



# Interim Runway Safety Area Study

September 2017



# INTERIM RUNWAY SAFETY AREA STUDY

YEAGER AIRPORT

PREPARED FOR:

THE CENTRAL WEST VIRGINIA  
REGIONAL AIRPORT AUTHORITY

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# INTRODUCTION

Yeager Airport (CRW) is a joint-use civil aviation/Air National Guard airport located three miles east of Charleston, West Virginia, **the state's capital**. Owned and operated by the Central West Virginia Regional Airport Authority (CWVRAA), CRW is the largest airport in the state and generates over 174 million dollars per year in economic impact to the state. The Airport offers approximately 20 daily scheduled flights from four airlines serving domestic destinations, and more than 225,000 passengers annually.<sup>1</sup> The Airport is also home to the **West Virginia Air National Guard's 130<sup>th</sup>** Airlift Wing, an Air Mobility Command (AMC) unit, and a thriving general aviation community. The **Airport serves as a vital component to the state's transportation system and serves as a key asset to the existing and future development of the area.**

## 1. EXECUTIVE SUMMARY

On March 12, 2015, a failure of a mechanically stabilized earth retention structure (slope failure) destroyed the Runway 05 Runway Safety Area (RSA) and Engineered Materials Arresting System (EMAS).<sup>2</sup> The EMAS was eight years old at the time and sat atop an engineered fill of 1.5 million cubic yards. The loss of the EMAS resulted in the displacement of the Runway 05 threshold and the shortening of the usable lengths of Runway 05-23 by as much as 500 feet in both directions. Because the Runway 05 threshold was moved, the glideslope became unusable, eliminating vertical guidance to Runway 05.

These changes have had a substantial effect on air service available from CRW, with some airlines refusing to serve the airport, and others reducing seating capacity on some flights. Further, the West Virginia Air National Guard now must accomplish some of their training missions at other airports – increasing their training costs.

As a result of the operational impacts and reduced RSA, the CWVRAA commissioned this Interim Runway Safety Area Study (RSA Study) in an effort to identify an interim solution to quickly improve safety and restore as much lost operational capability as possible. Simultaneous with this study, the CWVRAA is updating its Airport Master Plan to identify a permanent runway configuration that has RSAs that meet modern airport design standards and will accommodate the long-term air service needs of the regional market. Accordingly, this study focuses only on meeting existing air service needs and potential short-term changes enabled by the additional runway length provided by the interim RSA improvement. The interim improvements will also make substantial progress towards creating the permanent, ultimate

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<sup>1</sup> The 225,000 passenger figure is a representation of the 2015 figures found in the 2016 Yeager Airport *Economic Impact Study* released in October of 2016.

<sup>2</sup> An EMAS uses crushable material which is placed at the end of a runway to stop an aircraft overrun. The aircraft tires sink into the EMAS material, which forces the aircraft to decelerate. EMAS is provided for runways where it is not possible to have a 1,000-foot overrun area. According to FAA Advisory Circular (AC) 150/5300-13A, *Airport Design*, a standard EMAS provides an equivalent level of safety as a full-dimension RSA.

configuration of Runway 05-23. **Upon acceptance of this RSA Study's** recommended solution, the CWRRAA will immediately initiate design and construction activities to implement this interim solution on a highly expedited schedule.

The recommended solution extends the available RSA on the Runway 05 end by 200 feet through construction of a 82-foot high retaining wall and a combination of soil and Geofoam fill. This extended RSA accommodates a 352-foot EMAS bed, a 35-foot run-in area, and takes up only 87 feet of the existing runway pavement. This study demonstrates that this interim solution provides the best balance between improving safety and meeting existing operational needs. It provides the necessary landing distance in both directions, restores 98.7 percent of the previous take-off distance in the Runway 23 direction, and 98.6 percent of the previous take-off distance in the Runway 05 direction. The airlines operating at CRW have confirmed that this small loss of take-off distance does not materially affect the payloads they can carry on their flights. The runway lengths are also sufficient to end the refusal of some carriers to serve Yeager Airport. In addition, the added length allows the West Virginia Air National Guard to resume some of their training activities at CRW. Although it does not meet the undershoot RSA goal on the Runway 05 end, it does restore vertical guidance for Runway 05 arrivals immediately upon completion of construction, which improves safety by reducing the risk of an undershot landing on that end. Further, all of the elements of the interim solution can become an integral **part of the Airport's permanent solution for Runway 05-23.**

## 2. RUNWAY SAFETY AREA STUDY (RSA STUDY) OBJECTIVES

This RSA study had four main objectives:

- Improve Safety over Existing Conditions
- Reduce Runway Length Restrictions
- Reestablish Runway 05 Glide Slope
- Minimize Construction (Fast Implementation)

## 3. RUNWAY AND RSA BACKGROUND

Construction began in 1944 and the Airport opened in 1947 as Kanawha Airport, following the closure of Wertz Field during World War II. Kanawha Airport was later renamed Yeager Airport after famed aviator, Chuck Yeager, and his contributions to the aviation industry. The Airport originally opened with two active runways, Runway 05-23 and 14-32 (later renamed 15-33).

Per the recommendations of the 2007 Airport Master Plan, Runway 15-33 was closed in 2008 because it has a shorter length as compared to Runway 05-23, the cost of making the runway comply with more recent RSA standards, and to make room for additional general aviation hangar development and expansion of the Air National Guard apron. CRW currently operates exclusively on Runway 05-23, the sole runway on the airfield (see Exhibit 3-1, *Existing Airport Configuration*).

Exhibit 3-1  
EXISTING AIRPORT CONFIGURATION  
Yeager Airport



Sources: Google Earth, Image Date: September 14, 2015; Landrum & Brown analysis.

The CWVRAA conducted a *Runway Safety Area Determination Study* in 2003 (2003 RSA Study) in conjunction with the Federal Aviation Administration (FAA) because its RSAs did not meet modern design standards. The 2003 study recommended construction of a 520-foot long fill off the end of Runway 05 to support a 430-foot long EMAS bed. Meanwhile, declared distances<sup>3</sup> were recommended for the Runway 23 end to provide an RSA with a length of 500 feet beyond the Runway 23 threshold. At the time of the 2003 RSA Study, a determination was made that high construction costs **and potential impacts to Coonskin Park's access road** precluded construction of an EMAS bed or a full-dimension RSA on the Runway 23 end. In 2007, a 440-foot by 175-foot EMAS was installed on the Runway 05 end and declared distances were applied to Runway 23.

Three years after the installation of the EMAS on Runway 05, a US Airways CRJ 200 aborted takeoff and skidded 1,921 feet before entering the EMAS bed. As a result of being able to stop approximately 130 feet into the EMAS bed, there were no injuries among the 30 passengers and 3 crew members.

January 19, 2010 RSA Incident



<sup>3</sup> Per FAA AC 150/5300-13A, *Airport Design*, declares distances are "the distances the airport operator declares available for a turbine powered aircraft's takeoff run, takeoff distance, accelerate-stop distance, and landing distance requirements."

Nearly five years after the CRJ 200 aborted takeoff, on March 12, 2015, a slope failure destroyed the Runway 05 RSA and EMAS. The EMAS was eight years old and sat atop an engineered fill of 1.5 million cubic yards. The slope failure caused a significant amount of damage to the EMAS, as well as the surrounding area. In addition to the damage on the Airport, the landside also took out power lines, trees, and a nearby church, in addition to blocking a stream and Keystone Road. As a result of the stream blockage, one house was destroyed and there was minor flooding in the neighborhood, affecting additional properties.

### Before Slope Failure



### After Slope Failure



The loss of the EMAS resulted in the shortening of the usable lengths of Runway 05-23 by as much as 500 feet in both directions. Because the Runway 05 threshold was moved, the glideslope became unusable. The slope failure also resulted in the implementation of a 500-foot length RSA on the Runway 05 end (the standard is 1,000 feet or EMAS). This RSA Study focuses on improving safety over existing, post-slope failure conditions and on restoring sufficient operational capability to meet existing and historical air service needs.

Since the runway was shortened, CRW had another overrun incident. In February of 2017, a landing regional jet overran the declared landing distance and used the entire runway to come to a complete stop. In addition, a fatal accident occurred on May 5, 2017. A twin-engine turboprop Short 330 cargo plane crashed while landing on Runway 05, tragically killing two people. The left wing of the aircraft struck the runway and the aircraft skidded off the runway and went down a steep embankment. These incidents demonstrate the need to improve runway safety at the Airport.

## 4. RSA STANDARDS

RSAs are an integral part of an airport’s runway environment. The RSA is “a defined surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway.”<sup>4</sup> Stringent and critical FAA design requirements apply to the RSA. The FAA established the current RSA design standards in 1988. Because not all airports in the U.S. conformed to the new design standards, the FAA published FAA Order 5200.8, *Runway Safety Area Program*, in 2009.

Standard RSA dimensions are defined based on the Airport Reference Code (ARC) and are established in FAA AC 150/5300-13A, *Airport Design*. The ARC signifies the **Airport’s highest Runway Design Code (RDC) minus the visibility** component of the RDC. The ARC does not limit the aircraft that may be able to operate safely at the **Airport but does incorporate the Airport’s critical aircraft**. The critical aircraft for the Airport can be a specific aircraft or a composite of several aircraft that are using, expected, or intended to use the Airport or part of the Airport.

The existing ARC for CRW is C-III and is based on a composite of several C-III aircraft that are scheduled to operate at CRW in 2017. These aircraft make up over 800 operations annually and stem from the A319, B717, B737-700, and CRJ 900. Projected 2017 operations on these C-III designated aircraft are depicted in Table 4-1, *CRW Critical Aircraft Composite (C-III)*. Based on an ARC of C-III, the Runway 05-23 RSA should have a 500-foot width, extend 1,000 feet beyond the departure runway ends and have a 600-foot length prior to the arrival thresholds.

Table 4-1  
 CRW CRITICAL AIRCRAFT COMPOSITE (C-III)  
 Yeager Airport

AIRCRAFT	2017 OPERATIONS
A319	288
B717	306
B737-700	168
CRJ 900	42
Total	804

Note: Based on commercial passenger aircraft only. Does not include C-III cargo or general aviation aircraft.

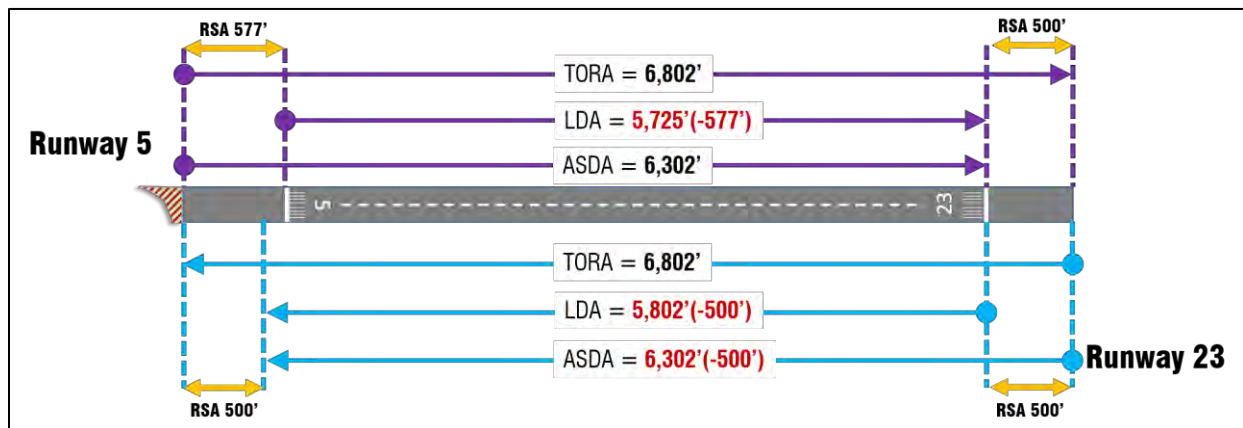
Sources: Official Airline Guide (OAG) Schedules Analyzer, accessed on February 28, 2017; Landrum & Brown analysis.

<sup>4</sup> FAA AC 150/5300-13A Change 1, *Airport Design*.

## 5. EXISTING CONDITIONS

The slope failure left Runway 05 with about 100 feet of RSA length beyond the Runway 05 end. In order to provide additional RSA length while awaiting a permanent solution, CWVRAA decided to decrease the declared distances on the runway. These declared distances resulted in a 500-foot reduction in Landing Distance Available (LDA) and Accelerate-Stop Distance Available (ASDA) on the Runway 23 end and a 577-foot reduction in LDA on the Runway 05 end,<sup>5</sup> as shown in Exhibit 5-1, *Declared Distances Post-Slope Failure*. The changes did not reduce the Takeoff Run Available (TORA) or Takeoff Distance Available (TODA). The FAA approved the resulting RSA lengths beyond the Runway 05 end.

