved in crashes were out-of-state residents (X^2 = 3.9, $p < 0.05$).

The pilot's occupation was known for 28 of the 37 cases during 1983–1986. Eleven were businessmen, 9 were professional pilots, 3 were physicians, and 5 had other occupations.

Time Trends

The numbers of crashes in successive 6-year periods showed no consistent trend. However, the percent of crashes that were fatal increased from 19% in 1964–69 to 37% in 1982–87 (Table III). General aviation operations (landings and departures) at Aspen increased from 14,000 in 1970 to a high of 40,000 in 1980 and then declined: there were 32,000 operations in 1986. A comparable decline in deaths did not occur. The increase in the percent fatal may have been due to a decrease in reporting of non-fatal crashes, since virtually all fatal crashes are reported.

Subgroup Results

Between 1979 and 1987, 22 airplanes crashed in mountain terrain under conditions of good visibility and without known malfunctions (Category I). Detailed reports were obtained for these 22 crashes.

Restraints: Investigators reported that all 44 front seat occupants in the subgroup were wearing lap belts and that 23 also wore shoulder restraints; 14 were not using shoulder restraints (6 by choice and 8 because they were not available) and usage was unknown for 7 occupants. Fatality rates were 13% (3/23) for those wearing shoulder restraints versus 50% (7/14) for those

TABLE II. DEATHS AND SERIOUS INJURIES BY CATEGORY OF CRASH.

Category	Airplanes	Occupants	Injuries	Deaths No.	Deaths %
Mountain terrain	57	188	32	91	48%
VFR into IMC	24	72	4	60	83%
Winds at airport	3	6	0	1	17%
Airport conditions	46	143	6	0	0%
Ice on airframe	7	31	12	6	19%
Powerplant operation	10	28	4	4	14%
Flight control operation	50	169	10	13	8%
Mechanical failure	21	63	1	0	0%
Miscellaneous	14	45	0	27	60%
TOTAL	232	745	69	202	27%

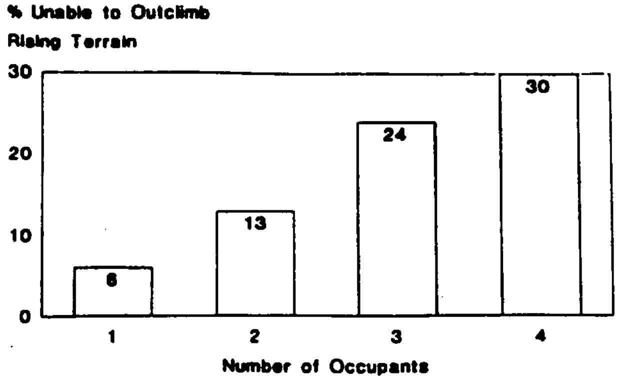

Fig. 2. Inability to outclimb rising terrain in relation to number of occupants.

who did not use them (Table IV). Almost half (11/23) of the restrained occupants had no reported injury, compared with all 14 of the unrestrained.

Five of the seven unrestrained front seat occupants who survived were known to have sustained facial lacerations in addition to their other injuries. Among the restrained occupants who escaped without injury were two whose airplane was demolished.

Alcohol: Toxicological reports were available for nine of the ten pilots who died. Eight were negative for alcohol and other drugs. The ninth, an instructor in mountain flying, had a blood alcohol concentration (BAC) of 0.15% and his student pilot had a BAC of 0.07% when they encountered high winds and flew into a 30° slope on a clear morning. This result is similar to other studies showing that roughly one-tenth of all fatally injured pilots were intoxicated (20).

DISCUSSION

The cost of airplane crashes in mountainous states is staggering, whether measured in human losses or dollars. Using a very conservative figure for the value of a human life ($500,000), the lives lost since 1964 in this small area would be worth more than $100 million. Nonfatal injuries, airplane loss or damage, and search and rescue operations add additional millions to the societal cost. In this 24-year period, airplane crashes thus wasted more than $4 million annually in an area that comprises only one-tenth of Colorado.

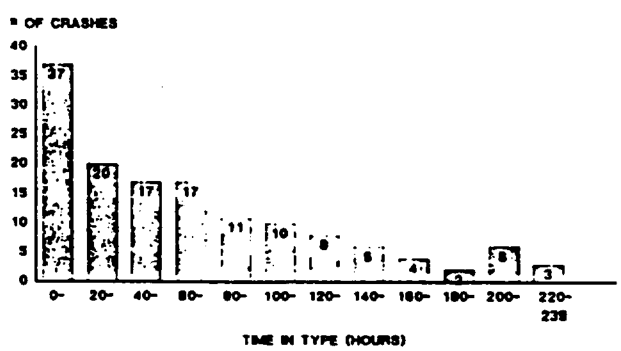

Fig. 3. Number of crashes by pilots' time in aircraft type.

TABLE III. YEAR OF CRASH BY FATALITIES.

Year	No. of Airplanes	1+ Fatality (No.)	1+ Fatality (%)
1964–69	48	9	19%
1970–75	63	19	30%
1976–81	64	20	31%
1982–87	57	21	37%
TOTAL	232	69	30%

Nor is the problem unique to Colorado: in neighboring mountain states, fatal crash rates are even higher than the rates for Colorado. The exceptionally high mortality in the mountain states is not due to air carrier crashes. Neither does it result from the greater general aviation activity in mountainous states, since the death rate in relation to the number of pilots or airplanes is several times as high in the mountain states as in nearby flatter states such as Kansas and Texas (24). Rather, the high rates of death appear to be associated with special hazards of mountain flying.

Despite the size of the problem, potential solutions are neither obvious nor simple. To the usual challenges of aviation, mountain flying adds the poor performance of aircraft operating at high altitude (23,25); unique meteorologic conditions, such as small-scale mountain weather, the mountain wave, and mountain drainage winds (10,11,12); difficulties in navigation (7); and a dearth of flat terrain for emergency landings. Terrain often dictates airport design, resulting in short and/or sloping runways and an orientation that requires crosswind or tailwind landings and takeoffs. As with motor vehicle crashes in remote rural areas (3), delays in rescue, emergency treatment, and definitive care no doubt contribute to the high death rates.

Many crashes involved poor pilot judgment: for example, underestimating the effects of mountainous terrain, flying a poorly maintained aircraft, ignoring or not obtaining weather information, or carrying too many passengers (9,10,12). The crashes involving instructors or pilots with air transport ratings showed that even experienced pilots sometimes exhibit extremely poor judgment. In fact, some studies suggest that general aviation crash rates and fatality rates increase as pilot experience increases (4,14).

Two types of inexperience are suggested by our data: unfamiliarity with the aircraft and with mountain ter-

TABLE IV. SHOULDER RESTRAINT USE IN RELATION TO INJURY: FRONT SEAT OCCUPANTS IN 22 AIRPLANES THAT CRASHED IN MOUNTAIN TERRAIN.

Shoulder Restraint	Injury Severity: Fatal	Serious	Minor	None	Total
Not used	7	3	4	0	14
Used	3	4	5*	11	23
Total	10	7	9	11	37

$X^2 = 11.3$, $p = 0.01$.

* Two people with minor injuries subsequently died of exposure, including one pilot who left to get help (his four passengers survived). Table excludes seven occupants whose shoulder restraint use was unknown; four of them died.

rain. Although most pilots had extensive experience in other aircraft, almost half had less than 100 hours in the type of plane in which they crashed. An unfamiliar aircraft is a major liability when a pilot is challenged by the special hazards of flying among mountains and at high altitude.

Many pilots neither recognize the poor performance of most non-turbocharged airplanes at high altitude, nor consider it in relation to expected downdrafts. For example, at gross weight and 0°C, at a pressure altitude of 10,000 ft, the Piper 28-161 (Warrior II) can climb at a rate of only 120 ft • min^{-1} (fpm); the Cessna 172, 225 ft • min^{-1}, and the Cessna 152, 285 ft • min^{-1}. Climb performance deteriorates rapidly at higher temperatures; for example, in the Cessna 152 it drops to 135 ft • min^{-1} at 20°C and 10,000 ft pressure altitude. Although climb rates can be slightly improved by carrying fewer passengers or otherwise reducing weight, single engine aircraft often cannot compensate for mountain downdrafts: 200–500 ft • min^{-1} downdrafts are commonplace and 1,000 ft • min^{-1} or more is not unusual.

The degree to which "flatlanders" account for crashes in mountainous areas has long been a matter of speculation. The present study indicates that this may well be a factor in the Aspen area, where a disproportionate number of crashes involve out-of-state pilots. For 90% of Colorado, however, out-of-state pilots were involved in only 25% of all crashes; therefore, they do not explain the fact that Colorado's general aviation death rate is 2.6 times the national average (1.29 versus 0.49 per 100,000) (24).

Clearly, not only "flatlanders" but also local pilots may lack adequate training in mountain flying. In recognition that many pilots will eventually fly in mountainous areas, pilot training manuals, courses, and owners' manuals should include more material relevant to mountain flying. To encourage appropriate training, the FAA could define designated mountainous areas and establish a mountain flying rating necessary for operation in such areas. This would provoke controversy, but the rulemaking process would focus attention on the severity of the problem of mountain crashes.

Two-thirds of the people killed in this series of crashes were passengers. The FAA could establish training and currency requirements, comparable to those for nighttime or instrument flying, for pilots who wish to carry passengers in mountainous areas. Definitive curricula could be established for mountain flying courses under the Federal Aviation Regulations for Pilot Schools (8). No such standards exist at present.

Insurance companies could play a major role in aviation safety by drafting a comprehensive mountain flying curriculum and insisting upon such training, certified by an accredited mountain flying instructor, before granting coverage effective in designated mountainous areas. In addition, insurers could offer lower premiums for pilots who take the courses and receive periodic refresher training.

