Appendix E – Supplemental Runway Length Justification

This Appendix includes supplemental information for Airport Sponsors, Airport Operators and Regulating Agency to use in the determination and selection of a final runway length at SGH. As mentioned in Chapter 4: Facility requirements, this information is not commonly used and/or not accepted by the FAA for the determination of funding from the Airport Improvement unless otherwise approved in writing.

E.1 GENERAL SUPPLEMENTAL INFORMATION

According to FAA AC 91-97A, *Mitigating the Risks of a Runway Overrun Upon Landing*, "A negative runway slope of 1 percent (downhill) increases landing distance by 10 percent." In addition to runway slope (gradient), several other factors that affect landing distance outside of what the aircraft operating manual states, including the following:

- High density altitude;
- Runway condition (wet, dry, standing water, slush, snow, ice);
- Unstabilized approach;
- Excess airspeed over the runway threshold;
- Wind conditions;
- Type of braking;
- Landing technique;
- Standard operating procedures;
- Minimum equipment list;
- Landing beyond the touchdown point;
- Excessive height over the runway threshold;
- Delayed use of deceleration devices.

The cumulated effect of these factors can in some cases almost double the landing distance required of an aircraft. (See **Exhibit E.1-1**.)

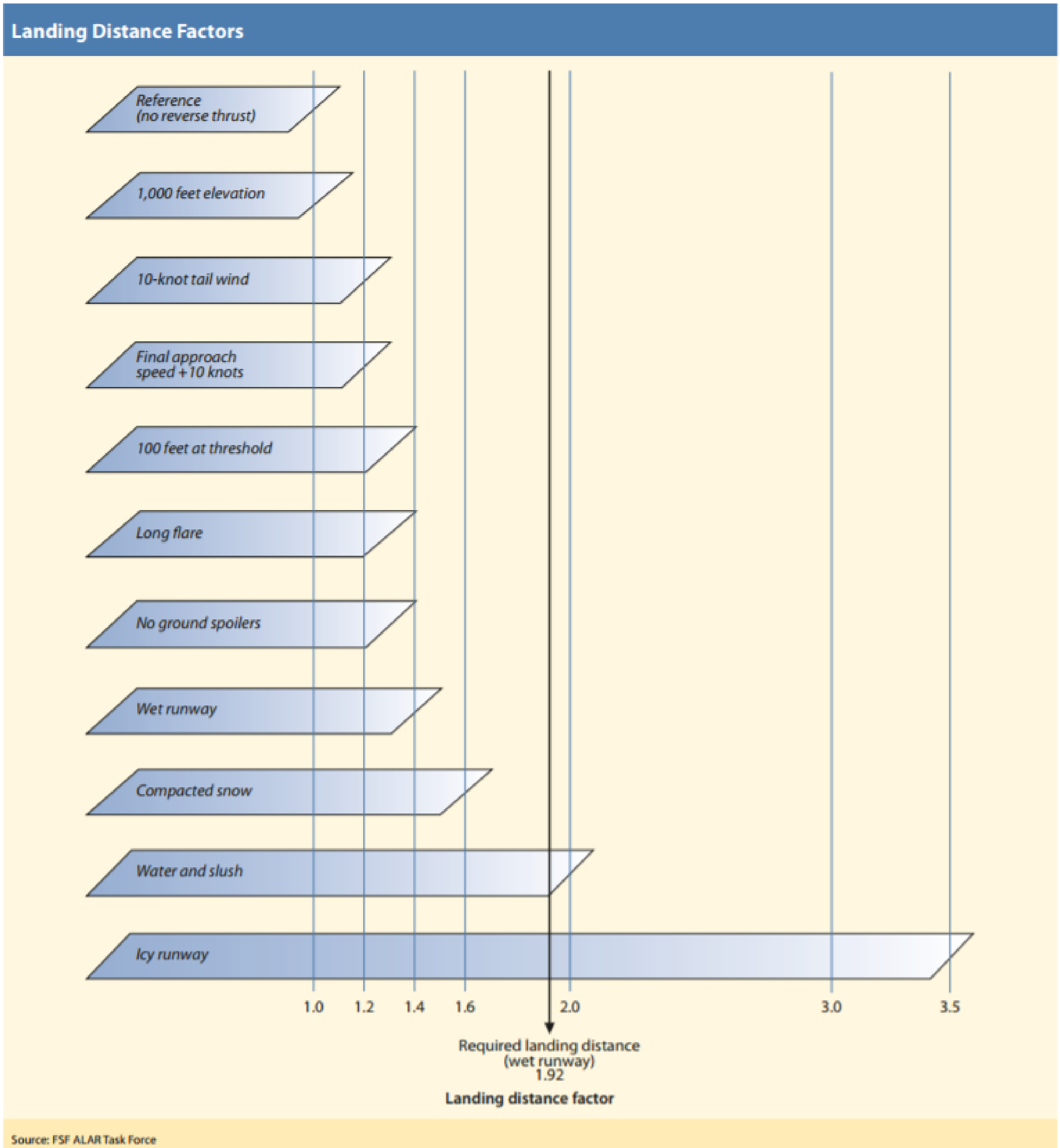
Additionally, FAA regulations require that all Part 91(k) and Part 135 (the regulations under which many private jet aircraft operate) flights must be able to land within 60% of the available runway length on any given runway.[1] This means that the aircraft must be able to land on 5,400 feet at SGH if operating under Parts 91(K) or 135. Any reduction in the existing 9,000 feet runway length is in effect reducing the landing length to even less than 5,400 feet for aircraft operating under these rules.