Exhibit 5-1  
 DECLARED DISTANCES POST-SLOPE FAILURE  
 Yeager Airport



DECLARED DISTANCES	BEFORE SLOPE FAILURE		AFTER SLOPE FAILURE	
	RWY 05	RWY 23	RWY 05	RWY 23
TORA/TODA	6,802	6,802	6,802	6,802
LDA	6,302	6,302	5,725	5,802
ASDA	6,302	6,802	6,302	6,302

Note: TORA = Takeoff Run Available; TODA = Takeoff Distance Available; LDA = Landing Distance Available; ASDA = Accelerate-Stop Distance Available.

Sources: FAA Airport Master Record Form 5010 for CRW; Landrum & Brown analysis.

<sup>5</sup> The Runway 05 RSA length goal was 500 feet. The Runway 05 threshold was displaced an additional 77 feet to accommodate construction activities that removed fill after the slope failure.

The declared distances assigned to the runway following the slope failure are still used today. The declared distances were set as a temporary solution following the slope failure. The displacement was derived for three reasons: first, the need to be able to clear a 35-foot high contractor piece of equipment located at approximately 120 feet from the former threshold to begin removal operations, second, that was the location of the nearest runway edge light, and third, to provide a safety area. Airport stakeholders were not consulted regarding the impacts of these declared distances at the time. As a result, the operational impacts to airlines, cargo operators, military operations, and general aviation pilots were not considered. This RSA Study takes stakeholder impacts into account to safely increase operational efficiency for the Airport.

The RSA lengths beyond both ends of Runway 05-23 are considered non-standard in accordance with FAA design standards found in FAA AC 150/5300-13A Change 1, *Airport Design*. The existing RSA overruns for both the Runway 05 and 23 ends are 500 feet long, while the FAA standards advise that the overrun be 1,000 feet long. This is a deficiency of 500 feet on each runway end. The RSA undershoot is also considered non-standard according to FAA, which specifies a 600-foot length for the undershoot. Currently, Runway 23 has an undershoot length of 500 feet and Runway 05 has an undershoot length of 577 feet. This is a deficiency of 100 feet and 23 feet, respectively. The length of the Runway 23 end RSA remains the same as what was recommended in the 2003 RSA Study, while the Runway 05 end RSA has changed due to the slope failure. As a result, this study focused on the RSA on the Runway 05 end.



## 6. RUNWAY LENGTH REQUIREMENTS

The first step in this RSA Study was to conduct a runway length analysis that examined various aircraft currently using the Airport. Future aircraft fleets were not used in RSA Study; they will be analyzed in the Master Plan Update. Runway length requirements were calculated in accordance with FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*. Two runway length analyses were conducted:

- Passenger and Cargo Aircraft: The charts published in the aircraft **manufacturers' manuals were used** to determine the landing and takeoff length requirements for the existing airline and cargo fleets. Takeoff length requirements were calculated by taking into account 2017 scheduled destinations in order to conduct a payload/range analysis. This type of takeoff length analysis is more accurate and can determine proper payload and fuel needs per aircraft by using the furthest destination by each aircraft type. Landing length requirements were assessed utilizing Maximum Landing Weight (MLW).
- General Aviation Aircraft: The charts published in the aircraft **manufacturers' manuals were** also used to analyze the existing general aviation aircraft at CRW. The analysis of runway length included both based and transient aircraft. Takeoff and landing length requirements were assessed utilizing Maximum Takeoff Weight (MTOW) and MLW, respectively. A payload/range analysis was not conducted for general aviation aircraft because the payload/range charts are not typically available for these aircraft.

Although this analysis utilized the aircraft manufacturers' manuals, individual operators (airlines) may have more stringent policies that will require additional runway length due to safety and other factors, such as insurance requirements.

### 6.1 RUNWAY LENGTH METHODOLOGY AND ASSUMPTIONS

Both runway length analyses took into account a number of fixed inputs and assumptions:

- Density altitude
- Runway characteristics
- Fleet mix

#### 6.1.1 DENSITY ALTITUDE

Density altitude is a natural phenomenon that decreases aircraft and engine **performance**. **It is a function of an airport's elevation and temperature**. The higher the elevation or temperature, the higher the density altitude and its effects will be. Because **high density altitude decreases an aircraft's operational performance**, longer runway distances are required for takeoffs and landings.

#### 6.1.1.1 Temperature

The aircraft manufacturers' manuals contain charts to calculate takeoff runway length requirements based on temperature. The calculations are based on "standard day" (defined as 59 degrees Fahrenheit) or a "hot day." The hot day charts in the aircraft manufacturers' manuals are based on different definitions of hot day, ranging from 84 to 87 degrees Fahrenheit.

The determination of which temperature chart to use depends upon the average or typical weather conditions for a particular region or airport. The mean daily maximum temperature at CRW is 85.6 degrees Fahrenheit<sup>6</sup> for the hottest month in the summer, making the hot day charts most appropriate. Therefore, the takeoff runway length requirements were calculated using the aircraft manufacturers' manuals for hot day conditions.

The aircraft manufacturers' performance manuals for landing requirements only contain charts for standard day. Therefore, landing lengths were assessed at standard day temperatures.

#### 6.1.1.2 Elevation

The Airport elevation is 947.2 feet Above Mean Sea Level (AMSL).<sup>7</sup>

### 6.1.2 RUNWAY CHARACTERISTICS

#### 6.1.2.1 Runway Gradient

The takeoff and landing charts in the aircraft manuals are based on a runway slope of zero. An aircraft taking off on an uphill gradient requires more runway length than it does on a flat or downhill slope. The average runway gradient for Runway 05-23 is 0.7 percent. The Runway 23 threshold is 52 feet higher than Runway 05 threshold. Given this elevation difference, the FAA formula for correcting a runway length requirement is to add 10 feet of runway length for every foot of elevation increase. Accordingly, runway lengths for Runway 23 departures are 520 greater than those required for a runway with no slope.

#### 6.1.2.2 Runway Contamination

Landing runway length requirements can be calculated for wet (contaminated) or dry runways. This study used wet runway conditions as required by FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*. Wet conditions require longer runways for landing than dry conditions, due to the additional distance needed to decelerate on wet pavement. For those aircraft where the aircraft performance manuals do not specifically show a wet landing length curve, the dry landing length was increased by 15 percent **as specified in the FAA's runway length AC**.

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<sup>6</sup> National Oceanic and Atmospheric Administration (NOAA) data, 2017.

<sup>7</sup> Yeager Airport Existing Airport Layout Plan (ALP), November 1, 2009.

### 6.1.3 FLEET MIX

The fleet of aircraft operating at an airport is a critical factor in determining runway length requirements. The fleet determines the critical aircraft for runway length need, which may end up being different from that of the overall critical aircraft for the Airport.

#### 6.1.3.1 Passenger and Cargo Fleet Mix

The passenger and cargo fleet is shown in Table 6-1, *Passenger and Cargo Fleet Mix*. The furthest destination served by each aircraft type is listed in the table. The 2016 and 2017 scheduled passenger fleet was obtained from the Official Airline Guide (OAG). The 2016 cargo fleet mix was obtained from the FAA Traffic Flow Management System Counts (TFMSC) database, which provides Instrument Flight Rules (IFR) operations. Because 2017 cargo operations are not available through the OAG, 2017 cargo operations were assumed to be equivalent to 2016. Most aircraft operating at CRW in 2016 are scheduled to remain operational in 2017. In the passenger fleet, CRJ 200 and B717 operations are projected to substantially increase in 2017, while Dash 8, A319, and CRJ 700 operations are expected to decrease.

Table 6-1  
 PASSENGER AND CARGO FLEET MIX  
 Yeager Airport

AIRCRAFT TYPE	TYPE OF OPERATION	FURTHEST DESTINATION	ANNUAL IFR OPERATIONS	
			2016	2017 <sup>1</sup>
CRJ 200	Existing Passenger	ATL	4,362	5,424
DASH 8	Existing Passenger	PHL	4,758	4,068
EMB 145	Existing Passenger	IAH	1,716	1,792
B717	Existing Passenger	ATL	148	306
A319	Existing Passenger	ATL	462	288
B737-700	Existing Passenger	ATL	156	168
DC-9	Existing Cargo	MCI	64	64 <sup>1</sup>
CRJ 900	Existing Passenger	ATL	36	42
B727	Existing Cargo	YIP	14	14 <sup>1</sup>
B757	Existing Cargo	MEM	6	6 <sup>1</sup>
CRJ 700	Existing Passenger	ORD	56	2
B737-800	Existing Passenger	ATL	2	0
Total			11,780	12,174

Legend:

	= existing aircraft with 500 annual operations or more
	= existing aircraft with less than 500 annual operations

<sup>1</sup> Cargo flights are not scheduled in OAG so 2017 cargo operations were assumed to be equivalent to 2016 operations.

Sources: FAA TFMSC database through [aspm.faa.gov](http://aspm.faa.gov); 2017; OAG Aviation Worldwide Ltd, OAG Schedules Analyzer, accessed on February 28, 2017; Landrum & Brown analysis.

It is important to note that the largest aircraft in the fleet is not always the critical aircraft for determining runway length requirements because the size of an aircraft does not directly correlate to runway length requirements. The design objective in the runway length analysis is for the runway to provide the length needed for all aircraft that will regularly use it without causing operational weight restrictions. For this reason, a three-tiered system was set up to weigh an aircraft's impact on the needed runway length at CRW:

- Existing aircraft with 500 or more operations: For federally funded projects, an aircraft or similar grouping of aircraft must prove to offer substantial use at the Airport according to FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*. This means the aircraft or grouping of aircraft being used to determine runway length need must have at least 500 or more annual operations at the Airport. This is the most critical tier of priority when determining runway length need and is used to determine a critical design aircraft for the runway. The largest, most demanding aircraft within the first tier is typically used as the critical aircraft for determining runway length at an airport.
- Existing aircraft with less than 500 operations: These aircraft are considered the next level of priority in determining runway length need. These aircraft not considered substantial use since they have less than 500 operations per year at CRW.
- Potential future aircraft: While future aircraft are not the focus of the study, three airlines have indicated that they would start or resume service with A320 and B-737-800 aircraft once the runway has a landing distance available of greater than 6,000 feet. Two of these airlines used to operate B737-800 and A320 charter aircraft approximately 10 to 20 times per year. The third airline is Allegiant, who currently operates from Huntington Tri-State Airport (HTS). Allegiant has indicated that they could operate some service from CRW once the runway has 6,000 feet available for landing. These future aircraft are not anticipated to exceed 500 operations per year.

When using the aircraft manufacturers' performance manuals to determine takeoff runway length requirements, there are multiple choices for engine types for each aircraft. Therefore, where possible, the fleet mix was compared to *JP Airline Fleets International, 47<sup>th</sup> Edition, 2013/2014* to determine the engine type best suited for the fleet operating at CRW.

### 6.1.3.2 General Aviation Fleet Mix

For the general aviation runway length analysis, the fixed-base operator (FBO), Executive Air, provided a sample of the largest general aviation aircraft operating at CRW. The FBO also provided a list of based aircraft at CRW, the largest, most demanding of which include two Learjets and one Challenger. The FBO information was combined with additional aircraft types identified in the FAA TFMSC database for 2016 to identify a general aviation fleet for the runway length analysis (see Table 6-2, *General Aviation Fleet Mix*). This 2016 fleet was compared to 2014 operations (obtained from the TFMSC database) to better understand how the general aviation fleet has changed since the slope failure.