Manufacturers can contribute by improving owners' manuals, which pilots use to predict aircraft performance. Such manuals should emphasize that performance figures are based on a new, precisely-rigged aircraft with a perfectly timed engine, flown by an experienced test pilot. The figures cannot be achieved with a poorly maintained machine or by a low-time pilot. Similarly, density altitude computation tables in the owner's manual are based on theoretically perfect performance and should be evaluated conservatively. Once airborne, many aviators forget that density altitude affects climb performance all the way to the aircraft service ceiling (the height above sea level at which the aircraft will only climb at 100 ft • min^{-1}). Owner manuals neglect to state that the service ceiling is, in effect, a density altitude. In one crash, for example, at an altitude of 11,700 MSL, the air temperature was 20°C (65°F). The density altitude computes to about 15,000 feet, well above the service ceiling of many single engine aircraft in the study.

General aviation crashes are both common and severe. Approximately one aircraft in four will crash during a 20-year lifespan (1). (In 1986 there were 116 general aviation crashes per 10,000 aircraft-years of exposure.) Three deaths occur for each serious injury (20)—12 times the ratio for highway crashes (15). Crash outcome can hinge on availability and use of shoulder restraints and crashworthiness of aircraft (22). In one crash, for example, the location of gas tanks directly under the front seats may have contributed to the fatal post-crash fire in an otherwise survivable crash.

NTSB researchers estimate that shoulder harnesses would reduce fatalities by 75% in potentially survivable crashes (17). Since 1978, shoulder restraint installation and use have been required for front-seat positions in all new general aviation airplanes, but they are rare in older planes and often not used even when available (21). Analyses of shoulder restraint effectiveness in airplane crashes have been needed, but NTSB brief reports lack data on restraint use, and computerized data do not differentiate between occupants killed in crashes and uninjured occupants who subsequently died of exposure. Review of detailed written reports allowed us to make this distinction, which is crucial when evaluating restraint systems.

Unlike either very minor airplane crashes, in which death is rare, or uncontrolled decelerations, in which survival is unlikely, the subgroup of mountain terrain crashes provided the opportunity to assess restraint effectiveness in crashes that typically were life-threatening but potentially survivable (Table IV). The 22 pilots had been flying in visual conditions when their planes were trapped by downdrafts or mountain drainage winds, or were unable to outclimb rising terrain. Unlike many pilots caught in blinding snowstorms or other visibility-limiting weather, they maintained some control of their aircraft as they attempted to avoid a crash or make a survivable landing. The high survival rate (87%) of occupants wearing shoulder restraints demonstrates that such crashes need not be fatal if shoulder restraints are provided and worn. The FAA and insurance companies should establish rules and incentives to augment availability and use of shoulder restraints.

Airplane crashes are an important public health problem. Since 1983, an average of 530 of the 715,000 licensed pilots in the U.S. have died each year (24). Their annual death rate of 72 per 100,000 pilots in airplane crashes rivals the death rate of 18-year-old males in motor vehicle crashes and greatly exceeds death rates in high-risk occupations such as mining and agriculture (2). Underscoring the public health impact of airplane crashes is the large number of job-related deaths: in Colorado, fully one-third of all aviation deaths are occupational (13).

Although airplane crashes may occur in any geographic area, high rates in the mountains are related to risks exacerbated by altitude and steep terrain. Crashes in mountainous areas are especially likely to be fatal and deserve further scientific examination and preventive efforts.

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The National Transportation Safety Board provided the reports and data tapes that were the basis for this study. We thank Stanley Smith and Robert Dodd of the NTSB and Daniel Webster and Anna Waller of the Injury Prevention Center for providing data and assisting in their interpretation and analysis.

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PART 6.00
COLORADO MOUNTAIN FLYING: CRASHES AND WEATHER

American Institute of Aeronautics and Astronautics, Inc

Margaret W. Lamb and Susan P. Baker

1989

Aspen Daily News
May 14, 1990

Recovery Team Nearly Stranded By Weather

Bodies Brought Down Despite Wind Delays

By SCOTT BROOM
Aspen Daily News Editor

Six of the eight rescuers sent to recover bodies from an April 28 plane crash north of Hagerman Pass were nearly forced to snowshoe back to civilization after gusty winds kept a recovery helicopter at bay Sunday afternoon.

The weather eventually broke, and the rescuers, including Pitkin County Coroner Steve Ayers, were picked up by the chopper after walking only part of the way to a rendezvous with Vail Search and Rescue members waiting to meet them at Homestake reservoir four miles away.

ALL RECOVERY volunteers were back to safety by 4 p.m., according to Pitkin County spokesman Bud Eylar.

The two day mission was successful despite being constantly threatend by dangerous winds and snow showers, according to Eylar. The bodies of six Salt Lake City area residents killed in the wreck of a single engine Piper Cherokee were recovered from the snowy, 11,800 foot crash site near the Continental Divide and taken to Aspen Valley Hospital for a coroner's investigation.

The helicopter was used to airlift the bodies from the avalanche prone area where the wreckage lay to a refrigerated truck waiting at Sellar Meadow, seven miles away.

THE START of the mission had been put off a full day because of weather. Once underway, the problems continued. Two Mountain Rescue Aspen volunteers were shuttled to the site near Lonesome Lake Saturday afternoon in order to make camp, but gusty winds made it impossible to deliver two more workers to the site before dark.

The volunteers who'd made it to the site began uncovering the bodies at 5:30 a.m. in order to take advantage of firm snow and the reduced danger of avalanches early in the day, according to Eylar. Meanwhile, the helicopter

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FROM PAGE 1

Foul Weather Hampers Successful

RECOVERY from page 1

resumed shuttling volunteers and Coroners officials to the site by about 7 a.m.

Four of the bodies had been airlifted from the site before gusty winds once again stopped flights at about 11:30 a.m. The operation resumed an hour later. The last of the victims and two resucers had been flown out when winds stranded the other six for more than two hours.

INVESTIGATORS FROM the National Transportation Safety Board cancelled their plans to visit the crash site because of bad weather.

Eylar said it could be summer before they can get to the crash site to determine a cause of the accident.

The six victims died April 28 when the plane carrying members of a singing chorus en route to a Colorado Springs singing competition crashed into the ridge inside the Holy Cross Wilderness area 15 miles northeast of Aspen.

The victims were pilot David Porter,

Recovery Operation At Crash Site

along with passengers Vern and Ann Schmidt, Kathy Ashbey, Kelly Carlson and Maureen Polletti, all from the Salt Lake City area.

Rescuers were able to get to the site earlier and mark the location of the bodies of the six victims, but were unable to recover them because of unstable snow conditions and turbulent weather.

COLORADO MOUNTAIN FLYING: CRASHES AND WEATHER

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Abstract

Almost half of all crashes in a mountainous area within 50 nautical miles of Aspen, Colorado involved one or more weather-related factors. The weather factor most commonly mentioned (48 of 113 weather-related cases) in reports provided by the National Transportation Safety Board was high density altitude. A rarely recognized phenomenon that appeared to be a factor in five crashes was downslope or gravity winds flowing downhill against prevailing winds aloft, when pilots were flying in an easterly direction and anticipating updrafts on the western slopes of the Continental Divide. Pilots generally have inadequate training in understanding mountain weather and its many implications for flying. Moreover, they are provided with too little information on the limitations of their aircraft in relation to density altitude. Pilots need specific knowledge and their own local weather forecasting techniques in order to travel safely among mountains. Pilot training should include more sophisticated weather instruction that reflects current knowledge. In-depth research must be undertaken into local mountain weather systems and their interaction with wider atmospheric patterns.

Introduction

Mountain states have high aviation death rates.[1] Weather is often a factor. 232 airplanes crashed in the mountainous area within 50 nautical miles of Aspen, Colorado, between 1964 and 1987; 202 people died and 69 were seriously injured.[2] Mountain crashes are an important public health problem. The societal cost in human lives, alone, in this small area has averaged over $4,000,000 yearly.

Methods

News reports suggested that a large number of crashes had occurred in mountainous terrain near Aspen, Colorado.[3] Our study area included a 70-mile segment of the Continental Divide, more than two dozen 14,000-foot peaks, and Independence Pass (12,094) and Monarch Pass (11,312) which are major general aviation routes through the mountains.

The National Transportation Safety Board supplied brief reports for all crashes in the study area between 1964 and 1987. Each report included information on place, date, time, basic weather, characteristics of aircraft, pilot, and circumstances, as well as number of occupants and whether they were killed or injured. We categorized the circumstances and contributing factors for each crash. In a subset of 22 full NTSB reports for our "mountain terrain" category, we examined the details of weather involved. For some of the crashes in the subset we garnered additional weather information, such as regional surface barometric pressures and temperatures, and winds and temperatures aloft, from the Climatic Data Center, Asheville, North Carolina.

We also obtained comparison data from NTSB tapes for other crashes in Colorado, from FAA publications for trends in air traffic activity,[4] and from NTSB national data concerning general aviation crashes.[5]

In a Navion belonging to one of the authors (MWL) we flew through or over many of the mountain passes prominent in the study, particularly evaluating the orientation and contours of each pass relative to prevailing winds aloft.

Results

Categories.

Analyzing the NTSB brief reports, we divided the crashes into nine groups, based on the predominant contributing factors.

1. Mountain terrain: of 57 aircraft, 37 were unable to outclimb rising terrain; 9 struck terrain while flying level or descending; 5 were snared by windshears on the windward side of a ridge; and 6 were caught in lee side downdrafts or rotors.

2. VFR into IMC: 24 flights.

3. High winds, crosswinds or turbulence at the airport: 3 crashes.

4. Airport conditions: 45 crashes (46 airplanes) involved water, snow, slush, ice, or asphalt chips on the runway; pavement holes or soft runway; deer on the runway; fences, rocks, dirtbanks or ditches near the runway, tailwinds at airports with runways used for opposite-direction takeoff and landing, and sloping runways.

5. Ice or frost on the airframe on takeoff: 7 crashes.

6. Improper operation of the powerplant: 10 crashes.

7. Improper operation of flight controls: 50 crashes included pilot loss of control on takeoff (13), landing (36), or inflight (1).

8. Mechanical failure: 21.

9. Miscellaneous: 13 crashes (14 aircraft) involved wire strikes, acrobatics, precautionary landings to avoid IMC, a low pass or a midair collision.

Pilots.