Another important reason not to reduce the runway length is the general increase in temperatures the earth is experiencing and how it relates to density altitude. Density altitude impacts aircraft performance. Hot and humid weather conditions increase density altitude. The higher the density altitude, the longer the takeoff run required before flight is accomplished. According to NASA, "Scientists have high confidence that global temperatures will continue to rise for decades to come, largely due to greenhouse gases produced by human activities. The Intergovernmental Panel on Climate Change (IPCC), which includes more than 1,300 scientists from the United States and other countries, forecasts a temperature rise of 2.5 to 10 degrees Fahrenheit over the next century."[2] According to research commissioned by the National Research Council, "for aircraft that use up most of the pavement on even the longest runways, even a 1 or 2% increase in density altitude from increased moisture may put those aircraft out of commission for daytime operations on certain days." [3] Increases in the number of very hot days or the presence of heat waves will

[1] FAA AC 91-79A, *Mitigating the Risks of a Runway Overrun Upon Landing*: This equates to 1.76 times the actual dry landing length and 1.92 times the wet landing length (additional 15% for wet) required for the aircraft. The Destination Airport Analysis Program (DAAP) can be used to decrease the dry length to 80% in certain situations.
[2] NASA, Global Climate Change, Vital Signs of the Planet, https://climate.nasa.gov/effects/, accessed August, 2017.
[3] *Climate Variability and Change with Implications for Transportation*, Thomas C. Peterson, et al., NOAA's National Climate Data Center.

also impact "lift-off load limits at high-altitude or hot weather airports with insufficient runway lengths, resulting in flight cancellations and/or limits on payload (i.e., weight restrictions)."[4]

Exhibit E.1-1: Factors Affecting Aircraft Landing Distance



Source: Flight Safety Foundation ALAR Took Kit, ALAR Briefing Note 8.3

[4] *Potential Impacts of Climate Change on U.S. Transportation*, Transportation Research Board Special Report 290, https://docs.lib.noaa.gov/noaa_documents/NOAA_related_docs/climate_GAO_071172.pdf.

Additionally, a review of the National Business Aircraft Association recommendations was made. The optimal length for business jets at sea level and standard atmospheric conditions according to NBAA is shown in **Exhibit E.1-2** with corrections for SGH's elevation at 86° Fahrenheit. These numbers further validate that SGH's runway is the appropriate length for their users.

Exhibit E.1-2: Optimal Runway Lengths for Jets according to NBAA

Runways at Sea Level and IAC	Dimensions (feet) at Sea Level	Corrected for SGH Elevation on 86® Fahrenheit	Weight Capacity (pounds)
Heavy Jet (above 50,000 lbs.)	7,500 by 150	10,350	120,000
Medium Jet (up to 50,000 lbs.)	5,500 by 100	7,590	75,000
Light Jet (up to 25,000 lbs.)	4,500 by 100	6,210	50,000
Very Light Jet/Turboprop up to 12,500 lbs.)	4,000 by 75	5,520	25,000

Source: National Business Aircraft Association Airport Advocate Guide, Advocacy Supplement to the NBAA Airports Handbook; FAA–P–8740–2, Density Altitude.

E.2 PRIMARY RUNWAY 06-24 – ADDITIONAL INFORMATION

1) Review of actual aircraft operating manuals

Some of these aircraft operating manuals were reviewed to determine specific runway length needs for specific aircraft, similar to how the aircraft pilot would do it in the field. Examples of the runway length needs of these aircraft (which are more than the generic curves shown in FAA AC 150/5325-4B) are shown in **Exhibit E.2-1 through Exhibit E.2-2**.