Table 6-2  
 GENERAL AVIATION FLEET MIX  
 Yeager Airport

AIRCRAFT TYPE	REPRESENTATIVE AIRCRAFT USED IN ANALYSIS	ANNUAL IFR OPERATIONS	
		2014	2016
Lear (all series)	Lear 55	477	313
Falcon (all series)	Falcon 900A	192	146
Gulfstream (all series)	Gulfstream 450 and 550	111	98
Global Express	Global Express	18	20
Challenger (all series)	BD-100 Challenger 300	125	53
Citation (all series)	Citation Mustang and X	1,172	1,059
Total		2,095	1,689

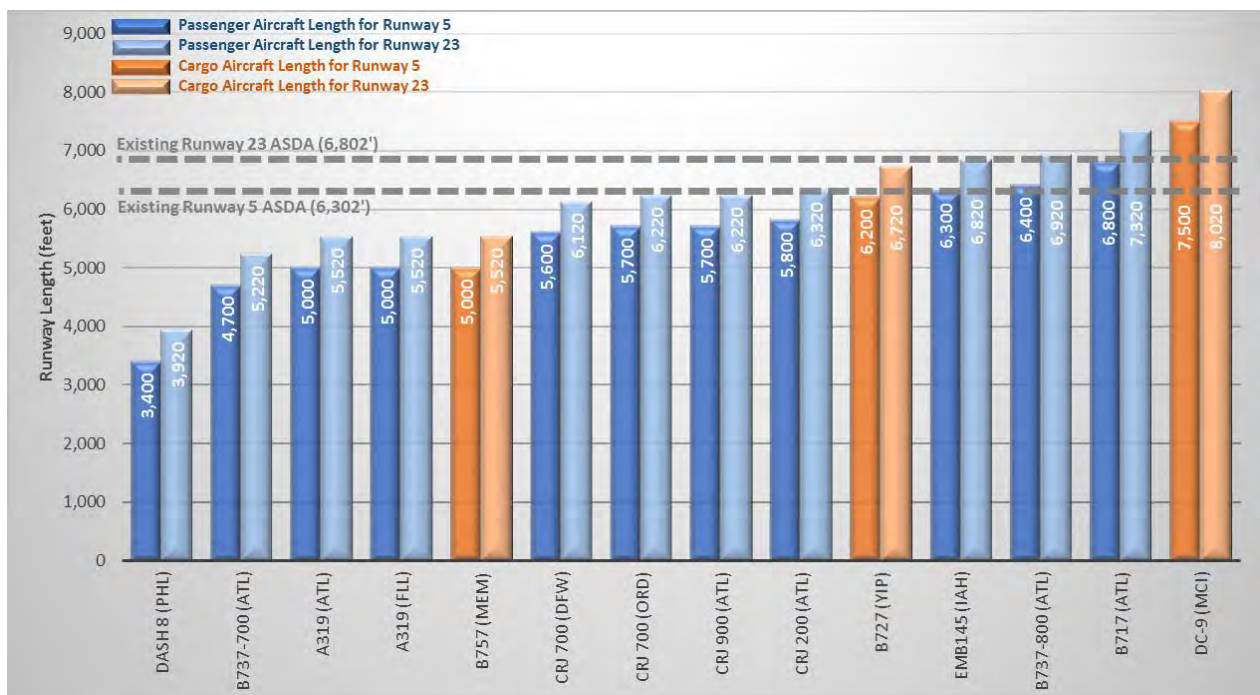
Sources: CRW FBO; FAA TFMSC database through [aspm.faa.gov](http://aspm.faa.gov); 2017; Landrum & Brown analysis.

In the cases where multiple versions of the aircraft were found in the operations counts, representative aircraft were selected based upon the availability of the **manufacturers' manuals and information available to properly conduct a full analysis**. When multiple versions of each representative aircraft were available, the most critical version was used to conduct the analysis. This analysis included some aircraft substitutions due the availability of the manufacturers planning manuals. However, the substitutions were carefully selected and operational similarities were considered during this selection.

## 6.2 TAKEOFF RUNWAY LENGTH REQUIREMENTS

Exhibit 6-1, *Passenger and Cargo Takeoff Length Requirements*, shows the hot day takeoff runway length requirements for the passenger and cargo fleet, based on the furthest destination served by each. The takeoff requirements exceed the existing ASDA for two aircraft with operations in 2017 (the DC-9 and B717). Together these aircraft are estimated to have 370 operations in 2017. The EMB 145 has the longest takeoff requirement (6,300 feet for Runway 05 and 6,820 feet for Runway 23) of aircraft with 500 or more operations. It is therefore the critical aircraft.

Exhibit 6-1  
 PASSENGER AND CARGO TAKEOFF LENGTH REQUIREMENTS  
 Yeager Airport

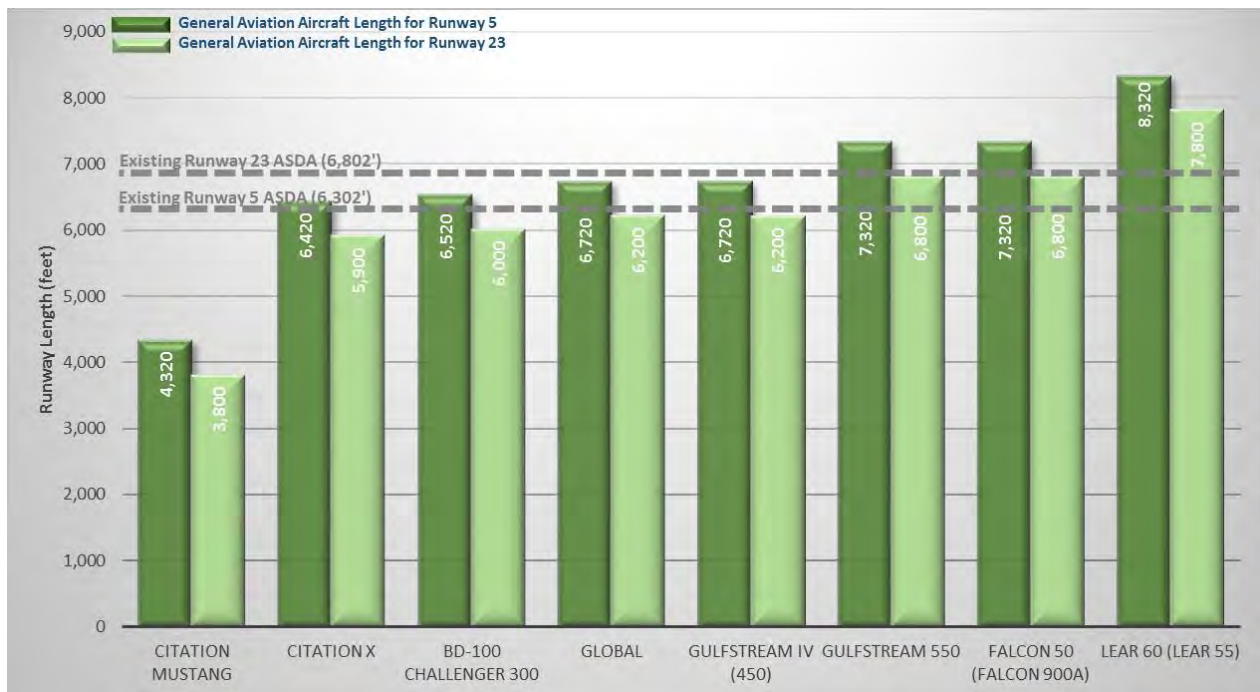


- Notes:
1. The takeoff runway length requirements shown for each aircraft represent Takeoff Run Available (TORA)/Takeoff Distance Available (TODA).
  2. This analysis takes into account the amount of fuel needed to take maximum payload to the identified destination depicted on the y-axis for each aircraft.
  3. Aircraft models used were chosen based upon what is being used at CRW. If a specific model could not be determined, the more critical of the models available was chosen.
  4. Hot day charts using 86 degrees F were used to determine takeoff length.
  5. Runway length requirements for Runway 23 include an additional 520 feet to adjust for a positive runway gradient. See Paragraph 304 in AC 150/5325-4B, *Runway Length Requirements*, for more details.

Sources: Aircraft Manufacturers' Charts; Landrum & Brown analysis.

Exhibit 6-2, *General Aviation Takeoff Length Requirements*, shows the hot day takeoff requirements for the general aviation aircraft at MTOW. The takeoff requirements for three of the general aviation aircraft exceed the existing available ASDA – the Lear 60, Falcon 50, and Gulfstream 550. Year 2016 IFR operations by these three aircraft are down 45 percent from 2014, the last full year of operations prior to the slope failure, and resulting runway length reduction. There were 557 IFR operations by the Learjet, Falcon, and Gulfstream series of aircraft in 2016.

Exhibit 6-2  
 GENERAL AVIATION TAKEOFF LENGTH REQUIREMENTS  
 Yeager Airport



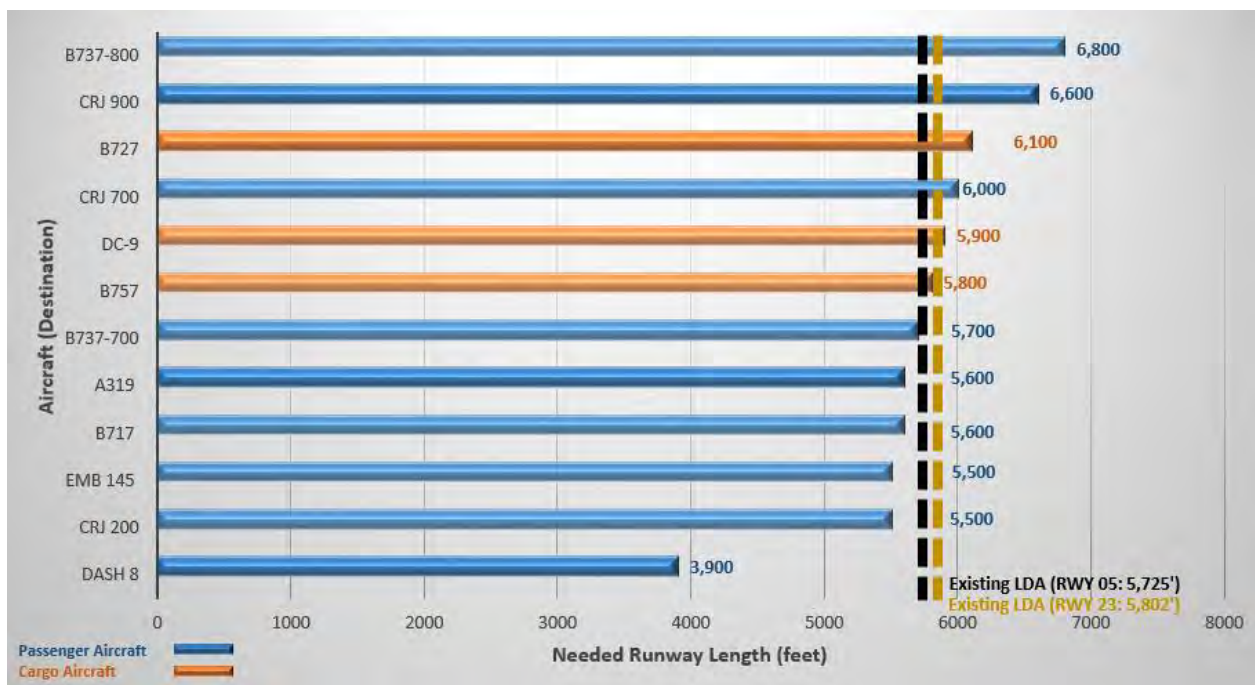
- Notes:
1. The takeoff runway length requirements shown for each aircraft represent Takeoff Run Available (TORA)/Takeoff Distance Available (TODA).
  2. Many general aviation aircraft manufacturers planning manuals do not depict enough information to determine payload/range, thus a MTOW analysis was conducted for the general aviation aircraft in this analysis.
  3. The Gulfstream 450 was substituted for the Gulfstream IV, the Falcon 900A was substituted for the Falcon 50, and the Lear 55 was substituted for the Lear 60. All aircraft substitutions were made based upon similar aircraft characteristics and performance. This was necessary if the planning manuals were not available or did not depict enough information to determine a takeoff length.
  4. Aircraft models used were chosen based upon what is being used at CRW. If a specific model could not be determined, the more critical of the models was chosen.
  5. Runway length requirements for Runway 23 include an additional 520 feet to adjust for a positive runway gradient. See Paragraph 304 in AC 150/5325-4B, *Runway Length Requirements*, for more details.

Sources: **Aircraft Manufacturers' Charts**; Landrum & Brown analysis.

### 6.3 RUNWAY LANDING LENGTH REQUIREMENTS

Exhibit 6-3, *Passenger and Cargo Landing Length Requirements*, depicts the landing length requirements for the passenger and cargo aircraft at MLW in wet conditions. Six aircraft have landing requirements that exceed the existing LDA in at least one direction, making up a total of 178 operations in 2016. These six aircraft are unable to land on at least one runway end without taking a weight penalty. The B737-800, which Delta will not permit to operate at CRW, exceeds the Runway 05 LDA by 1,075 feet.