52% of pilots had more than 1000 hours and only 9% less than 100 hours. 46% had an ATP and/or commercial license. Only 5% were students flying without an instructor. 17% of the pilots-in-command were instructors; one was teaching a mountain flying course when he crashed. 16% had less than 20 hours in the type of aircraft flown at the time of the crash and 44% had less than 100 hours time in type.

Restraints.

From a subgroup of 22 crashes between 1979 and 1987 we learned that use of seat belts and shoulder harnesses was very effective in preventing injury. Fatality rates were 13% for front-seat occupants wearing shoulder restraints versus 50% for those not using them.

Aircraft performance.

Four-seat aircraft of 180 horsepower or less comprised nearly half of the airplanes unable to outclimb rising terrain. With three or four people aboard, many were under legal gross weight yet practically overloaded for high altitude flight. Performance charts in aircraft owner manuals are over-optimistic. Some four-seat aircraft perceived by pilots as step-up models have less climb performance than the same manufacturer's two-seat trainer. For example, at 0°C and 10,000 feet pressure altitude, a Cessna 172 at gross weight can climb at only 225 fpm, compared to 285 fpm for a Cessna 152 at gross weight.

Mountain weather.

We reviewed all NTSB reports with special attention to atmospheric phenomena, including mountain waves, downdrafts, rotors, valley and drainage winds, whiteout, icing, windshears, turbulence, gusty winds, crosswinds or tailwinds upon takeoff or landing, density altitude, and combinations of these. We documented weather as a factor in all categories and in 113 (49%) of crashes (Table 1).

We also obtained from the NTSB full reports for a subgroup involving 22 airplanes which crashed between 1979 and 1987 in mountain terrain under VFR conditions and without known malfunctions (Category 1). Only one of those reports contained what might be termed a "weather package." However, witness, passenger or pilot statements often described components of small scale mountain weather. Considered with those statements, data from the National Climatic Data Center confirmed the existence of windshears in crash areas.

Discussion

Three-quarters of the 202 deaths occurred in the "mountain terrain" and "VFR into IMC" categories. In those two groups, pilots frequently misjudged weather.

Meteorology is apparently well-addressed in FAA and other publications used in airman training. Why should weather be such a constituent in mountain flying crashes? Traditional weather training is too general. Most pilots have no idea that extremely powerful systems exist next to mountains, in very small dimensions. Pilots are not taught to interpret surface barometric pressure slopes and temperatures, and winds and temperatures aloft. Pilots do not know how to read relative to landforms the messages expressed by mountain clouds (virga, steady and unsteady lenticulars, rotors, and Kelvin-Helmholtz, for example). Airmen are unaware of the influences of timber barriers, slope heating, angle and texture, solar radiation and soil heat fluxes, upon local mountain atmosphere.

Pilot mountain weather training offers a broad view of weather systems[6] together with the suggestion that pilots will avoid trouble if they maintain at least 2000 feet terrain clearance. That is unrealistic considering that many airplanes cannot fly that high. Pilots need specific knowledge and their own local weather forecasting techniques in order to travel safely among mountains.

Aviation ground schools should include sophisticated weather training. For example, weather courses should detail current theory about airflow over mountain barriers in relation to the vertical profile of windspeed, the effect of mountain shape on airflow and flow separation, and predicting various types of thermally induced winds.[7]

Valley winds.

Crashes in the "mountain terrain" category of the series included several involving mountain drainage and valley winds. A well-documented example of a crash involving a valley wind is Case X-14. In July at 0840 MDT (1440 Zulu) a relatively low-powered four-seat aircraft crashed on the southeast (lee) side of Weston Pass, at the 11,900-foot contour. All three people aboard were killed. The front seats were occupied by two low-time private pilots.

A hiker working his way up the northeast side of the pass observed the entire crash sequence, first noticing the plane coming up the valley from the southeast, hearing the laboring of the engine, then watching the aircraft make a 180 degree turn to the south and hit the hillside. The hiker commented in his written report: "The weather at the time was clear with a light high scattered cloud cover. There was a light breeze blowing up the canyon."

Weston Pass (11,921 msl) is oriented approximately northwest-southeast (magnetic), is about ten nm long and is flanked by terrain rising nearly 2000 feet. Considering the southeasterly slope orientation under the aircraft approach path, it is apparent that solar heating in July would tend to promote valley winds. The closest observed winds aloft report was that of Denver, 70 nm northeast, for 1200 Zulu. The report is very interesting -- if applicable to the atmosphere over Weston Pass. Between 6575 and 8468 feet msl the temperature lapse rate was 2.3 degrees C; between 8468 and 10,394 it was 4.1 degrees C; between 10,394 and 12,428 it was 5.9 degrees C, and between 12,428 and 14,577 it was 6.0 degrees C. Observed winds aloft at 8468 feet were 320° at 6 knots; at 10,394 were 298° at 6 knots; at 12,428 were 339° at 2 knots; and at 14,557 were 342° at 6 knots. Surface barometric pressures for mountain stations were generally about .24 inch higher than surface pressure in Pueblo to the east.

In brief, it appears that the aircraft in X-14 was floating upwards on a valley wind, perceived by the pilot as an acceptable rate of climb produced by the aircraft engine. At the boundary layer of the southeasterly valley wind with northwesterly winds at pass level, the aircraft would have encountered a shear layer in which the pilot exhausted airspeed, altitude and options.

In our analysis of weather for this crash, one difficulty with figures obtainable from NOAA was that the copies sometimes did not reflect the date or time of observation. Unique to this case was the hiker's excellent on-scene surface observation of an upslope morning wind.

Mountain drainage winds.

We concluded that five crashes took place in circumstances under which there were downslope or gravity winds flowing downhill against prevailing winds aloft. The pilots in these cases assumed that they would ride uphill aided by updrafts caused by the action of westerly winds against the western slopes of the Continental Divide.

An example of this type of crash is our case A-7, involving another relatively low-powered four seat aircraft trying to fly eastward over 12,094-foot Independence Pass at about 4:30 on a September afternoon. The pilot reported climbing at 300 fpm west of the pass, encountering light turbulence at about 11,700 feet, followed immediately by an airspeed loss of 35-40 mph which put the aircraft well below stall speed, and sinking at 2000 fpm. The only options were to drop flaps, level the wings and make a controlled crash parallel to the spine of the ridge below. The airman estimated the total time elapsed from windshear encounter to impact at 10-15 seconds. This pilot, an experienced aviator with an airline transport pilot (ATP) certificate and 5000+ hours, was at a loss to explain what really happened.

Investigation revealed that forecast winds aloft and surface winds at Aspen, the nearest airport to the west of the pass, were northwesterly. The surface pressure corrected to sea level at Aspen (7815 feet msl) was 30.42, and at Leadville (9927 feet msl), 30 miles across the Continental Divide to the east, the pressure was 30.59. Normally, Aspen's surface pressure is higher than that at Leadville; usually surface barometric pressures slope from west to east across the Colorado Rockies.

Looking at case A-1, a four-seat turbocharged retractable heading east from Aspen towards 11,925-foot Hagerman Pass (also on the Continental Divide), which crashed at the 11,500-foot level west of the pass, we noted that the pilot, an ATP with 6000+ hours, reported lowering full flaps prior to impact and that the airspeed decayed. The airman, who could not recall much, said later: "I believe that I encountered a downflow of air caused by the winds aloft interacting with the terrain ..." Winds aloft at flight-planned altitude were forecast northwest 30 knots or greater. Surface pressures at the time of the crash were 29.77 for Aspen and 29.96 at Leadville.

Another crash (A-10) of this sort took place in October on the west side of Independence Pass at the 11,300-foot contour. A 98-hour private pilot had been taught to expect updrafts on the west sides of the Continental Divide passes when winds aloft were westerly. Aspen reported surface winds of 340 at 11 and the pilot recalled forecast winds aloft as 240 at 12. Climbing out eastward towards the pass in a low-powered four seater he encountered 1500 fpm updrafts. The aircraft was ascending at 250-300 fpm when suddenly the airspeed dropped from 100 mph to about 65. In seconds the airplane crashed. The Aspen altimeter at the time was 30.08 and that at Leadville, 30.25, another pressure reversal.

We noted similar surface pressure reversals in two other cases involving Continental Divide crashes, A-13 (Aspen, 30.13 and Leadville, 30.23) and 78-0 (Aspen, 30.13; Eagle 30.30 and Gunnison 30.25).

Until earlier work leading up to this study,[8] no one has proposed that cold air flowing out in all directions from the Continental Divide plateau could be causing windshears and downdrafts in terrain where pilots are trained to anticipate updrafts. Yet we have at least five instances in which pilots of various skill levels have been snared by unexpected atmospheric conditions beyond their experience and judgment. In each situation there was a sudden airspeed drop below stall, following some turbulence. This distinguishes this group of cases from the "failure to outclimb" type of crash, in which an aircraft labors upwards toward rising terrain with slowly decreasing airspeed until the wing simply will not lift anymore and no alternatives remain.

How can pilots be trained to anticipate downslope or gravity winds in terrain where updrafts are normal? A very simple indication is the comparison of station surface barometric pressures such as those at Aspen and Leadville. In all of the cases we labeled as "mountain drainage" there was a pressure slope reversal. If a pilot on preflight weather briefing simply requested regional surface pressures the pilot might receive a clue that unfavorable conditions exist.

One technical difficulty with use of reported surface pressures is that the pressures cited are actual station measurements corrected to sea level. It is well known that diurnal temperature changes, large- and small-scale variations in airmass motion, and differences in radiation due to cloudiness, air drainage, sheltering and other orographic effects, affect sea level pressure reductions.[9] Nonetheless, if corrected pressure at a high altitude station provides an obvious clue, pressure comparisons should be utilized by pilots.

Downdrafts and rotors.

A large group of cases in our "mountain terrain" category involved mishandling of downdrafts and rotors. Lenticulars, rotor clouds and virga are obvious and aviators should be taught to interpret those cloud types and resulting airflow over different types of terrain. For example, wind blowing across a broad mountain valley, striking a mountain barrier rising 7000 feet above the valley floor with a drop of 9000 feet to the next valley downwind, will have predictable locations for downdrafts and rotors. Personal analysis of winds and temperatures aloft forecasts and surface barometric pressure up- and downwind of the mountain chain will yield a valid turbulence and windshear forecast.