Exhibit E.2-1: Examples of 25% Fleet Aircraft needing more Runway than FAA Curves show

Hawker 800XP – MTOW (Remaining 25% fleet)									
Takeoff (Flaps 15°)									
0° C							30°C		
Dry	Wet	Compact Snow	Standing Water	Slush	Wet Snow	Dry Snow	Dry	Wet	Standing Water
4951	5690	6761	11776	10609	9766	9822	6049	6677	13675

Manufacturer operational manual

LearJet 60 – MTOW (Remaining 25% fleet)							
Takeoff (Flaps 8°)							
40° F				60° F	90° F		
Dry	Wet	Slush (Flaps 20)	Dry Snow	Standing Water	Dry	Wet	Standing Water (Flaps 20)
5820	6220	7810		8170	7150	7490	9560

Manufacturer operational manual

Exhibit E.2-2: Examples of 75% Fleet Aircraft needing more Runway than FAA Curves show

Beechjet 400 – MTOW (75% fleet)									
Takeoff (Flaps 10°)									
0° C	0° C	10° C	0° C	10° C	0° C	30°C	30°C	30°C	20°C
Dry	Compact Snow	Standing Water	Slush	Wet Snow	Dry Snow	Dry	Wet	Standing Water	Standing Water
4038	6682	8720	8256	7007	6682	5053	5873	10425	9562

Manufacturer operating manual

Cessna Citation 550 - MTOW (75% fleet)									
Takeoff (Flaps 15°)									
0° C							30°C		
Dry	Wet	Compact Snow	Standing Water	Slush	Wet Snow/Icy	Dry Snow	Dry	Wet	Standing Water
3260	4650	5400	7600	7400	12250	6300	5050	7200	10800

Manufacturer operating manual

Cessna Citation III - MTOW (75% fleet)							
Takeoff (Flaps 7°)							
0° C				**10° C**	**30°C**		
Dry	**Wet**	**Slush**	**Dry Snow**	**Standing Water**	**Dry**	**Wet**	**Standing Water**
5641	7333	12974	14103	13444	7211	9374	16585

FlightSafety International Training Manual

LearJet 35/36 – MTOW (75% fleet)							
Takeoff (Flaps 8°)							
4° C				**10° C**	**27°C**		
Dry	**Wet**	**Slush**	**Dry Snow**	**Standing Water**	**Dry**	**Wet**	**Standing Water**
5213	7298				6526	9136	

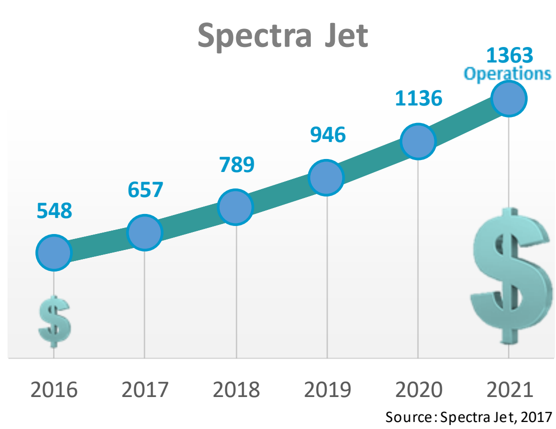
Manufacturer operational manual

2) Airport user survey and Critical Operators Service Need

The need for the existing 9,000 feet length is validated by the user surveys, which included responses from operators of 17 aircraft that indicated the optimal length of the primary runway to be 9,000 feet or more (see Appendix D). Many of these critical operators use Spectra Jet for aircraft maintenance on Bombardier's Learjet and Challenger 300/600 series aircraft. Both Spectra Jet and many of their customers indicated the existing runway should be maintained for safe and efficient operations.

Spectra Jet had 548 operations for their customers in 2016 and they have shared their growth plans over the next 5 years. (See **Exhibit E.2-3**.) Currently, they are underway to expand their apron and construct a new hangar building similar in size to its existing. It is estimated that 50-75% or their customers (those in the remaining 25% fleet and those in the 75% under adverse conditions) need up to 9,000 feet. These estimates have been prepared in conjunction with feedback from Spectra Jet.