Exhibit 6-3  
 PASSENGER AND CARGO LANDING LENGTH REQUIREMENTS  
 Yeager Airport



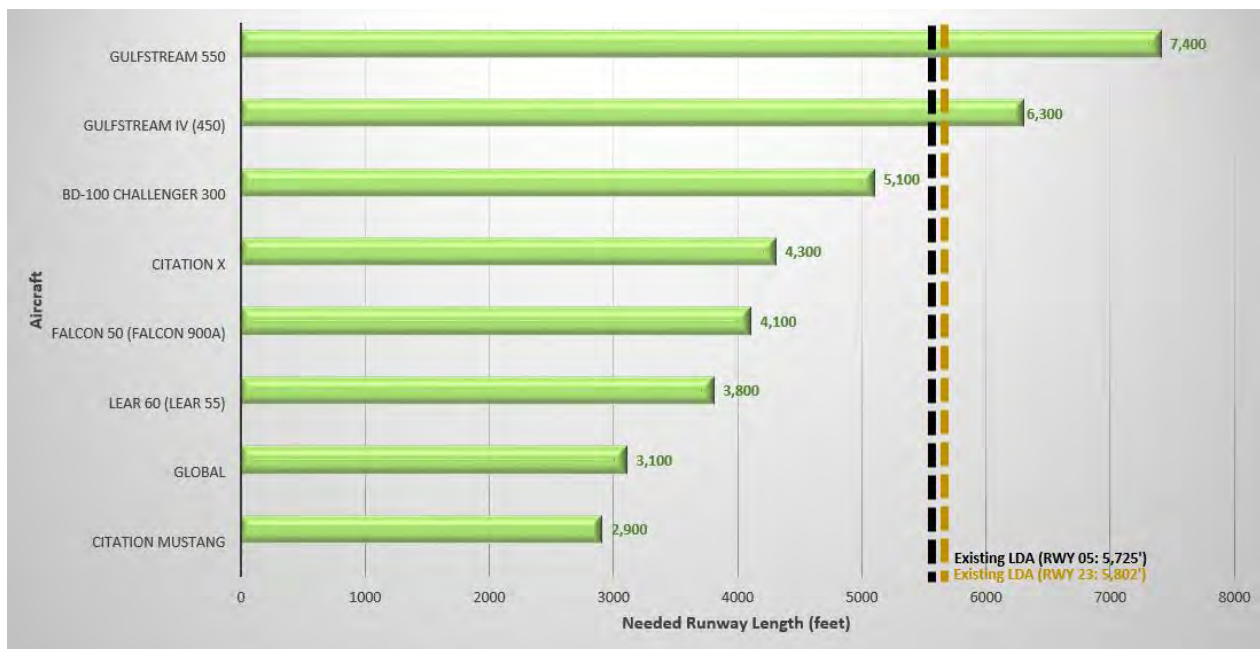
- Notes:
1. Landing length was determined based upon the maximum landing weight for each aircraft found in the aircraft manufacturers' airport planning manuals.
  2. Aircraft models used were chosen based upon what is being used at CRW. If a specific model could not be determined, the more critical of the models was chosen.
  3. Analysis assumes wet runway conditions.

Sources: Aircraft Manufacturers' Charts; Landrum & Brown analysis.



Exhibit 6-4, *General Aviation Landing Length Requirements*, depicts the LDA requirements for the general aviation fleet operating out of CRW at MLW in wet conditions. The Gulfstream series of aircraft have landing length requirements that exceed the available LDA at CRW. The Gulfstream 550 has the longest landing length requirement at 7,400 feet. As a result, Gulfstream aircraft require weight limitations for landings at CRW in wet conditions. The Gulfstream series of aircraft had 98 operations in 2016, down from 111 in 2014 (before the slope failure).

Exhibit 6-4  
 GENERAL AVIATION LANDING LENGTH REQUIREMENTS  
 Yeager Airport



- Notes:
1. Landing length was determined based upon the maximum landing weight for each aircraft found in the aircraft manufacturer's airport planning manuals.
  2. The Gulfstream 450 was substituted for the Gulfstream IV, the Falcon 900A was substituted for the Falcon 50, and the Lear 55 was substituted for the Lear 60. All aircraft substitutions were made based upon similar aircraft characteristics and performance. This was necessary if the planning manuals were not available or did not depict enough information to determine a landing length.
  3. Aircraft models used were chosen based upon what is being used at CRW. If a specific model could not be determined, the more critical of the models was chosen.
  4. Analysis assumes wet runway conditions.

Sources: Aircraft Manufacturers' Charts; Landrum & Brown analysis.

## 6.4 STAKEHOLDER INPUT

Following the slope failure, it was critical to restore the Airport to a safe operational state as quickly as possible. This required immediate action by the Airport, and FAA approval of an interim runway length solution, to make up for the lack of a standard RSA on the Runway 05 end. During the development of the post-slope failure solution, stakeholder input was not considered and as a result, the Airport was unaware of the potential impact the preferred interim solution may have on Airport stakeholders. Over the last two years, the Airport operators and potential operators have communicated that the interim solution following the slope failure has brought about limitations and challenges.

It was pertinent to include stakeholder input during this RSA Study in order to ensure that the appropriate operational expertise and experience informed the analysis process and decision-making for the runway length need at CRW. This was accomplished through a number of data requests, discussions, and meetings with stakeholders in order to determine the impact of the reduced runway length that was implemented in 2015. Stakeholder concerns regarding runway length have been documented and are included in Appendix A, *Runway Length: Operator Correspondence Database*.

### 6.4.1 AIRLINE AND CARGO OPERATORS

As the largest stakeholders at CRW with the most demanding aircraft operating on the airfield, the passenger airlines and cargo operators have expressed limitations regarding the runway length at the Airport since the 2015 slope failure. Of the four airlines providing scheduled passenger service at CRW, three provided information regarding how the existing runway lengths restrict their operations:

- American Airlines:
  - CRJ 700 weight limited when landing on wet runways.
  - Use of the EMB 145 results in a two- to six- passenger reduction on each flight during the summer months.
- Delta Air Lines:
  - Restricted from operating the B737-800 into CRW.
  - CRJ 200 departure weights are limited to less than MTOW.
  - Once or twice per week the airline will have a flight to Atlanta that is weight limited. Occurs more often during summer months – sometimes several times per week.
  - Designated CRW as a Special Winter Operations Airport (SWOA).

- United Airlines:
  - CommutAir flight to Washington D.C. is weight limited at least three times per week.
  - Express Jet service to Houston on the EMB 145 is weight limited in the summer months. United indicated that they withhold one to five seats from sales on the Houston flight from April to August. The Houston flight departs at 05:00 PM, during the hottest time of the day when runway length requirements are greatest. Houston is the second largest market from CRW, with 9,724 annual origin and destination passengers in 2015, approximately 32 per day.<sup>8</sup> This represents the majority of the seats available on this single, six days per week departure. The fact that Houston is a strong destination markets means that United cannot simply reroute this flight through a closer hub to avoid the payload penalty.

Unscheduled charter and cargo operations have also been affected by the runway length. There were 13 charters at CRW in 2014 (before the slope failure) and only four in 2016 (after the slope failure). Historically, Allegiant, jetBlue and Miami Air have operated charter flights out of CRW. These airlines had intended to fly charters into CRW in 2016 but switched to HTS due to the runway length restrictions. These airlines indicated that they require a 6,000-foot LDA to operate at an airport. Both have expressed interest in returning to CRW if their minimum runway length needs are met. With regards to cargo operators, both Ameristar and USA Jet Airlines indicated the currently available runway lengths are restrictive. Ameristar indicated they lose 10,000 pounds of capacity on their DC-9 when the runway is contaminated.

In addition to these existing operators, Allegiant has expressed interest in operating scheduled service at CRW. However, the Allegiant Flight Standards Board and Flight Safety determined in 2016 that Allegiant is not able to safely operate into CRW with their current aircraft types. Allegiant's **primary concern is the available landing distances**, complicated by the lack of vertical guidance (which can be provided by a glide slope). Allegiant indicated they do not operate at airports with less than 6,000 feet of usable runway length. They indicated they would reconsider their decision if the usable runway lengths were extended and vertical guidance was provided.

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<sup>8</sup> Bureau of Transportation Statistics, Office of Airline Information, Airline Origin and Destination Survey.

## 6.4.2 GENERAL AVIATION

Most general aviation aircraft require shorter runway lengths for takeoffs and landings compared to passenger and cargo aircraft, however, some larger corporate aircraft require longer lengths, particularly when traveling to longer haul destinations.

Below is a summary of the general aviation runway length restrictions:

- A business jet operator indicated that his aircraft (a Learjet 60) could not be used a total of 15 times since the slope failure. As a result of this limitation, he was selling the affected aircraft and purchasing a smaller aircraft with less stringent requirements.
- Professional Aeronautical Services flies three Cessna Citations. Under high temperatures and with a contaminated runway, their aircraft are weight restricted. This limitation forces them to limit passengers, bags, and/or buy supplemental fuel at other airports instead of buying their fuel for the entire trip at CRW.
- **Executive Air, the Airport's FBO, indicated that they frequently receive feedback from pilots regarding the runway length distances. Operators have indicated that they cannot take the fuel required to reach their final destination and must make an intermediate fuel stop. The FBO also indicated that pilots are excluding CRW as their alternate airport.**

## 6.4.3 MILITARY

**The West Virginia Air National Guard's 130<sup>th</sup> Airlift Wing** operates C-130 cargo aircraft on the airfield. The Air National Guard explained that certain training requirements for touch-and-go landings in the C-130 require a usable runway length of 6,000 feet or greater. These training exercises are unable to be completed by the Air National Guard at their home base of CRW due to the reduced runway length. The Air National Guard currently travels to other airfields to perform these training exercises due to the insufficient length at CRW. They have expressed interest in performing these training exercises at their home base if sufficient runway length was made available.

## 6.5 OVERALL RUNWAY LENGTH CONCLUSIONS

A minimum of 6,300 feet of ASDA is recommended for Runway 05 and 6,800 feet of ASDA for Runway 23. The aircraft that require these lengths for takeoff are shown in Table 6-3, *ASDA Requirement*. The detailed aircraft manufacturers' charts for the aircraft shown in the table are contained in Appendix B, *Runway Length Charts*.

Table 6-3  
 ASDA REQUIREMENT  
 Yeager Airport

AIRCRAFT TYPE	RUNWAY 5 TAKEOFF REQUIREMENT (in feet)	RUNWAY 23 TAKEOFF REQUIREMENT (in feet)	ANNUAL OPERATIONS	
			2016	2017
DC-9	7,500	8,000	64	64
B717	6,800	7,300	148	306
B737-800	6,400	6,900	2	0
EMB 145	6,300	6,800	1,716	1,792
Learjet (all series)	7,800	8,300	313	313
Falcon (all series)	6,800	7,300	146	146
Gulfstream (all series)	6,800	7,300	98	98
Total			2,487	2,719

Notes: 1. Cargo and general aviation flights are not scheduled in OAG so 2017 cargo operations were assumed to be equivalent to 2016 operations.  
 2. Runway 23 takeoff requirement includes 500 additional feet to reflect the uphill gradient in the Runway 23 direction.

Sources: FAA TFMSC database through [aspm.faa.gov](http://aspm.faa.gov); 2017; OAG Aviation Worldwide Ltd, OAG Schedules Analyzer, accessed on February 28, 2017; Landrum & Brown analysis.

A minimum LDA of 6,000 feet is recommended in both the Runway 05 and 23 directions. The existing LDA is 5,725 feet in the Runway 05 direction and 5,802 in the Runway 23 direction. The aircraft that require more than the existing Runway 05 and/or Runway 23 LDA are shown in Table 6-4, *LDA Requirement*, along with the most common passenger jet aircraft at CRW.

Table 6-4  
 LDA REQUIREMENT  
 Yeager Airport

AIRCRAFT TYPE	LANDING REQUIREMENT (in feet)	ANNUAL OPERATIONS	
		2016	2017
Aircraft Requiring Greater Than 5,725 of LDA			
B737-800	6,800	2	0
CRJ 900	6,600	36	42
B727	6,100	14	14
CRJ 700	6,000	56	2
DC-9	5,900	64	64
B757	5,800	6	6
Gulfstream (all series)	7,400	98	98
Total		276	226
Most Common Passenger Jets			
A319	5,600	462	288
B717	5,600	148	306
EMB 145	5,500	1,716	1,792
CRJ 200	5,500	4,362	5,424
Total		6,688	7,810

Note: Cargo and general aviation flights are not scheduled in OAG so 2017 cargo operations were assumed to be equivalent to 2016 operations.

Sources: FAA TFMSC database through [aspm.faa.gov](http://aspm.faa.gov); 2017; OAG Aviation Worldwide Ltd, OAG Schedules Analyzer, accessed on February 28, 2017; Landrum & Brown analysis.