A typical case in this category is S-21, in which a 3500-hour ATP operating a low-powered four-seater was crossing from the Arkansas Valley towards Denver. The pilot made a controlled crash in the lee of a mountain barrier, stating later that he encountered 500 fpm downdrafts and rotors. He also identified showers and virga in the area. (Incidentally, regional surface pressures at the time of the crash were Leadville, 30.51, Buena Vista, 30.34, and Pueblo, 29.99.)

Airmen should use their flight instruments to analyse real-time mountain weather conditions. For example, the instant the vertical speed indication sinks, the pilot should suspect a downdraft and turn away out of it. Many people do not realize they are in trouble until the engine labors and airspeed is just above stall -- and then it is too late.

Consolidation of FAA flight service locations and closing of staffed weather bureau offices pose a severe problem for mountain flyers. An astute pilot nowadays will telephone the destination airport for weather conditions. Commonly the pilot must fashion a personal weather forecast. That is why pilots must receive much more sophisticated weather training in connection with licensing procedures.

Mountain geography.

A number of crashes occurred on the lee sides of Colorado mountain passes in basins or bowls where downdrafts would normally be expected. For example there were several cases just east of 11,312-

foot Monarch Pass. In this area the Divide runs north and south for many miles, perpendicular to westerly airflow coming up the Gunnison River Valley. From case G-1 we learned a typical aviator's perspective on a lee-side downdraft situation: "At 10,300 feet the plane did not want to climb anymore. We had a big problem. Suddenly the plane just dropped. I don't know why." Observed winds aloft at Grand Junction for 11,821 feet were 268 degrees at 10 knots.

Density altitude.

Density altitude was identified as a factor in many of our "mountain terrain" crashes and could not be isolated as a separate cause. Deteriorated aircraft performance associated with the high density altitude obviously must be taken into consideration in outwitting vertical motion in the atmosphere. Aircraft owner handbooks do not emphasize the true effects of density altitude, do not suggest using in DA computations the temperature at wing level above a runway, and often do not point out that service ceilings and climb performance figures involve density altitudes. Table 2 illustrates the effect of both altitude and temperature on climb performance.

Table 1

Weather Factors Mentioned in 113 Crashes

Density altitude	48
Downdrafts/updrafts	22
Snow	14
Icing	14
Tailwinds takeoff/ landing	11
Crosswinds takeoff/ landing	6
High/gusty winds	6
Turbulence	5
Fog	4
IMC, unspecified	4
Rain	2
Mountain wave	2
Hail	1
Whiteout	1
TOTAL	140

Table 2

Maximum Rate of Climb
Cessna 152 @ Gross Weight

Pressure Altitude	Rate of climb (ft/min) 0°C	20°C
Sea Level	765	700
10,000 feet	285	230
12,000 feet	190	135

Recommendations

Our study identified components of small scale mountain weather and demonstrated that such weather is unrecognized by aviators. In-depth research must be undertaken into local mountain weather systems and their interaction with wider atmospheric patterns. The results should be shared with pilots as quickly as possible. Pilot weather education should reflect current knowledge.

Using available technology, windshear prediction instrumentation should be developed for airflow through passes used as mountain general aviation routes.

The authors appreciate the assistance of the National Transportation Safety Board in providing brief and full reports and other material utilized in the study. Although the NTSB is understaffed and overworked, we recommend that the Board obtain, as part of its investigation of each mountain crash, regional forecast and reported winds and temperatures aloft, and regional airport sequence reports in their entirety. Post-crash interviews should include questions tending to identify windshear and other invisible atmospheric conditions.

Additional recommendations are that FAA and/or insurance companies establish a mountain flying rating or checkout required for passenger-carrying in defined mountainous areas.

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APPENDIX
NIGHT VFR SAFETY STUDY

If you don't want it printed, don't let it happen.

Fall Home Pullout Inside

Aspen Daily News

517 E. HOPKINS, ASPEN, COLORADO 81611 FRIDAY, OCTOBER 11, 1991 VOL 14 #88 FREE

REAL WORLD

Turks Hunt Kurds

ANKARA, Turkey (AP) — Turkish warplanes and helicopters have begun an intensive search for Turkish Kurdish guerrillas along its southeastern border with Iraq following a rebel raid that killed 11 soldiers, officials said Thursday.

Yugoslavs Make Deal

THE HAGUE, Netherlands (AP)—Yugoslavia's army agreed in principle Thursday to withdraw from Croatia within a month, and

Aspen Unable To Handle Major Plane Wreck
Drill This Weekend Underlines Shortcomings

By JEANNE McGOVERN
Aspen Daily News Staff Writer

Sooner or later, an 85-seat BAE-146 jet may come screaming out of the sky and crash at Aspen's airport. If and when that terrible event happens, many people will suffer — not only because of the crash, but because of insufficient emergency services here.

"All the signs and all the indicators are there. We are living on borrowed time," said Steve Crockett, emergency management coordinator for the Pitkin

Crockett and other local emergency officials admit that Pitkin County cannot handle the casualties a major plane crash would bring, but say they doing their best to make do with what they have.

Thirty-one local agencies will participate in a mock air disaster Saturday at Sardy Field. The drill simulates a 48-seat plane crashing into the runway and catching fire. (*See related story*)

BUT THE question remains: what would happen if a United Express jetliner really missed the runway, or one of Continental Express' 48-seat planes did

"The good news is that all bleeding eventually stops and all fires are eventually put out."
Steve Crockett

Everyone seems to agree the results could be deadlier than if the same crash

Please see DISASTER on page 6

FROM PAGE 1

AVH Can't Handle Caseload Caused By Major Plane Wre

DISASTER from page 1

happened somewhere else.

"People assume that we are capable of providing the same standard of care as a large municipality," Crockett said. "But the reality of the situation is that we are a very small, remote, rural area with finite resources."

Aspen Valley Hospital, although technologically advanced, is simply not equipped to deal with mass casualties.

"We would not be able to handle it," said Barbara Graves, Emergency Department nurse manager for AVH. AVH is a 49-bed hospital, with only 18 beds in the emergency room and two surgical suites.

WHILE THE hospital is prepared to call in air assistance from St. Mary's Hospital in Grand Junction and from the Front Range, the immediate standard of care would drop if there were a massive plane crash.

"We will strip the city's resource immediately and tap out AVH and Valley View (Hospital in Glenwood Springs) immediately," Crockett said. "We'd still be beyond the care we can provide and the standard of care will drop. What that translates into is casualties."

Sheriff Bob Braudis, who is in charge of disaster preparation for the county, said a plane crash of this magnitutude would leave the county "out in the weeds."

"The big load is going to fall on the emergency medical personnel and I think they'll find they're swamped," Braudis said. "If we did have a plane crash, this hospital would have to deal with a situation that they may not be equipped to deal with."

AND IF the effort to move people out of Aspen was stifled by bad weather or a crash on the runway, the number of deaths probably would increase.

"What we are trying to do in this drill is evacuate victims through air resources. If we lost this resource, we'd be in even worse shape," Crockett said.

Graves said being forced to bring all the casualties to AVH is "just moving the disaster from one place to another." Victim care would be as good for people lying on the runway as it would be at AVH, since the hospital couldn't handle the numbers, even with a round-the-clock effort by the hospital staff, Graves said.

"We would do the best we can with what we have, but we would do everything we could to get them out as qu as we can," Graves added.

BEING underequipped to deal disaster is not a problem uniqu Aspen.

"I don't know anyone who h handle on this, or a leg up," Cro said, adding that most Colorado re towns "are in the same boat."

Aipont Manager Scott Smith said Pitkin County may not be equippe deal with a major air disaster, bu using the disaster drill to learn w improvements can be made. Most l airports could not handle a major di ter, either, Smith believes.

"Big airports have the same probl but on a different scale," Smith "It's very common. You don't t

Please see DISASTER on page 7

APPENDIX

Item No.	Description
1	Abstract, M. Dole, Meet The Press, 12/19/83.
2	Congressional Record, October 20, 1990, Report H10884. and enlargement of report portion.
3	Washington, D.C. FAA Meeting Memo 09/13/90
4	Rocky Mountain High Flying: Flying 05/86
5	Curriculum Vitae, Susan P. Baker

Appendix Item No. 1: Abstract, M. Dole, Meet the Press 12/19/83

SECTION: Washington news
STORY TAG: drunkdrive-airillinoi
December 19, 1983
TIME: 06:22ps CYCLE: pm
PRIORITY: Regular WORD COUNT: 0326

Mrs. Dole said Sunday she was in close contact with the Federal Aviation Administration about the case, which stemmed from a special investigation that found several Air Illinois safety deficiencies.

Appearing on NBC's "Meet the Press," Mrs. Dole disclosed that she recently ordered a department review to ensure that deregulation has not reduced safety in airlines, trucking and railroads.

"I will in no way tolerate any dimunition of safety in any of our modes of transportation," Mrs. Dole said. "We will be looking very carefully at this matter."

Mrs. Dole said she issued a memo last week that instructed all department administrators to conduct an in-depth review of their inspection as well as certification, licensing and enforcement procedures.

As for the Air Illinois case, Mrs. Dole said was in close touch with FAA Administrator J. Lynn Helms "at the time certification was withdrawn. I approved withdrawal."

Air Illinois voluntarily suspended flight operations following a special investigation by the FAA, one of several such federal safety inquiries in recent months.

Mrs. Dole was asked why a "special investigation" was necessary since the FAA should ensure safety as part of its regular job. Without directly responding, the secretary said she had ordered a review by her agencies.

"I am working very hard with all my modal administrators, those who head various transportation modes ... to ensure that safety is in no way compromised, especially in a period of changes in our society technological changes, deregulation," she said.