Exhibit E.2-3: Specta Jet Growth Plan



433* 25% fleet category that need 9,000 ft.
\+ 179 Less than 25% fleet that need 9,000 ft.
612
\+ 408 to 611 – 50 to 75% of Spectra Jet growth in customers
1,020 to 1,223 users that need 9,000 ft. *

*These numbers are from a different timeperiod as evaluated in Chapter 3 as it was written before the FAA provide City-Pair data.

Reducing the runway length at SGH is also not prudent based on several other reasons, one being the aircraft maintenance performed at the airport by Spectra Jet, Inc. As a full service maintenance company for all Learjet models and the Bombardier Challenger 300 and 600 series aircraft, Spectra Jet, Inc., performs major/heavy aircraft maintenance (e.g., complete wing removal for the Learjet 12,000 hour inspection) which can result in post-maintenance flight checks. "Several accidents and serious incidents have highlighted the higher risk associated with conducting functional check flights." Because of the higher risk associated with this type of flight, optimal runway length is vital to flight safety during this type of operation. [5]

A reduced runway length does not meet the needs for many of Spectra Jets customers' aircraft (e.g., CL60, LJ35/36) and it reduces the safety margins valued during test flights after maintenance or during ferry flights of aircraft in need of repair (safety criteria).

E.3 CROSSWIND RUNWAY 15-33 – ADDITIONAL INFORMATION

Design aircraft operating manuals were also evaluated for smaller, cross-wind sensitive jet aircraft that commonly weigh at or about 12,500 lbs. and would commonly use a crosswind runway when possible under crosswind conditions. The aircraft listed below are aircraft that would have a preference for use of crosswind Runway 15-33 when wind direction favors its use but they exceed the A/B-I wind criteria for justification (they are forced to the primary Runway 6-24). However, should the crosswind runway be reduced to less than 5,000 ft., this runway is likely to be unusable to most of these aircraft.

Exhibit E.3-1: Specific Aircraft Specifications

Cessna 510 (MTOW Less than 12,500)							
Takeoff (Flaps 15°)							
0° C				**10° C**	**30°C**		
Dry	**Wet**	**Slush**	**Dry Snow**	**Wet**	**Dry**	**Wet**	**Standing Water**
3070	3230	8050	5900	3330	3810	4200	9550

Manufacturer operating manual

Cessna 525 CJ2 (MTOW 12,500)							
Takeoff (Flaps 15°)							
0° C				**10° C**	**30°C**		
Dry	**Wet**	**Slush**	**Dry Snow**	**Wet**	**Dry**	**Wet**	**Standing Water**
3,300					4,700		

Manufacturer operating manual

Cessna Citation 550 (MTOW 14,100)									
Takeoff (Flaps 15°)									
0° C							**30°C**		
Dry	**Wet**	**Compact Snow**	**Standing Water**	**Slush**	**Wet Snow/Icy**	**Dry Snow**	**Dry**	**Wet**	**Standing Water**
3260	4650	5400	7600	7400	12250	6300	5050	7200	10800

Manufacturer operating manual

[5] Runway length is of imperative importance during post maintenance test flights. An example according to the NTSB is as follows: "An FAA maintenance alert published in 1996 described an incident at the Hartzell Propeller Service Center that involved a Beech A-100. According to the Alert: 'On the first flight after propeller installation, both propellers had a dramatic RPM loss immediately after lift off from the runway, fortunately the aircraft was able to land safely. This aircraft, and certain other Beech [Pratt and Whitney] powered aircraft, have a two position low blade angle which effectively provides both a flight idle and a ground idle stop, the difference controlled by a landing gear switch. The combination of switch actuation plus an engine/propeller combination that was not properly rigged, initiated the incident.'"
https://www.ntsb.gov/about/employment/_layouts/ntsb.aviation/brief2.aspx?ev_id=20001215X45419&ntsbno=IAD01FA015&akey=1, accessed 8-14-17

LearJet 31A (MTOW 15,500)									
Takeoff (Flaps 8°)									
40° F							**90°F**		
Dry	**Wet**	**Compact Snow**	**Standing Water**	**Slush**	**Wet Snow/Icy**	**Dry Snow**	**Dry**	**Wet**	**Standing Water**
3845							5215		

Manufacturer operating manual

Beechcraft King Air 350 (MTOW 15,000)								
Takeoff (W/ Flaps)								
0° C	**5° C**			**0° C**		**35°C**		
Dry	**Wet**	**Slush**	**Wet Snow**	**Dry Snow**	**Compact Snow**	**Dry**	**Wet**	**Standing Water**
3201	3604	6101	6032	5886	3347	4504	4794	7387

FlightSafety International Training Manual