Although the combination of aircraft requiring more LDA than is available today in at least one direction totals less than the substantial use threshold of 500 operations, the provision of 6,000 feet of LDA provides the airlines with improved fleet allocation flexibility. Additionally, a 6,000-foot LDA would allow charter airlines to return to CRW, and allow Allegiant to consider initiating service at the Airport.

Moving forward into the alternatives process, these ASDA and LDA recommendations should be highly considered when developing, evaluating, and selecting a preferred alternative at CRW.

## 7. GLIDE SLOPE REQUIREMENTS AND EFFECT ON RUNWAY LENGTH

The slope failure and subsequent relocation of the arrival threshold for Runway 05 eliminated vertical guidance for the Runway 05 ILS approach. Without vertical guidance, the Runway 05 approach has a greater likelihood of an undershoot approach. According to FAA Order 5200.8, *Runway Safety Area Program*:

*"When considering the configuration of RSA, if the total RSA area available is less than the total required to meet the design standard, an appropriate balance may be achieved by allocating a greater portion of RSA to one runway end. The factors to consider in this allocation are: NAVAIDS (ILS, PAPI, PLASI, VASIs), which provide vertical guidance and lessen the likelihood of an undershoot; predominant direction of runway use by air carrier aircraft, and historical data on overruns on the runway." [Emphasis added]*

Because of this lack of vertical guidance on Runway 05, the CRW air traffic controllers have indicated they are using the Runway 23 approach more often than they would like. The controllers estimated they are using Runway 23 about 85 percent of the time. The controllers also estimated they would use Runway 05 approximately 30 percent of the time if the approach had vertical guidance, with the remainder (70 percent) of operations on Runway 23.

To confirm this data and understand runway use, 12 years of hourly weather conditions observations collected at CRW between January 1, 2005 and December 31, 2016 were evaluated. The data was compiled for average all-weather conditions and for Instrument Meteorological Conditions (IMC). As shown in Table 7-1, *Percent Wind Coverage of Runway 23 versus 05*, Runway 23 has 88 percent average annual wind coverage with three knots of tailwind or less. With zero knots tailwind, the average wind coverage for Runway 23 drops to 73 percent. The weather analysis confirmed the controller estimates regarding runway use.

These data indicate that the controllers are operating Runway 23 with tailwinds an average of 15 percent of the time in all weather conditions due to the lack of vertical guidance on Runway 05, even though they would prefer to operate without a tailwind because of the short runway. Tailwinds increase runway landing length requirements because it takes longer for an aircraft to slow down and exit a runway when winds are behind the aircraft. The Aeronautical Information Manual (AIM) indicates that operating with a tailwind increases runway length requirements by three to five percent per knot of tailwind.

Table 7-1  
 PERCENT WIND COVERAGE OF RUNWAY 23 VERSUS 5  
 Yeager Airport

RUNWAY	ALL-WEATHER (100%)		IMC WEATHER (7.3%)	
	TAILWIND COMPONENT			
	3 KNOTS	0 KNOTS	3 KNOTS	0 KNOTS
Runway 23	88%	73%	84%	65%
Runway 05	12%	27%	16%	35%
Total	100%	100%	100%	100%

Note: IMC does not include Category (CAT) II or III conditions because the Airport does not have the instrumentation to operate below CAT I.

Source: Hourly National Oceanic and Atmospheric Administration (NOAA) CRW Weather Observations, 2005-2016

This is particularly an issue during IMC when pilots have no choice but to use Runway 23 due to the lack of instrumentation on Runway 05. During approximately 16 percent of IMC weather, aircraft must operate on Runway 23 with tailwind of three knots or more (or not land at CRW). Runway length needs are further compounded in IMC, when there is a higher likelihood of wet or contaminated runways.

All of the runway length requirements presented in the previous section assume a wind speed of zero knots. As a result of the tailwind issue, those runway length requirements may understate runway length needs by as much as 9 to 15 percent at three knots of tailwind. As an example, the EMB145 wet runway landing requirement is 5,500 feet with a zero-knot tailwind. That requirement increases to 6,000 to 6,400 feet with a three-knot tailwind. The provision of vertical guidance (restoration of the glide slope) on Runway 05 would eliminate the need to operate with tailwinds on Runway 23 during most weather conditions.



## 8. ALTERNATIVES

This section presents the alternatives analysis for this RSA Study.

### 8.1 METHODOLOGY

The purpose of the alternatives analysis is to identify an interim RSA solution that will quickly improve safety over existing conditions and restore operational capabilities to CRW. These operational capabilities include providing additional runway length to meet existing requirements of aircraft currently operating at the Airport and an operational Runway 05 Instrument Landing System (ILS), which involves restoring the Runway 05 glide slope. The following goals were developed based on the requirements analysis and FAA guidance on RSA standards:

- Provide LDA of at least 6,000 feet in both directions: This would allow over 200 operations to land at CRW without weight restrictions in 2017. This LDA length would also enable the restart of charter service by jetBlue and Miami Air, and allow Allegiant to reconsider CRW for air service. In addition, it would enable the West Virginia Air National Guard to relocate their training missions back to Yeager Airport from other locations.
- Provide at least 6,300 feet of ASDA for Runway 5 and 6,800 feet of ASDA for Runway 23: This would allow over 2,700 operations to takeoff without weight restrictions in 2017. The provision of this length would also reduce the need for United to block between one and five seats per departure by EMB 145 aircraft between April and August. This operational restriction affects as many as 130 out of 312 annual EMB 145 departures per year to Houston.
- Restore Vertical Guidance (Glide Slope) to Runway 05 ILS: Restoring vertical guidance would eliminate the need to use Runway 23 exclusively during poorer weather conditions, often with a tailwind.
- Provide at Least 500-foot Long Undershoot and Overrun RSAs on Both Runway Ends as an Interim Solution: The Runway 23 end currently has a 500-foot long RSA. The Runway 05 end also has a 500-foot long RSA (post-slope failure). The provision of 500-foot long RSAs (or the EMAS equivalent) as an interim solution would be consistent with the RSAs CRW has today. The recently initiated Master Plan will identify permanent solutions for providing a standard RSA.

## 8.2 2003 RSA STUDY ALTERNATIVES

The first step in the RSA Study alternatives analysis was to consider the alternatives that were evaluated as part of the 2003 RSA Study. That study evaluated both runway ends.

The 2003 RSA Study evaluated several alternatives on the Runway 23 end. The study ultimately determined that it was not practicable to provide more than a 500-foot graded area on the Runway 23 end at that time. A further extension on the Runway 23 end to increase runway length and improve the Runway 05 RSA length would require an extensive amount of fill, have a long construction time frame, and be cost prohibitive for an interim solution. As a result, any extension of the Runway 23 end was not considered further in this study.

The 2003 RSA Study considered the following on the Runway 05 end:

- Option 1: Install embankment (fill) material to provide a full-dimension RSA at the required design grades
- Option 2: Enhance/increase the RSA by reducing the available runway length through the application of displaced thresholds and declared distances
- Option 3: Install a combination of fill embankment (2:1 slope) and a 70-knot EMAS in order to enhance runway safety
- Option 4: Install a combination of fill embankment (1:1 slope) and a 70-knot EMAS in order to enhance runway safety

The provision of a full-dimension RSA (Option 1) would require an extensive amount of fill, have a long construction time frame, and be cost prohibitive for an interim solution. The reduction in available runway length (Option 2) would not meet the goals and objectives of this RSA Study. As a result, neither of these options was considered further.

Options 3 and 4 considered EMAS on a fill embankment. Option 4 was selected as the recommended solution in the 2003 RSA Study. This solution resulted in a slope failure in 2015. Rebuilding to this prior condition would be inconsistent with FAA guidance. As stated in the *FAA Technical Assistance Memo – Use of Airport Improvement Program Funds for Disaster Relief*, March 14, 2016:

*“Simply rebuilding a facility to its prior condition does little to prevent recurrence of the same damage in the future. For example, rebuilding a failed earthen slope will likely result in the same problem at a future date.”*

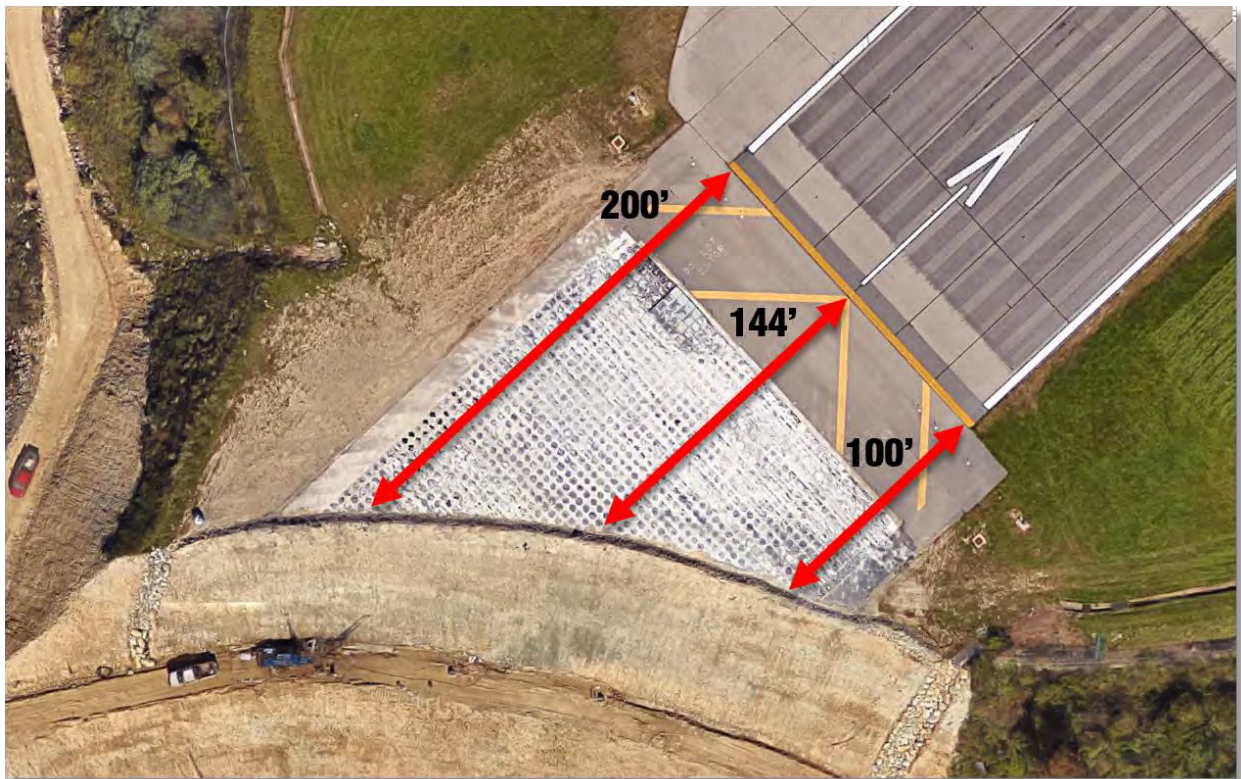
As a result, rebuilding to the prior condition (Option 4) was not considered further. Option 3 is similar to Option 4 so was also not considered further in this study.

## 8.3 ALTERNATIVES CONSIDERATIONS

### 8.3.1 ADDITIONAL RSA LENGTH

After the slope failure, CWVRAA had to “deconstruct” the Runway 05 slope/EMAS. Upon completion of this deconstruction, there will be an additional length available for use for RSA length on the Runway 05 end (see Exhibit 8-1, *Additional RSA Length*). The FAA normally defines the RSA length by the length of the shortest dimension; in this case it is 100 feet. All of the alternatives made use of this area.

Exhibit 8-1  
ADDITIONAL RSA LENGTH  
Yeager Airport



Source: Landrum & Brown analysis.

### 8.3.2 STANDARD LENGTH EMAS

This study considers EMAS as a means to improve the RSA. In the event of an overrun accident, a standard length EMAS bed provides a level of safety that is equivalent to a full-dimension RSA constructed to FAA standards. Studies have shown that a standard EMAS installation will arrest 90 percent of overruns and accommodate 90 percent of undershoots.<sup>9</sup>

The required length of an EMAS bed varies depending on the design aircraft and exit speed target. According to FAA AC 150/5220-22B, *Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns*, a standard EMAS is designed to decelerate the design aircraft at an exit speed of 70 knots. While this advisory circular provides information on the standard length EMAS required to stop an aircraft from 70 knots, only three of the aircraft examples provided in the advisory circular are relevant to CRW. These aircraft are shown in Table 8-1, *EMAS Lengths Required to Stop an Aircraft from 70 Knots*.