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H 10884 CONGRESSIONAL RECORD — HOUSE *October 20, 1990*

air passengers equally for immigration inspection services provided, (b) scores the fees as offsetting receipts, and (c) imposes, as a compliance standard, the requirement that all passengers arriving in U.S. air terminals be cleared by the Immigration and Naturalization Service within 45 minutes of their presentation for inspection under present airline schedules. The House bill contained no such provisions.

The conference agreement accepts the Senate language, and adds new language as follows:

Examinations Fee Account—Subsection (d)(1) provides that adjudications and naturalization fees be deposited into the Examinations Fee Account as offsetting receipts. Subsection (d)(2) allows the Department to establish adjudications and naturalization fees at a level that will ensure recovery of the full costs of the program, to include the overseas program and administration.

Land Border Inspections Pilot Project—Subsection (d)(3) establishes a pilot project to study the feasibility of charging fees to enhance services at land border points of entry. The conferees are aware of problems at land border entry points to the United States from both Canada and Mexico resulting in one to two hour delays at certain times of the day. Extensive delays are both costly and irritating to the tens of thousands of individuals who cross the borders on a daily basis. The need to speed up the inspection of vehicles and passengers at these stations must be counterbalanced by the need to halt the flow of illegal drugs and illegal aliens into the country. These delays could be significantly reduced by the INS, with no impact on the interdiction of illegal drugs and aliens, through the use of some innovative, automated procedures, and by the expansion of the number of inspectors. The major impediment to these improvements is a lack of appropriated funds to pay the necessary expenses to enhance services. At a time of increasing budgetary constraints, it is difficult for the Congress to maintain ongoing programs, let alone fund new ones.

The conferees that the only available means of financing needed improvements at border crossing ports is by charging the users for the cost to enhance services. There are numerous proposals for improvement which the conferees believe will reduce delays for all individuals, while not imposing a financial burden on those who can least afford it. One such proposal is to charge an annual fee to certain pre-approved individuals who would be allowed to utilize an expedited commuter lane. Fees collected from these individuals would be used first, to pay for the costs of establishing the commuter lanes, and then, to add additional inspectors to improve the service for the remaining individuals.

There are other proposals which may also prove feasible, especially since each border entry point has its own unique problems and what works at one entry point may not work at another. In order to allow for a test of the efficacy of this concept and the various proposals, the conferees have included bill language which will allow the Attorney General to establish a pilot project under which user fees may be charged, and to utilize those fees only to enhance inspection services.

The conferees agree that this pilot project should be developed by the Attorney General in consultation with the Secretary of the Treasury, as well as the Congress. The conference agreement includes language requiring the Attorney General to provide a report to the Committees on Appropriations identifying the proposed pilot project no less than 30 days prior to its implementation. Implementation of the pilot project is to be subject to the reprogramming procedures of the Committees on Appropriations. The conferees also agree that this pilot project should last until September 30, 1993, and that the Attorney General shall provide quarterly reports on the status of the pilot project to the Committees on Appropriations of the House and Senate. In addition, the conferees believe that the pilot project should take place at several points on both the Northern and Southern borders in order to ascertain the impact on various geographic areas.

Amendment No. 83: Reported in technical disagreement. The managers on the part of the House will offer a motion to recede and concur in the Senate amendment with an amendment as follows:

In lieu of the matter proposed by said amendment insert the following:

SEC. 211. Notwithstanding any other provision of law, in the specific case involving the Iowa Power Inc. and Redlands, Inc. ownership within the proposed Walnut Creek NWR, condemnation is authorized to determine the just compensation of the Iowa Power Inc. and Redlands Inc. lands, provided there is agreement by both parties involved.

The managers on the part of the Senate will move to concur in the amendment of the House to the amendment of the Senate.

The conference agreement deletes language proposed by the Senate which prohibits the Department of Justice from engaging in litigation or other action involving the requiring of the Aspen-Pitkin County Airport, CO, to adjust its curfew to a single time for all types of aircraft using the airport.

Aspen/Pitkin County Airport—The conferees recognize that the Aspen/Pitkin County Airport's (Sardy Field) curfew is from the one half hour after sunset to 7:30 a.m. Nearly twelve years ago, commercial carriers negotiated a waiver of this restriction to permit commercial service operations up to 11:00 p.m. In exchange for this waiver and to insure safe operations, commercial operators installed private navigational aids, and agreed to require certain aircraft performance standards, as well as special pilot training and experience, to perform after-dark operations at Sardy Field. In addition, the costs of operating the airport's Index A Crash Fire Rescue capability after the official curfew is borne by the commercial service companies.

The conferees are aware that the Federal Aviation Administration recently initiated proceedings to force Pitkin County to permit operations for general aviation aircraft after dark. These proceedings have included the withholding of Airport Improvement Program entitlement funds and grants, as well as the threat of litigation.

The conferees believe that the interest of the people of Pitkin County and the Federal Government would be best served by a negotiated solution, rather than litigation conducted by the Department of Justice, at the request of the Federal Aviation Administration.

Walnut Creek Refuge—The conference agreement adds new language, not in either bill, dealing with the condemnation procedures for the Walnut Creek Refuge.

The U.S. Fish and Wildlife Service is in the process of obtaining land for the Walnut Creek Refuge.

Even though the U.S. Fish and Wildlife Service is not condemning any land for this project, one of the owners, Redlands Inc., has agreed to sell their land for a price to be determined through procedures normally used in condemnation. The provision in the bill permits the parties to use those procedures to settle a difference of opinion concerning the price in this specific case.

Amendment No. 84: Reported in technical disagreement. The managers on the part of the House will offer a motion to recede and concur in the Senate amendment with an amendment as follows:

In lieu of the matter proposed by said amendment insert the following:

SEC. 212. (a) Notwithstanding any other provision of law, for fiscal years 1991 and 1992, the provisions of the Office of Management and Budget Circular A-76 and any similar provisions in any other order or directive shall not apply to activities conducted by the Federal Bureau of Prisons, Federal Bureau of Investigation, Drug Enforcement Administration, Immigration and Naturalization Service, United States Attorneys, United States Marshals Service, the Office of Justice Programs, the Office of Inspector General, and any of the litigating activities of the Department of Justice, unless such provisions are specifically approved by an Act of Congress.

(b) For fiscal years 1991 and 1992, no reduction in resources for the Justice Department activities described in subsection (a) shall be effected pursuant to the provisions of the Office of Management and Budget Circular A-76 or any similar provision in any other order or directive unless specifically provided therefore by an Act of Congress.

The managers on the part of the Senate will move to concur in the amendment of the House to the amendment of the Senate.

The Senate amendment added a new general provision (Sec. 212) which restricted the authority of the Office of Justice Programs to contract out certain positions pursuant to OMB Circular A-76. The House bill contained no similar provision.

The conference agreement expands the Senate's contracting out prohibition to include all of the law enforcement and litigating activities of the Department of Justice, unless such contracting out proposals are specifically approved by Congress. The conferees have been made aware of serious doubts concerning the propriety of privatizing many of the functions relating to the administration of justice, particularly the law enforcement and litigating activities of the Department of Justice. The enforcement of Federal law is an inherently governmental function which should not be contracted out to private industry. Furthermore, there are concerns that, after a decade in existence, in many instances, contracting out programs have failed to produce both desired management improvement and projected savings. Under the conference agreement, no positions, workyears or associated funding for the law enforcement and litigating components of the Department of Justice associated with contracting out initiatives may be reduced unless specifically approved by the Congress. The conferees agree that it is incumbent upon the Administration to prove that future privatization proposals will produce savings and management improvements before such proposals are submitted to and approved by the Congress.

TITLE III—DEPARTMENT OF STATE

ADMINISTRATION OF FOREIGN AFFAIRS

SALARIES AND EXPENSES

Amendment No. 85: Reported in technical disagreement. The managers on the part of the House will offer a motion to recede and concur in the Senate amendment which adds the words "international agreements and bilateral contracts" to the bill language, thus making the appropriation available for expenses pursuant to these contracts.

...al provisions.

conference agreement accepts the language, and adds new language as

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... conferees that the only available ... of financing needed improvements at ... crossing ports is by charging the ... for the cost to enhance services. There ...merous proposals for improvements ... the conferees believe will reduce ... for all individuals, while not impos- ... financial burden on those who can... afford it. One such proposal is to ... an annual fee to certain pre-ap... ...d individuals who would be allowed to ... an expedited commuter lane. Fees ...ed from these individuals would be ...ted, to pay for the costs of establish-...he commuter lanes, and then, to add ...nal inspectors to improve the service ... remaining individuals.

...e are other proposals which may also ... feasible, especially since each border ... point has its own unique problems. ...hat works at one entry point may not ...at another. In order to allow for a test ... efficacy of this concept and the vari-...oposals, the conferees have included ...guage which will allow the Attorney ...al to establish a pilot project under ... user fees may be charged, and to uti-...ose fees only to enhance inspection ...s.

the conferees believe that the pilot project should take place at several points on both the Northern and Southern borders in order to ascertain the impact on various geographic areas.

Amendment No. 83: Reported in technical disagreement. The managers on the part of the House will offer a motion to recede and concur in the Senate amendment with an amendment as follows:

In lieu of the matter proposed by said amendment insert the following:

SEC. 211. Notwithstanding any other provision of law, in the specific case involving the Iowa Power Inc. and Redlands, Inc. ownership within the proposed Walnut Creek NWR, condemnation is authorized to determine the just compensation of the Iowa Power Inc. and Redlands Inc. lands, provided there is agreement by both parties involved.

The managers on the part of the Senate will move to concur in the amendment of the House to the amendment of the Senate.

The conference agreement deletes language proposed by the Senate which prohibits the Department of Justice from engaging in litigation or other action involving the requiring of the Aspen-Pitkin County Airport, CO, to adjust its curfew to a single time for all types of aircraft using the airport.

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The conferees are aware that the Federal Aviation Administration recently initiated proceedings to force Pitkin County to permit operations for general aviation aircraft after dark. These proceedings have included the withholding of Airport Improvement Program entitlement funds and grants, as well as the threat of litigation.

The conferees believe that the interest of the people of Pitkin County and the Federal Government would be best served by a negotiated solution, rather than litigation conducted by the Department of Justice, at the request of the Federal Aviation Administration.

Walnut Creek Refuge.—The conference agreement adds new language, not in either bill, dealing with the condemnation procedure for the Walnut Creek Refuge.

The U.S. Fish and Wildlife Service is in...

SEC. 212. (a) Notw... provision of law, fo... 1992, the provisions ... ment and Budget C... similar provisions ... rective shall not appl... ed by the Federal Bu... Bureau of Investigat... Administration, Imm... tization Service, Un... United States Marsha... Justice Programs, ... General, and any of ... of the Department ... provisions are speci... Act of Congress.

(b) For fiscal year... duction in resources ... ment activities desc... shall be effected pur... of the Office of Ma... Circular A-76 or an... any other order or ... cally provided there... gress.

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TITLE III—DEPA...

ADMINISTRATION ...

FAA MEETING SUMMARY
WASHINGTON, D.C.
September 13, 1990

The following is a summary of our impressions of the conference which Dwight K. Shellman, Jr. (Special Council to the Board of County Commissioners of Pitkin County) and Tim Whitsitt (Pitkin County Attorney) engaged in on September 13, 1990 at the FAA Administration Building in Washington D.C. Present for the FAA were Col. Griggs (and balance of the names of the FAA attendees).

The following is not intended to be a verbatim record. Rather it is intended to be a summary of the communications which were made or intended by Messrs. Shellman and Whitsitt on behalf of Pitkin County and some of the significant colloquy between representatives of each entity. Parenthetical material is inserted where it is deemed to be significant in the context for future reference.

Mr. Shellman and Mr. Whitsitt opened the meeting by stating that Pitkin County had three basic requests to make of the FAA at the meeting:

1. That the FAA provide the county with copies of the FAA's administrative record which resulted in the determination that unrestricted night access to the Pitkin County Airport by general aviation and others was safe and appropriate under the current circumstances.

2. That FAA undertake a NEPA Environmental Assessment (NEA) or Environmental Impact Statement (EIS) as a prerequisite to insisting on FAA's direction that the county change long standing night operational restrictions and policies.

3. That FAA participate in and fund the forthcoming county safety and noise studies. Draft Requests for Proposals (RFP) were previously transmitted to the FAA along with copies of the Pitkin County Board of County commissioners 8/7/90 hearing record on the subject.

FAA personnel present were asked by Mr. Shellman if they had reviewed the August 7, 1990 county administrative record. When they confirmed that they had not, Mr. Shellman and Mr. Whitsitt then summarized that County administrative record (see below). They noted that the record was a direct response to FAA's prior request that the county document its concerns as to safety and other matters the county believes supported the historical and present night operational restrictions. Whitsett noted that Pitkin County's prior request for FAA's administrative record (See Request #1 above) had never been responded to by FAA.

The summary of the Pitkin County hearing included a review by Messrs. Shellman and Whitsitt of the map exhibits for the Aspen area, showing the so-called "Aspen sucker hole" (the area within a

25 mile radius of the Pitkin County Airport) and the accident patterns identifying the "Woody Creek/Lenado and Grizzly/Independence "sucker holes" within that 25 mile radius. Messrs. Shellman and Whitsitt confirmed that the underlining data which was depicted on the maps and tabulated was National Transportation Safety Board (NTSB) data.

In general this data reflected that within the entire 10,000 square mile area depicted on the map, aircraft accidents had claimed 129 dead, 37 injured, 45 uninjured and 66 aircraft destroyed. This larger area included the Monarch Pass "sucker hole" which bears little relationship to activities in Aspen.

If Monarch Pass was excluded, the other Aspen Airport related areas on the map included 111 dead, 35 injured, 38 uninjured and 54 aircraft destroyed. If only the area within a 25 mile radius of Aspen was considered, the tally was 89 dead, 29 injured, 21 uninjured and 39 aircraft destroyed.

The crash groupings in the Woody Creek/Lenado and Grizzly/Independence areas were identified as reflecting patterns which appear to show recurrence of accidents related to deceptive mountain valley conditions inducing entry into terrain that pilots or planes could not out climb or out turn.

In response to questions from FAA personnel, it was confirmed that (with only a few exceptions) all of the accidents shown occurred in the daytime, although some of them were compromised by daytime weather conditions. Most which occurred within and immediately outside the 25 mile radius were related in some way to the Aspen Airport (either an arrival or departure). Local impact of one of the exceptions (a 1990 night overflight which crashed on Independence Pass) included extended use of large numbers of local volunteer mountain rescue people over two weeks, and their efforts to locate the crash and extract the bodies over several weeks under extremely dangerous winter mountain and snow avalanche conditions. Shellman and Whitsitt said the data and conclusions were necessarily preliminary, but that more study was clearly justified. That study was contemplated to occur in the forthcoming safety studies which the county was going to proceed with, and which the FAA was requested to fund and participate in.

In response to questions, Shellman and Whitsitt expressed their impressions that the record already showed a great majority of accidents probably were classified as "pilot error", and that substantially all mechanical failure related accidents had been excluded, perhaps improperly, since mechanical failures do occur and mountain conditions increase the seriousness of the consequences.

An analysis of local safety conditions included the map referred to during the BOCC hearing by Ed Wachs regarding the airport vicinity. This depicted the steeply rising terrain which severely obstructs the air space within the turning radius of a Learjet, as measured from the missed approached point at the Pitkin County Airport. The Wachs testimony review included his observations as to the terrain and air space constraints in both landing and departing scenarios, as well as a review of the special conditions reflected by the approach plates produced by Jeppeson, Aspen Airways/United Express and Rocky Mountain Airways/Continental Express, and the procedures peculiar to each.

It was pointed out that Mr. Wachs' testimony also indicated that very few GA aircraft utilizing the Pitkin County Airport had the performance abilities to out climb or out turn the terrain in the dark, and almost none had the ability to do so in one-engine aircraft.

Shellman and Whitsitt also stated that the testimony in the August 7, 1990 hearing showed that the comments concerning capability of aircraft, pilot familiarity with the airport and other contributors to special risks were addressed and accommodated in the special conditions under which Continental Express and United Express were allowed to obtain an exception to the daytime only airport operating hours which had always been in effect at the airport.

The five conditions which were being met by the two airlines to take advantage of the after-dark operational exception were:

1. Utilization of high performance aircraft.

2. Crew "recurrency" with the local conditions. These are included in the hearing record.

3. Use of precision (MLS) or near precision (TALAR) (plus special operation procedures) instrument landing systems which are owned and operated by each of the users.

4. Very quiet aircraft.

5. No more than 24 night operations before 11:00 p.m. (subject some special adjustments, e.g. allowing airlines to make up for air traffic control delays, etc.).

Shellman and Whitsitt stated that these policies evolved through joint development by the airlines and the FAA with county approval and incorporation thereof into County night operation regulations.

Notwithstanding the sad accident patterns of daytime non-scheduled commercial and general aviation operations, these scheduled airline operational conditions had resulted in zero night time accidents, injuries or deaths over a period in excess of ten years, and permitted high levels of visitor service by the airport at night with noise levels which were compatible with the high quality resort environment which the community required.

FAA representatives stated that three of the five night time exception conditions were safety related and not within the authority of the County to consider. Shellman and Whitsitt responded that these conditions were an amalgam of "appropriate technology" practical solutions to an important problem. Both indicated that there was a need and desire to produce the kind of data which the FAA required, and (assuming the data supported it) to consider appropriate modifications of the night operational restrictions. They noted that George Baker, the former NTSB chief in the region had unconditionally stated at the BOCC hearing that it would be irresponsible for the County to accede to the FAA demands under the current circumstances.

Shellman and Whitsitt also said that characterizations by the FAA that the operational hours exception merely allowed commercial operations at night and excluded all others was an inaccurate characterization.

Dick Danforth stated several times that FAA could not allow airport operators to specify aircraft operational rules. Shellman and Whitsitt acknowledged FAA's concern, but reiterated that the Pitkin County night flight operational hour restrictions were developed with the FAA, which had always supported differential operational hours on safety grounds, and that FAA's current position reflected a significant change in FAA policy.

Former airport manager Dick Arnold's letter (in the 8/7/90 record) was read aloud. Former airport manager Doug McCoy's testimony was referenced, in this regard.

Both of these former airport managers stated that when AOPA or others had objected to the differential operating hours restrictions, FAA had confirmed verbally (and perhaps in writing) that such differences were not unjustly discriminatory because of the different conditions which applied to each group of users.

Dick Danforth stated that FAA had a dilemma to not intrude the federal presence unless there was a complaint and that FAA had merely "not enforced" the grant assurances in prior years.

Shellman disagreed and noted that he (as a former County Commissioner) and many subsequent County Commissioners had signed those same grant assurances during the more than ten years that the FAA had been making grants to the airport. Those grant assurances were presented by the FAA and signed by various boards of County Commissioners during the period of time that the current airport operational restrictions were evolving with the full knowledge and participation of the FAA.

Mr. Shellman said that the County and those who signed grant assurances would certainly resist an attempt by FAA to revise the historical facts in a way that would suggest that written grant assurances were really untrue when they were signed.

At the conclusion of their review of the August 7th record, there was extensive discussion as to the three requests which the County had made.

The substance of the discussion as to each category is summarized below, with parenthetical material inserted where appropriate.

1. Request_for_FAA_night_policy_revision_record. Shellman repeated a statement he had made to Mr. Danforth on a prior day that based upon what he has seen at this point, it appeared that the County might have a better administrative record than the FAA. (Mr. Danforth had stated the prior day that he had in fact "touched his bases" or words to that effect) by a "contact" with the safety people in the Region before he prepared the FAA's letter to the County, which found night operations by GA to be safe as a matter of FAA policy (presumably the Wiechmann letter of 2/9/90 to Chairman Ross). Mr. Whitsitt said that the County had previously requested disclosure of the same information on at least one occasion as well. (Lack of an FAA record supporting its decision was also noted in Mr. Yasgur's letter which was included in the August 9th hearing record). None of the FAA personnel present responded to the County's request for FAA's support for its safety and other administrative record supporting FAA's Pitkin County action.