Table 8-1  
 EMAS LENGTHS REQUIRED TO STOP AN AIRCRAFT FROM 70 KNOTS

AIRCRAFT TYPE	GROSS WEIGHT (LBS.)	EQUIVALENT CRW A/C	MTOW (LBS.)	EMAS BED LENGTH	TOTAL LENGTH <b>75'</b> RUN-IN	TOTAL LENGTH <b>35'</b> RUN-IN
737-400	150,000	737-700	154,000	320 Feet	395 Feet	355 Feet
CRJ 200	53,000	CRJ 200	47,450	240 Feet	315 Feet	275 Feet
DC-9	114,000	717-200	118,000	315 Feet	390 Feet	350 Feet

Source: FAA AC 150/5220-22B, *Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns*

<sup>9</sup> FAA Order 5200.9, *Financial Feasibility and Equivalency of Runway Safety Area Improvements and Engineered Material Arresting Systems*.

Given the limited applicability of the aircraft types listed in the advisory circular, a summary of three years of aircraft activity from CRW was provided to Zodiac Aerospace, the sole manufacturer of EMAS systems. Their analysis indicated that the EMB 145 aircraft at 80 percent of MLW is the aircraft that requires the longest EMAS bed at 352 feet. Assuming a 35 foot run-in area, the total length required to support the EMAS would be 387 feet. This analysis assumed that the maximum gradient of the EMAS bed would be a two-foot downward slope from the end of the runway to the end of the EMAS bed. Additional aircraft modeled by Zodiac Aerospace are shown in Table 8-2, *Aircraft Evaluated for 70 Knot Stopping Distance with EMAS*.

Table 8-2  
 AIRCRAFT EVALUATED FOR 70 KNOT STOPPING DISTANCE WITH EMAS

AIRCRAFT TYPE	MTOW (LBS.)	MLW (LBS.)	RUNWAY LIMITED TOW (LBS.)	80% MLW (LBS.)
B737-700	154,500	129,200	154,500	103,360
B737-800	174,200	146,300	152,000	117,040
B717	114,000	102,000	104,000	81,600
A319	166,450	137,788	158,000	110,230
A320	169,756	143,298	158,000	113,758
EMB-145ER	45,415	41,226	45,415	32,981
EMB-145XR	53,131	44,092	49,000	35,273
CRJ-200	47,450	44,700	47,450	35,760
			EMAS Modeling Weights	

- Notes:
1. Runway Limited Takeoff Weights based on declared distance of 6,750 feet with an uphill gradient of 52 feet, which yields an effective level runway takeoff length of 6,200 feet.
  2. Zodiac Aerospace Modeling Summary indicates that an EMAS bed of 352 feet with a run-in length of 35 feet (387 feet total) stopped these aircraft at the Runway Limited Weights Takeoff Weights and 80% of the Maximum Landing Weight from 70 knots. Their analysis indicated that the maximum EMAS bed length of 352 feet is determined by the EMB-145XR at 80% of the Maximum landing Weight. Additional analysis by Zodiac Aerospace also indicated that an EMAS bed length of 340 feet (plus 35-foot run-in) would stop all aircraft from 70 knots with the CRJ-200 as the critical aircraft. This study assumes the longer length EMAS as the basis for runway threshold siting.
  3. Additional detailed EMAS design analysis may result in the adjustment of the required EMAS bed length and runway threshold locations.

Source: Landrum & Brown and Zodiac Aerospace analysis.

### 8.3.3 REDUCED LENGTH EMAS

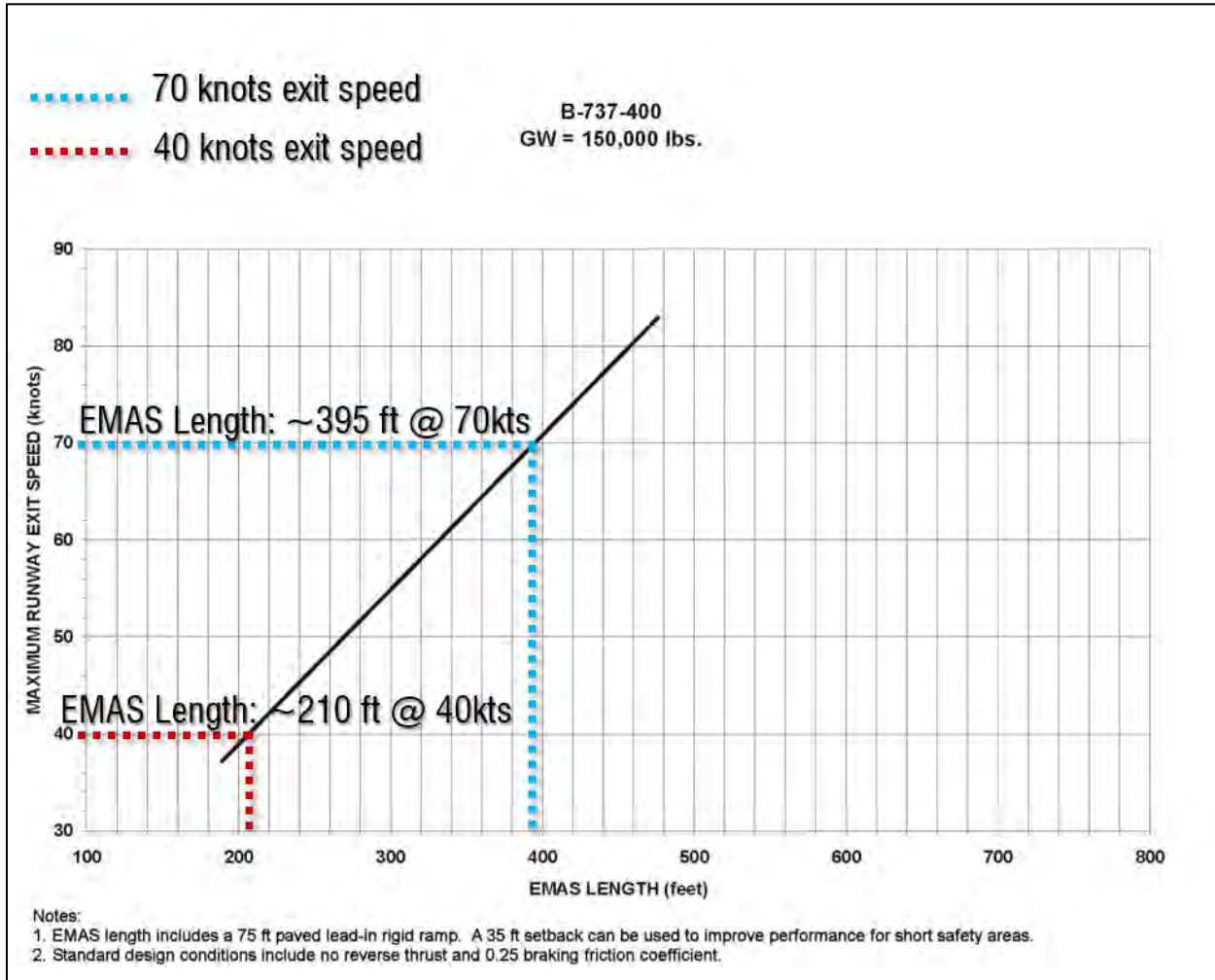
FAA AC 150/5220-22B, *Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns*, states that a 40-knot minimum exit speed can be used for the design of a non-standard EMAS in cases where there is insufficient RSA available for a standard EMAS. There is precedent for non-standard EMASs at other U.S. airports:

- LGA – 310' RSA with 275' EMAS (RW 4) & 280' RSA with 215' EMAS (RW 13)
- BOS – 375' RSA with 190' EMAS (RW 22R)
- CLE – 440' RSA with 365' EMAS (RW 10) & 450' RSA with 275' EMAS (RW 28)
- EWR – 510' RSA with 440' EMAS (RW 11)
- MDW – 190' EMAS (RW 31C) 215' EMAS (RW 13C) 250' EMAS (RW 22L) 305' EMAS (RW 4R)
- FLL – 350' RSA with 215' EMAS (RW 10L)
- PBI – 275' RSA with 225' EMAS (RW 32)
- TEB – 290' RSA with 250' EMAS (RW 24) 100,000 lb. weight limit
- DCA – 140' EMAS (RW 33) 330' EMAS (RW 15)
- AVP – 320' EMAS (RW 22) 160' EMAS (RW 4)

In line with other U.S. airports, a 40-knot EMAS was considered for the Runway 05 end due to the terrain issues at CRW. The EMAS AC provides planning charts for select aircraft that can be used as a planning tool to identify preliminary EMAS bed length. The EMB 145 is CRW's design aircraft for EMAS, but a chart for the EMB 145 is not available in the AC. In order to be conservative in the length determination for the alternatives process, the larger and more demanding B737-400 and B757 aircraft were used, as shown in Exhibit 8-2, *B737-400 EMAS Planning Chart*, and Exhibit 8-3, *B757 EMAS Planning Chart*. Based on this information, a 40-knot EMAS should be around 215 feet long. This length is within the range of non-standard EMASs at other airports in the U.S.

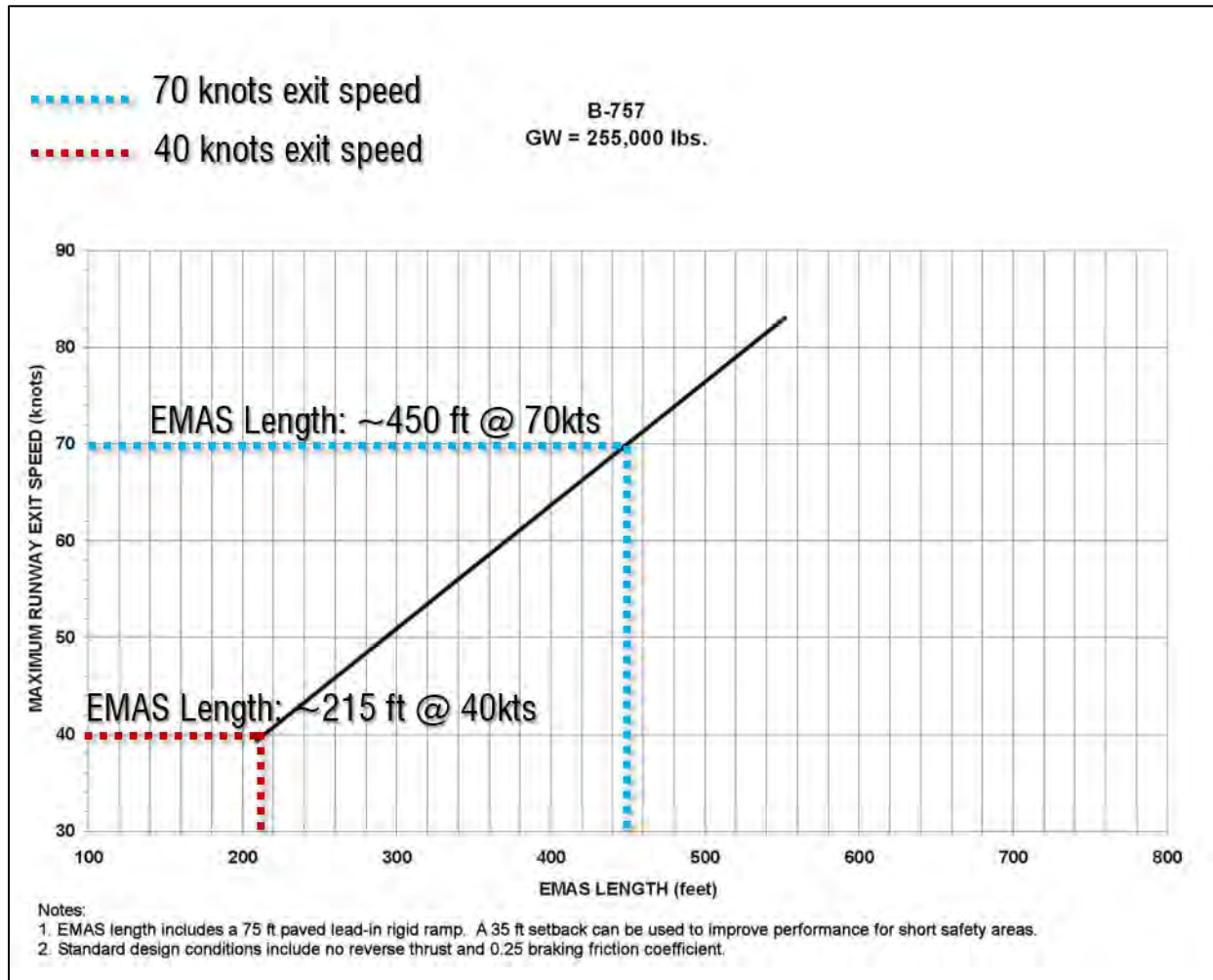
CRW has had two overrun incidents since 2010, both of which could have been stopped by a 40-knot EMAS bed. The previous EMAS stopped a regional jet within 130 feet in January 2010 after an aborted take-off. In February 2017, a landing regional jet overran the declared landing distance and was able to come to a complete stop within the 500 feet of RSA available.