2. NEPA EA/EIS. Our second request was that the FAA undertake an Environmental Assessment to determine if NEPA required an Environment Impact Statement process. With due respect to the FAA's recent recharacterization of the facts so as to classify their current position as merely a delayed "enforcement" matter, Mr. Whitsitt and Mr. Shellman stated that it was in fact a change of longstanding FAA/County policy with regard to night operational exceptions being made for the airlines under the five conditions mentioned above. The import of FAA's current position was exacerbated by the fact that FAA had indicated they would only "temporarily" accept an eleven o'clock curfew for all airport users. This was a further significant departure in that it clearly implied the possibility of FAA insisting that the County keep the airport open for other periods of the night, or perhaps on a twenty-four hour basis. Therefore, the current position of the FAA, and also what it portends, is a major federal action likely to have major impacts on the local community.

We were requested to identify what those impacts were. We stated that the purpose of an EA was to identify those impacts, but that a few examples had already come up in the record. One of these was the fact that minimal obstruction lighting was needed to handle the scheduled airlines under the current exception to daytime only flight operations. However, if the airport became available after dark to all comers, there was a significant probability that the valley would have to be lighted up like a refinery. That would not be compatible with a remote mountain resort community, which is already struggling with how to control or reduce residential light intrusion at night.

Also, the existing problems which are occurring with regard to noise from daytime operations are in part a function of the fact that the valley tends to "channel" the air traffic and also tends to magnify and reverberate the noise. It was noted that we had evidence in the hearing of noise complaints as far as ten miles away from the valley, which phenomenon was fairly common.

Because the Pitkin County Airport is already constrained in the wintertime by terrain and frequent weather days, we were very likely to begin to realize very quickly that it has finite limits. At the moment with only United Express and Continental Express operating under the night hours exception, wintertime weather conditions frequently place the airport under considerable capacity restraints. The reality of a finite capacity is likely to be realized much sooner at the Pitkin County Airport than in many other airports. That will give rise to the question of the environmental and economic utility of allowing a hundred Donald Trumps to fly in by a hundred lightly occupied business jets, or to bring in the same number of people with one or two airline operations.

In addition to the possibility of conflict in the air between non-scheduled operations and scheduled operations, there is a very different use pattern on the ground. Where a scheduled operation can turn over the same ramp space for many high capacity passenger operations, the general aviation use typically requires parking spaces for each airplane which are frequently occupied by the same airplane for days or weeks.

It was repeated that the purpose of an EA or an EIS is to identify the effects of the purposed federal action. We have certainly identified some of them, but we would have to defer to the studies themselves before the full impact of the FAA decision could be evaluated.

3. Funding and safety of noise studies. Our third request was that the FAA participate in funding county safety and noise studies for the reasons already stated. In the case of the safety study, while we recognized the FAA's authority in that area, we felt that it was in the interest of everyone concerned for the FAA to fund the County in making the "best case" as to the problems which the County is concerned about. Lynn Picard (FAA) pointed out that the FAA noise study funds which might be available might address many of the environmental issues which were creating concern. She also pointed out that (contrary to common belief) FAA noise studies do not have to stop at the 65LDN contour. That is simply a minimum which the FAA insists upon and it is entirely up to the sponsor to go to lower levels if desired. This response was made to our expression of concern that the FAA would use the part 150 to prevent us from going below 65LDN, to ambient noise levels. This type of restraint was disclaimed by FAA.

At the conclusion of the meeting Col. Griggs read a written previously prepared statement stating that the FAA's position was stated essentially as follows:

1. FAA would do its own safety study.

2. FAA solicited Pitkin County's input and data for FAA safety study.

3. FAA would not fund Pitkin County's safety study.

4. If Pitkin County wanted to do its own study, it could do so with its own funds.

5. FAA would have no objection to Pitkin County and the FAA doing parallel studies on the safety issues.

6. If parallel safety studies occurred, they could be "interactive" ie: each could participate in the other study or solicit the others input.

7. Pitkin County must give "parity" to all aircraft until 11:00 p.m. and not enforce their current night time restrictions. There must be an 11:00 p.m. curfew for all aircraft.

8. If Pitkin County did not comply with seven above, the matter would be referred by FAA to the Department of Justice for litigation.

9. FAA would fund a part 150 study by Pitkin County.

10. FAA's funding of a part 150 study was "linked" to Pitkin County's compliance with 7 above. FAA would not fund Pitkin County's noise study if Pitkin County did not comply with 7 above.

The County's repeated requests for an environmental analysis was not accepted, rejected, or otherwise addressed by FAA.

The County's repeated requests for the FAA's administrative records supporting its position was not accepted, rejected or even addressed by FAA.

Shellman and Whitsitt stated that the FAA conditions were probably beyond the current instructions of the Board of County Commissioners; that Mr. Shellman would be attending a legal conference in the Soviet Union until September 25th; that the FAA proposals would be taken up with the board immediately after his return.

DKS/ema

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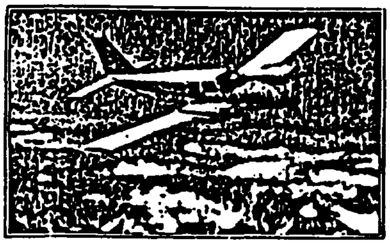
Minifeature FLYING, May, 1986



ROCKY MOUNTAIN HIGH RISK

FLYING A charter into Aspen a few years ago, I wondered why so many mountain accidents had occurred nearby. Did peculiar facets of weather or terrain snare pilots in those 12,000-foot passes east of the famed resort? Those of us operating in that region thought inexperience and bad judgment were to blame. We put it down to "the flatlanders"—a convenient catch-all.

Then I had a chance to speak with a pilot who had crashed west of Independence Pass in a single-engine airplane. A 5,000-hour ATP with plenty of mountain experience, he had been across the pass (12,093 feet) to and from Aspen three times earlier that same day. He checked weather often during the interval. Surface winds at Aspen and forecast winds aloft were both northwest, suggesting updrafts flowing along the valley, trending southeast from Aspen to the pass.

According to traditional mountain-flying wisdom, this pilot could have anticipated a good rate of climb to Independence. And indeed that happened; a couple of miles west of the pass the aircraft ascended at a steady 300 fpm in updrafts. But then, the pilot encountered turbulence, followed immediately by a loss of 30 to 35 knots in indicated airspeed. He had been climbing at 80 knots and now found himself settling at 2,000 fpm without enough airspeed to turn. He lowered the nose, dropped the flaps and tried to maintain control. Rocks loomed in the windshield, and all he could do was swing the fuselage parallel to the spine of the hill and level the wings. Everyone survived the ensuing crash. The pilot said that the time from first encounter with wind shear to impact was about 10 to 15 seconds. The wreckage lay at 11,700 feet.

In my analysis of events, this pilot judged all the factors correctly using the latest knowledge of mountain airflow. Theoretically, he should not have encountered a downdraft on the upwind side of the pass. Yet he did.

Some weeks after that accident I flew into Leadville, Colorado (9,927 feet msl), 30 miles east of Aspen and 15 miles northeast of Independence Pass. Leadville is nestled into an immense mountainous high plateau that straddles the Continental Divide in central Colorado. Aspen, at 7,793 feet msl, sits in a valley immediately west of the loftiest summits in Colorado and the main bulk of the plateau. I was startled to receive a Leadville altimeter setting of 30.61. Ursula Gilgulin, the FBO at Leadville, remarked that the atmospheric pressure frequently reached that high. Suddenly I realized that such elevated pressure might be a significant anomaly. Usually in the Rocky Mountains, with westerly winds aloft, you can count on steadily dropping pressure as you fly eastward. But high pressures on the Leadville plateau could cause hitherto unrecognized mountain drainage winds traveling downhill in every direction. There really might be downdrafts on the west side of the divide, flowing against the prevailing winds aloft.

Leadville's barometric pressure for the time of the accident described above was 30.59; Aspen's had been 30.42. In a straight-line distance of only 30 miles, pressure increased from west to east by .17 of an inch.

From the NTSB I obtained a computer printout of all accidents near Aspen since 1978. In March 1982, a pilot flying a turbocharged Mooney climbed out of Aspen en route to Denver. Apparently he planned to cross Hagerman Pass, which offers more favorable terrain towards Leadville than does Independence. The aircraft crashed at the 11,500-foot level west of Hagerman Pass. The pilot survived, and later informed the NTSB that he had lowered full flaps just prior to impact and that the airspeed was decaying. According to the National Weather Service, surface pressure at Aspen around time of departure was 29.77. At Leadville, the barometer read 29.96—.19 higher.

Another crash occurred in an area west of the Continental Divide at a similar elevation when the Leadville altimeter setting was .17 inches higher than Aspen's, again with forecasts of westerly winds aloft. The pilots reported abrupt drops in airspeed followed by strong downdrafts.

Most meteorology texts merely mention mountain drainage winds. They originate in high, cold areas and flow down known channels. One prominent example is the Santa Ana wind in California. This drainage current spawns in high pressure in the Mojave Desert, where the floor averages 3,000 feet msl. Santa Ana winds tumble through passes and over 9,000-foot mountain ranges as they surge southwest against the usual circulation aloft.

Chinook winds, drying and heating as they descend, are notorious east of the Rockies. Generally, they are associated with mountain-wave conditions. Many years ago I started comparing surface pressures upwind and downwind of mountain chains in order to fashion my own turbulence predictions. You will be jostled by hefty downdrafts and rotors on the lee side if the atmosphere is stable, winds aloft at mountain-top level are predicted at 25 knots or greater perpendicular to the range axis, and surface pressures in the lee of a mountain range are at least .1 inches lower than those to windward. A good example is the Alamosa and Trinidad pair, which brackets Colorado's La Veta Pass. If Alamosa's pressure is .24 or more higher than Trinidad's, and winds aloft at 12,000 feet are westerly above 35 knots, expect a memorable journey. Over the past 18 months I have made random comparisons of Aspen and Leadville altimeter settings. Usually Aspen is higher than Leadville, in line with the traditional pressure slope from west to east.

Preconceived notions of pressure gradient, and the ever present suspicion of pilot error, probably prevented accident investigators from identifying mountain drainage wind as a cause for those crashes east of Aspen. No one thought to check barometric pressures at Leadville. Few believed any hazard existed such as severe downdrafts flowing from the east.

These accidents involved high density altitudes, no doubt. All the aircraft, however, were below maximum weight and well under their service ceilings and, but for mountain drainage winds (a condition not known to any of the pilots), they should have reached their destinations.

When planning a flight eastbound from Aspen, obtain the Leadville surface observation as part of your weather briefing. Leadville weather comes out on a special circuit at 20 minutes past the hour. If Leadville's pressure is higher than Aspen's, don't try Independence, Hagerman or any other pass crossing the divide east onto the plateau unless you are flying a machine capable of a 3,000-fpm climb at a density altitude of 12,000 feet.

MARGARET LAMB

Appendix Item No. 5: Curriculum Vitae, Susan P. Baker

CURRICULUM VITAE

SUSAN P. BAKER, M.P.H.

PERSONAL

- Born May 31, 1930, Atlanta, Georgia
- Married 1951, to Timothy D. Baker, M.D.; three children
- Social Security Number: 215-28-3154
- Office Telephone Number: 301-955-2078

APPOINTMENTS

1988 - Co-Director, the Johns Hopkins Injury Prevention Center

1987-88 - First Director of the Johns Hopkins Injury Prevention Center

1983 - Professor of Health Policy and Management (Joint Appointment in Environmental Health Sciences), The Johns Hopkins University School of Hygiene and Public Health

1983 - Professor of Pediatrics (Joint Appointment), The Johns Hopkins University School of Medicine

1975-86 - Visiting Professor, University of Minnesota School of Public Health

1984-87 - Visiting Lecturer in Injury Prevention, Harvard School of Public Health

1968-83 - Research Associate 1968-71; Assistant Professor 1971-74; Associate Professor 1974-83 in Department of Public Health Administration, The Johns Hopkins University School of Hygiene and Public Health

1968-81 - Research Associate, Office of the Chief Medical Examiner of Maryland

EDUCATION

- Cornell University, 1947-51, B.A. (With Distinction) Zoology

- The Johns Hopkins University School of Hygiene and Public Health, 1966-68, M.P.H., Epidemiology

- Arizona State University, Course in Airplane Crash Survival Investigation, April-May, 1981

- International Center for Safety Education, Advanced Crash Survival Investigation School, 1987

ADVISORY COMMITTEES

- Chair, Agenda-Setting Panel on Occupational Injury, Centers for Disease Control, 1990-
- Member, Agenda-Setting Panel on Unintentional Injury, Centers for Disease Control, 1990-
- Advisory Committee, Citizens for Reliable and Safe Highways (CRASH), 1990-
- Advisory Committee for Injury Prevention and Control of the Centers for Disease Control, 1989-
- Vice-Chairman, Advisory Committee to Develop Injury Prevention Plan for Maryland, 1985-87
- Governor's Task Force on Homicide, Suicide, and Unintentional Injuries, 1986-87
- Vice-Chairman, Committee on Trauma Research, National Academy of Sciences/National Research Council, 1984-85
- Chairman of the National Review Panel for the National Accident Sampling System (NASS) of the National Highway Traffic Safety Administration (NHTSA) 1976; 1978; 1980-81
- National Academy of Sciences, Transportation Research Board Advisory Committee on Pedestrian Separation 1974-81
- Appointed by President Ford to the National Highway Safety Advisory Committee. Vice-Chairman; Chairman of Vehicle Subcommittee; 1975-77
- U.S. Department of Transportation, Truck and Bus Safety Advisory Committee, 1976-78
- Cornell University - Advisory Committee to Dean of College of Arts and Sciences, 1975-80; University Council, 1974-76
- Maryland Alcohol Safety Action Program, Advisory Board, 1971-74
- Maryland State Health Department, Emergency Medical Services Advisory Council to Secretary of Health of Maryland, 1973-74
- National Safety Council Occupant Restraint Workplace Advisory Comm.1982-
- National Society to Prevent Blindness, Committee on Occupational Eye Health and Safety, 1985-

CONSULTANT

- Expert Panel, Age 60 Rule, FAA-sponsored research by Hilton Syst.,1991-
- Expert Panel, FAA-sponsored Airplane Shoulder Restraint Study, 1987
- American Academy of Pediatrics, Maryland Chapter, Consultant to Committee on Accident Prevention, 1982-
- American Academy of Pediatrics, Task Force on Food Choking, 1983
- Centers for Disease Control, International Classification of Diseases Revisions, 1984-
- Medical and Chirurgical Faculty of Maryland, Consultant to Transportation Safety Committee, 1974-
- Institute of Medicine, consultant for Report to the Secretary of Health that became Volume I,"Healthy People," The Surgeon General's Report,1978
- Consultant to New York State Health Department Burn Injury Study, 1977
- Centers for Disease Control; consultant for development of their proposal for an injury control program for health departments, 1977

PROFESSIONAL ORGANIZATIONS

- American Public Health Association: Governing Council 1975-77; Action Board 1977-79, Section Council 1979-81, Section Program Chairman, 1973
- American Association for Automotive Medicine (AAAM): Board of Directors, 1971-76; President 1974-75
- American Trauma Society: Board of Directors, 1972-88
- International Association for Accident and Traffic Medicine 1972-
- American Burn Association 1978-
- The Johns Hopkins Medical and Surgical Association, 1983-
- Aircraft Owners and Pilots Association, 1985-
- Aerospace Medical Association, 1988-
- Aerospace Human Factors Association, 1990-

EDITORIAL BOARDS

- American Journal of Public Health, 1983-1986
- Journal of Accident Analysis and Prevention, 1975-84
- Journal of Trauma, 1979-
- Journal of Public Health Policy, 1980-

OTHER ACTIVITIES (selected list)

- Co-Director, The Johns Hopkins Program for the Study and Control of Childhood Injuries, 1983-
- Injury Scaling Committee of the American Association for Automotive Medicine, 1973-
- Director, two-week course on "Injury Prevention in Developing Countries," sponsored by World Health Organization, 1983
- Co-Chairman, National Conference on Injury Control, 1981
- Faculty member, NHTSA course, Biosciences for Engineers, 1981
- Developed Clinical Modifications to the 9th Revision of International Classification of Diseases (ICD-9-CM), Chapter 17, Injuries, 1977-78
- Member of committee of 15 outside experts to review the 5-year Research and Development Plan for National Highway Traffic Safety Administration (NHTSA) rulemaking on Motor Vehicle Safety Standards, 1979
- Member of Transportation Research Board Committee to Review 5-year Plan for NHTSA's Highway Safety Programs, 1979
- Preventive Medicine Task Force Member and contributing author, "Preventive Medicine, U.S.A." Fogarty Center and American College of Preventive Medicine, 1974-75
- Baltimore Safety Council, Board of Directors, 1969-74
- American Academy of Orthopaedic Surgeons, Continuing Education Faculty, 1974
- Armed Forces Institute of Pathology, Accident Course, Faculty, 1971-72
- National Institutes of Health Review Committee, Sudden Infant Death Syndrome, 1972

PARTICIPATION IN INTERNATIONAL CONFERENCES AS INVITED GUEST OR KEYNOTE SPEAKER

- Utrecht, Netherlands, Highway Safety Conference, 1974 (Prize Recipient)
- Haifa, Israel, International Conference on Pedestrian Safety, 1976 (Keynote Speaker)
- Melbourne, Australia, International Conference on Alcohol, Drugs, and Traffic Safety, 1977 (Keynote Speaker)
- Brisbane, Australia, Conference on Childhood Accidents and Prevention, 1979 (Keynote Speaker)
- Kathmandu, Nepal, International Conference on Deprived and Disabled Children, 1982 (Invited Speaker)
- American Medical Association Conference on Prevention of Disabling Injuries, 1983 (Keynote Speaker)
- Calgary, Alberta, Canada, Injury-Trauma Conference, The John T. Law Memorial Lecture, 1984 (Keynote Speaker)
- Korean Preventive Medicine Society, 1987 (Keynote Speaker)
- Sydney, Australia, Public Health and Road Safety Conference, 1990 (Keynote Speaker)

HONORS AND AWARDS

- Cornell National Scholar 1947-51
- Phi Beta Kappa
- Delta Omega (Public Health Honor Society)
- Prince Bernhard Medal and $1500 prize for Dissertation in Traffic Safety, from the Dutch Association for Traffic Medicine, 1974
- Safety First Club of Maryland, Leader in Lifesaving Award, 1978
- American Trauma Society, Distinguished Achievement Award, 1981
- America Association for Automotive Medicine, Award of Merit, 1985
- American Trauma Society, Stone Lectureship Award, 1985
- Named "Bad Guy of the Month" by Road Rider Magazine for efforts promoting motorcycle helmet laws
- Who's Who of American Women, since 15th Edition
- Who's Who in the East, since 21st Edition
- Who's Who in America, since 44th Edition
- American Association for the Surgery of Trauma, Honorary Fellow, 1988-
- Charles A. Dana Award for Pioneering Achievements in Health and Higher Education, 1989
- American Epidemiological Society, Member, 1990-

COURSES TAUGHT

- Issues in Injury Control
- Aviation Safety
- Epidemiology of Injuries (Text is Injury Fact Book by Susan Baker, et al.)

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Baker, S.P., Myers, A.H., and Smith, G.S. Injury Prevention in the Workplace, Proceedings of The Johns Hopkins University Conference on Research in Work, Health, and Productivity. Oxford University Press, in press.

Rivara, F.P., and Baker, S.P. Epidemiology of Pediatric Trauma, in Planning and Managing Systems for Pediatric Emergency Care. Edited by R.A. Dieckmann, Baltimore, Maryland: Williams and Wilkins, in press.

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Simpson, S.G., Reid, R., Baker, S.P., and Teret, S.P. Injuries in the Keams Canyon Service Unit, 1979-80. Report to Indian Health Service, Requisition #KCH 008-82. Baltimore, The Johns Hopkins School of Hygiene and Public Health, June 4, 1982.

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