Exhibit 8-2  
B737-400 EMAS PLANNING CHART



Sources: FAA AC 150/5220-22B, Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns; Landrum & Brown analysis.

Exhibit 8-3  
 B757 EMAS PLANNING CHART



Sources: FAA AC 150/5220-22B, Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns; Landrum & Brown analysis.

### 8.3.3 RSA INCIDENT DATA

RSA length is provided prior to a runway's **threshold** (to protect against undershoots) and at the end of a runway (to protect against overruns). According to FAA Order 5200.9, *Financial Feasibility and Equivalency of Runway Safety Area Improvements and Engineered Material Arresting Systems*, protection against overruns appears to be more valuable than protection against short landings (undershoots). Short landings do not occur as often as overruns, and typically occur close to the runway threshold.

The 2008 Airport Cooperative Research Program (ACRP) Report 3, *Analysis of Aircraft Overruns and Undershoots for Runway Safety Areas*, states that only 20 percent of RSA incidents are a landing undershoot. Overruns make up 80 percent of RSA incidents (60 percent are landing overruns and 20 percent are takeoff overruns).



## 8.4 INITIAL ALTERNATIVES

Various combinations of EMAS and declared distances alternatives were considered in this study. These are the only practical solutions to enhance safety at the Airport due to the terrain issues. In an effort to improve safety and operational capability, the initial range of alternatives consisted of combinations of the following options:

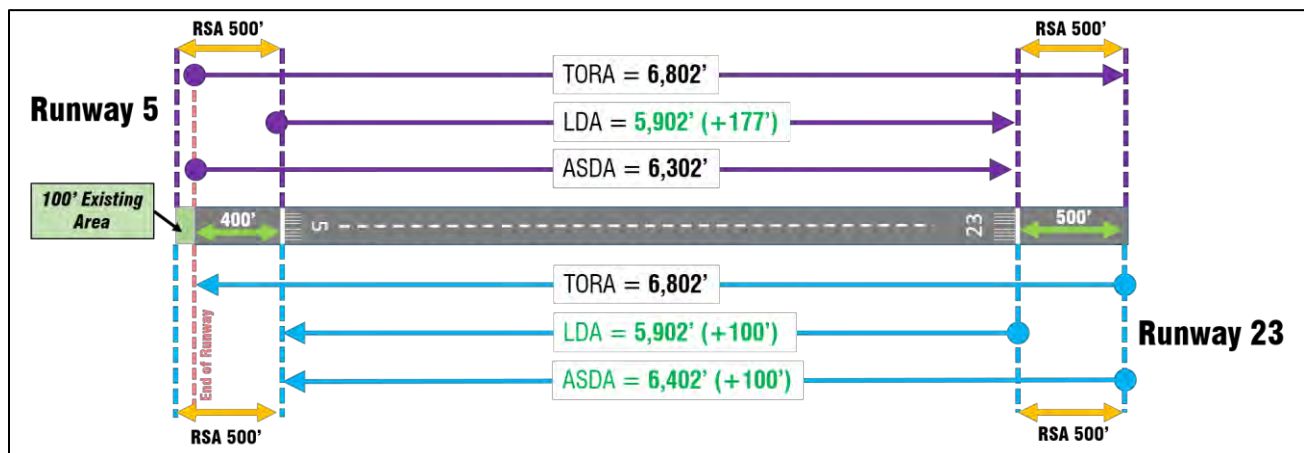
- Restore construction area to use as RSA
- Increase operational capability by reducing undershoot RSA length
- Increase operational capability by reducing overrun RSA length
- Increase safety and operational capability by installing 40-knot EMAS

A 70 knot EMAS was not considered in the initial alternatives because the Runway 05 safety area does not have sufficient length to accommodate most of its length.

### 8.4.1 ALTERNATIVE 1: CONSTRUCTION STANDARDS

Alternative 1, depicted in Exhibit 8-4, *Alternative 1: Construction Standards*, utilizes the 100 feet of land gained upon completion of the hillside reconstruction project as additional RSA on the Runway 05 end. The undershoot/overrun RSA is 500 feet on both runway ends. Although the LDA increases from existing conditions in both directions, it is not enough to accommodate the 6,000-foot LDA. It does, however, meet the ASDA requirement for Runway 05, but not for Runway 23. This option displaces the Runway 05 threshold by 400 feet, requiring the relocation of the Runway 05 glide slope.

Exhibit 8-4  
 ALTERNATIVE 1: CONSTRUCTION STANDARDS  
 Yeager Airport



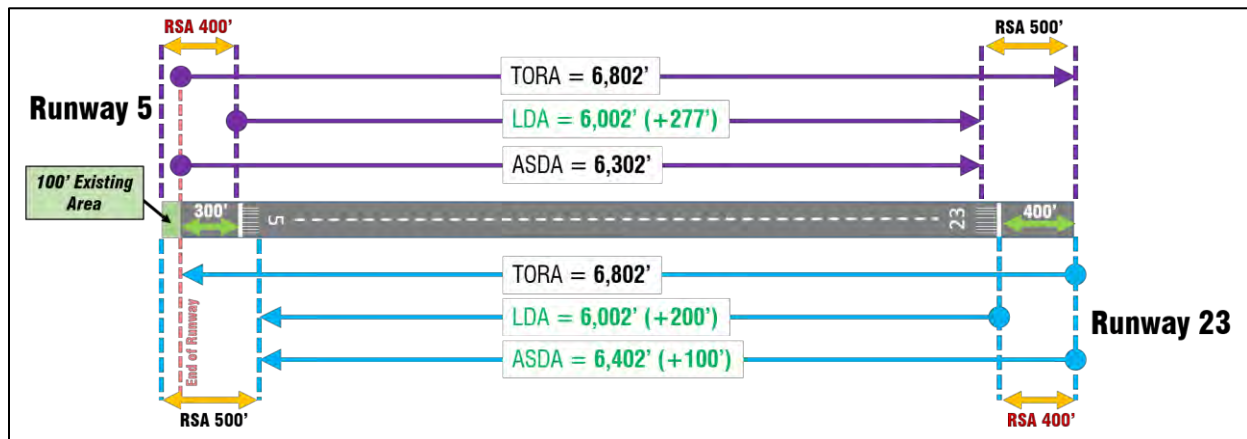
Note: Distances are compared to existing conditions

Source: Landrum & Brown analysis.

### 8.4.2 ALTERNATIVE 2: REDUCE RUNWAY UNDERSHOOT RSA

Undershoot RSAs provide a safety margin for aircraft landing on a runway. Alternative 2 considers reducing this safety margin to provide additional available runway distances while also utilizing the 100 feet of land gained upon completion of the hillside reconstruction project. Exhibit 8-5, *Alternative 2: Reduce Runway Undershoot RSA*, shows the reduction of the undershoot RSAs to 400 feet on both runway ends. The overrun RSA remains at 500 feet in both directions. This alternative meets the runway LDA goals in both directions. It meets the ASDA goals for Runway 05, but not Runway 23. With this alternative, the Runway 05 threshold is displaced by 300 feet, resulting in the need to relocate the glide slope. This alternative also relocates the Runway 23 threshold, requiring the relocation of its approach lighting system.

Exhibit 8-5  
 ALTERNATIVE 2: REDUCE RUNWAY UNDERSHOOT RSA ALTERNATIVE  
 Yeager Airport



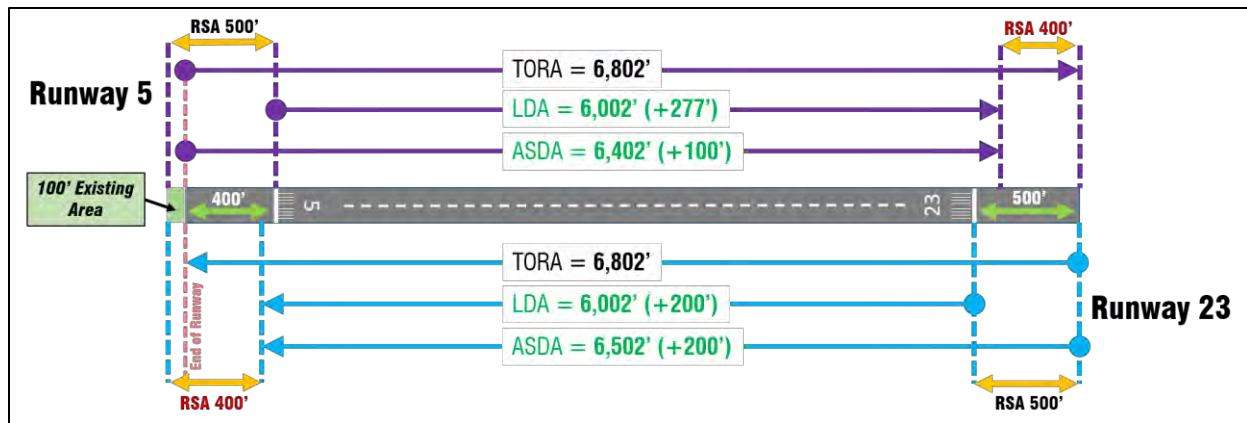
Note: Distances are compared to existing conditions

Source: Landrum & Brown analysis.

### 8.4.3 ALTERNATIVE 3: REDUCE RUNWAY OVERRUN RSA

The RSA provided at the end of runway for approaches and departures is considered the overrun RSA. Alternative 3 considers reducing the overrun RSA in order to increase the declared distances while also utilizing the 100 feet of land gained upon completion of the hillside reconstruction project. Exhibit 8-6, *Alternative 3: Reduce Runway Overrun RSA*, shows the reduction of the overrun RSAs to 400 feet on both runway ends. This alternative meets the runway LDA goals in both directions. It meets the ASDA goals for Runway 05, but not Runway 23. The Runway 05 threshold is displaced 400 feet, which requires the glide slope to be relocated.

Exhibit 8-6  
 ALTERNATIVE 3: REDUCE RUNWAY OVERRUN RSA  
 Yeager Airport



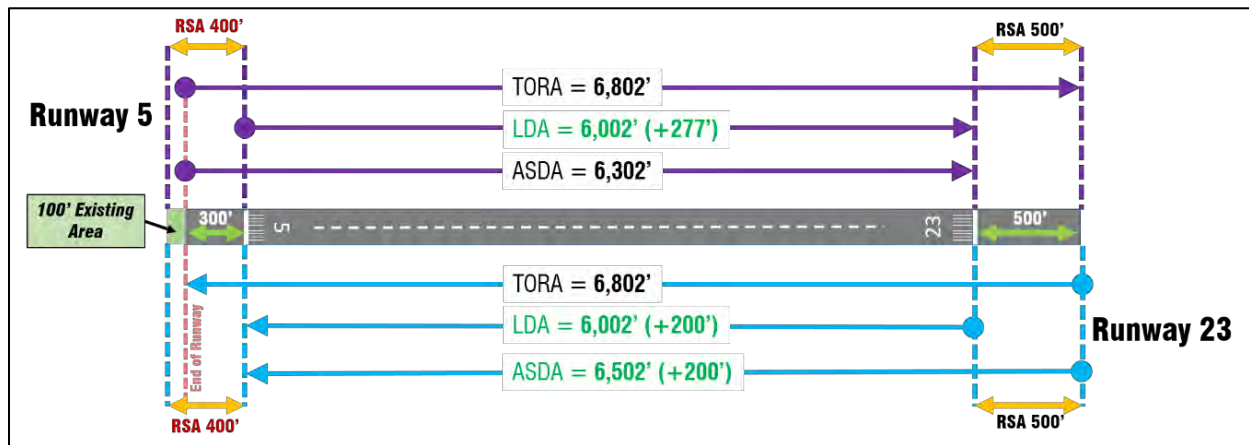
Note: Distances are compared to existing conditions

Source: Landrum & Brown analysis.

### 8.4.4 ALTERNATIVE 4: AIRPORT PROPOSAL

In November of 2016, the Airport proposed a short-term solution to address operational restrictions occurring as a result of the hillside reconstruction project. This alternative makes use of the 100 feet of land gained upon completion of the hillside reconstruction project in addition to calling for a reduced Runway 05 undershoot RSA and reduced Runway 23 overrun RSA (see Exhibit 8-7, *Alternative 4: Previously Proposed Alternative*). The Runway 05 undershoot RSA and the Runway 23 overrun RSA are reduced to 400 feet. The Runway 05 overrun RSA and Runway 23 undershoot RSA remain at 500 feet. This alternative meets the runway LDA goals in both directions. It meets the ASDA goals for Runway 05, but not Runway 23. With this alternative, the Runway 05 threshold is displaced by 300 feet, resulting in the need to relocate the glide slope.

Exhibit 8-7  
 ALTERNATIVE 4: PREVIOUSLY PROPOSED ALTERNATIVE  
 Yeager Airport



Note: Distances are compared to existing conditions

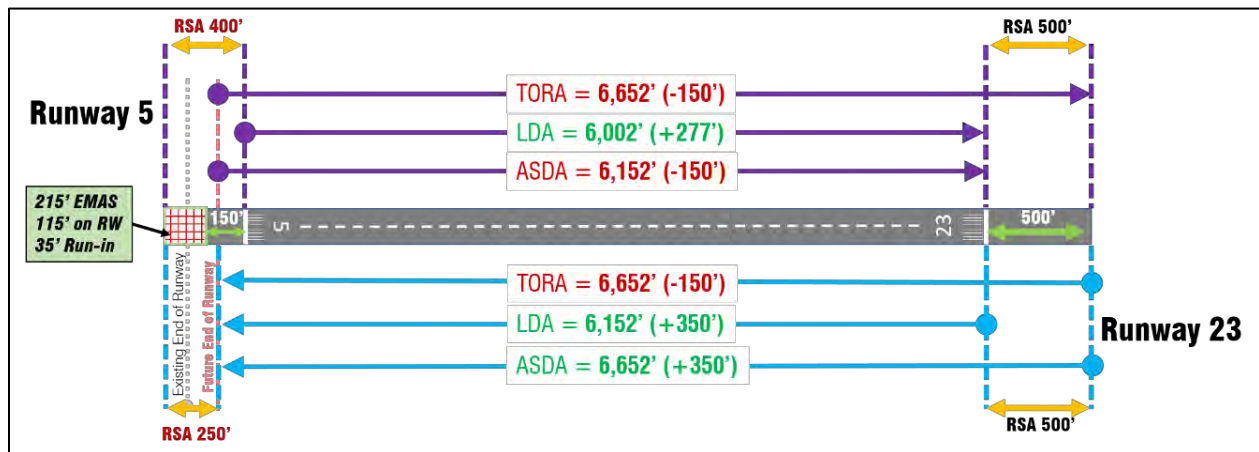
Source: Landrum & Brown analysis.

### 8.4.5 ALTERNATIVE 5: 215-FOOT EMAS BED ALTERNATIVE

Alternative 5, shown in Exhibit 8-8, *Alternative 5: 215-Foot EMAS*, includes a 215-foot EMAS bed. Approximately 100 feet of the EMAS is on the 100-foot land area gained upon completion of the hillside reconstruction project. The remaining 115 feet of the EMAS bed is on the existing runway pavement. This alternative has a 35-foot run-in area for the EMAS bed from the end of the runway. The EMAS bed and run-in area occupy 150 feet of the existing runway pavement, reducing the total runway length from 6,802 feet to 6,652 feet.

With this alternative, the Runway 05 undershoot RSA is reduced to 400 feet. The runway length provided by this alternative meets the LDA goal in both directions, but does not meet ASDA goals in either direction. The ASDA is 150 feet short of goals in both directions. The Runway 05 threshold is displaced 150 feet from the relocated end of runway, requiring the relocation of the glide slope.

Exhibit 8-8  
 ALTERNATIVE 5: 215-FOOT EMAS  
 Yeager Airport



Note: Distances are compared to existing conditions

Source: Landrum & Brown analysis.

## 8.5 EVALUATION OF INITIAL ALTERNATIVES

Each initial alternative was evaluated based on the following criteria:

- Achievement of Aircraft Performance Objectives
- Achievement of Runway Safety Objectives
- Ability to Restore Vertical Guidance to the Runway 05 Approach
- Construction Time
- Cost

Each initial alternative was evaluated against the evaluation criteria as shown on Table 8-3, *Initial Alternatives Evaluation Matrix*. Each criteria for each alternative was shaded green, yellow or red in the matrix based on how the alternative performed:

- Achievement of Aircraft Performance Objectives: The alternatives were evaluated against the aircraft performance goals identified for this RSA Study (6,000 feet of LDA, 6,300 feet of ASDA for Runway 05, and 6,800 feet of ASDA for Runway 23). If the alternative meets the LDA and ASDA goals in both directions, the alternative was shaded green in the matrix. If the alternative meets all but one of the LDA/ASDA goals, it was shaded yellow. If the alternative does not meet two or more of the LDA/ASDA goals, it was shaded red.
- Achievement of Runway Safety Objectives: The alternatives were evaluated against the runway safety goals for this RSA Study (500-foot long RSAs to protect against undershoots and overruns, or an equivalent level of safety with an EMAS). Protection against overruns was given higher priority than undershoots because overruns occur more often than undershoots (80 percent vs. 20 percent, respectively). If the alternative meets the undershoot and overrun RSA goals in both directions, it was shaded green in the matrix. If the alternative only meets the overrun goal, it was shaded yellow. If the alternative only meets the undershoot goal, it was shaded red.
- Ability to Restore Vertical Guidance to Runway 05 Approach: Vertical guidance is key to allowing air traffic controllers to use the most appropriate runway and in reducing the risk of undershoots. If the alternative restores vertical guidance, it was shaded green. If the alternative does not provide vertical guidance it was shaded red.
- Construction Time: Because CRW is operating with less than the required runway length, one of the objectives of this study was to minimize construction time. The alternatives were assigned a "short," "medium," or "long" construction time frame ranking based on the complexity of construction. Alternatives with a short time frame were shaded green, alternatives with a medium time fame were shaded yellow, and alternatives with a long time frame were shaded red.

Table 8-3  
INITIAL ALTERNATIVES EVALUATION MATRIX  
Yeager Airport

Evaluation Criteria	Range of Alternatives				
	Alternative 1 Construction Standards	Alternative 2 Reduced Undershoot	Alternative 3 Reduced Overrun	Alternative 4 Previous Proposal	Alternative 5 EMAS
Achievement of Aircraft Performance Objectives	RW 5 LDA: <b>5,900'</b> ASDA: 6,300' RW 23 LDA: <b>5,900'</b> ASDA: <b>6,400'</b>	RW 5 LDA: 6,000' ASDA: 6,300' RW 23 LDA: 6,000' ASDA: <b>6,400'</b>	RW 5 LDA: 6,000' ASDA: 6,400' RW 23 LDA: 6,000' ASDA: <b>6,500'</b>	RW 5 LDA: 6,000' ASDA: 6,300' RW 23 LDA: 6,000' ASDA: <b>6,500'</b>	RW 5 LDA: 6,000' ASDA: <b>6,150'</b> RW 23 LDA: 6,150' ASDA: <b>6,650'</b>
Achievement of Runway Safety Objectives	RW5 Under/Over RSA: 500'/500' RW23 Under/Over RSA: 500'/500'	RW5 Under/Over RSA: <b>400'</b> /500' RW23 Under/Over RSA: <b>400'</b> /500' NO EMAS	RW5 Under/Over RSA: 500'/ <b>400'</b> RW23 Under/Over RSA: 500'/ <b>400'</b> NO EMAS	RW5 Under/Over RSA: <b>400'</b> /500' RW23 Under/Over RSA: 500'/ <b>400'</b> NO EMAS	RW5 Under/Over RSA: <b>400'</b> /500' RW23 Under/Over RSA: 500'/250' 40-KNOT EMAS
Ability to Restore Vertical Guidance to the Runway 05 Approach	Yes with relocated Runway 05 GS antenna	Yes with relocated Runway 05 GS antenna	Yes with relocated Runway 05 GS antenna	Yes with relocated Runway 05 GS antenna	Yes with relocated Runway 05 GS antenna
Construction Time	<b>Short:</b> Runway 05 threshold and GS antenna relocation	<b>Long:</b> Relocation of 23 threshold would be extensive due to relocation of approach lighting system (ALS)	<b>Short:</b> Runway 05 threshold and GS antenna relocation	<b>Short:</b> Runway 05 threshold and GS antenna relocation	<b>Med:</b> EMAS construction and GS antenna relocation
Cost	<b>Low:</b> Runway 05 threshold and GS relocation, re-striping and signs <b>\$2.1 Million</b>	<b>Med:</b> Relocation of 23 threshold would be costly due to relocation of ALS and NAVAIDS <b>\$5.0 Million</b>	<b>Low:</b> Runway 05 threshold and GS relocation, re-striping and signs <b>\$2.1 Million</b>	<b>Low:</b> Runway 05 threshold and GS relocation, re-striping and signs <b>\$2.1 Million</b>	<b>High:</b> EMAS construction <b>\$9.7 Million</b>

Legend:

	= Meets Goal
	= Partially Meets Goal
	= Does not Meet Goal

- Notes:
1. **Red text** indicates the LDA, ASDA, or RSA number that does not meet the goal.
  2. GS=Glide Slope.
  3. ALS=Approach Lighting System.
  4. Costs are shown in 2016 dollars. The costs are order of magnitude estimates for comparison purposes only.

Source: ADCI, Schnabel Engineering, and Landrum & Brown analysis.

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- **Cost:** One of the objectives of this study was to minimize cost. Order of magnitude cost estimates were developed for each alternative and compared against each other.<sup>10</sup> **The alternatives were assigned a “low,” “medium,” or “high” cost ranking based on the cost estimates. Alternatives with total costs of less than \$5 million were considered “low” and shaded green. Alternatives with costs of at least \$5 million to less than \$9 million were considered “medium” and shaded yellow. Alternatives with costs of \$9 million or greater were considered high and shaded red.**

The construction standards alternative (Alternative 1) does not provide sufficient landing length and therefore was not considered as a viable alternative for this study.

Alternative 2 reduces both undershoot RSAs, requiring the modification of the approach lighting system on both runway ends. Although the Runway 23 approach lighting system is near the end of its useful life, the recently initiated Master Plan will likely recommend replacing it with a new system, potentially in a different location. As a result, the relocation of Runway 23 threshold is not considered a viable option, and Alternative 2 was not considered further for this study.

Alternative 3 reduces the overrun RSAs and Alternative 4 reduces the Runway 05 undershoot RSA and the Runway 23 overrun RSA. Protecting for the overrun RSAs is more critical than the undershoot RSA, due to the fact that 80 percent of accidents occur as overruns. Without an EMAS, reducing the overrun safety area reduces the overall safety of the Airport. Alternatives 3 and 4 therefore were not considered further for this study.

Alternative 5 adds a 215-foot EMAS bed on the Runway 05 end. This alternative **meets all of this study’s objectives except for providing sufficient ASDA in both directions and undershoot RSA.** While this alternative fell short of meeting ASDA requirements in both directions, the differences between the ASDA provided and the ASDA needed were smaller in this alternative than with other alternatives. This alternative has higher costs and a longer construction time frame than the other alternatives, but the provision of EMAS provides a higher level of safety than the other alternatives. It may be possible to refine Alternative 5 to allow for the ASDA in both directions and undershoot RSA for Runway 05 to be increased. Therefore, it is recommended that the EMAS alternative be carried forward for refinement and further analysis.

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<sup>10</sup> Order of magnitude cost estimates were developed for comparison purposes only. Costs include a 35 percent contingency factor.

## 8.6 REFINED EMAS ALTERNATIVES

The evaluation of initial alternatives has shown that the existing limited space available beyond the end of Runway 05 does not provide any solutions that simultaneously increase safety and retain operational capability. Therefore, two types of solutions were investigated to extend the range of alternatives. The first was to identify the minimum length EMAS bed that still provided some increase in safety while preserving operational capability. The second was extending the available area beyond the end of Runway 05 through construction of a retaining wall. All of the refined EMAS alternatives combine an EMAS (which minimizes the length of safety area needed) with a retaining wall (which extends the area available beyond the end of Runway 05).

Two lengths of EMAS beds were considered. First, Zodiac Aerospace determined that the minimum EMAS bed length that should be considered is 180 feet with a 35-foot run-in area. This bed length is sufficient to stop an EMB 145, which is the critical aircraft, at an exit speed of 47 knots at 80 percent of its maximum landing weight. Second, Zodiac Aerospace determined that a 352-foot bed with a 35-foot run-in area is sufficient to stop all of the critical aircraft from 70 knots or more. This length is also set by the EMB 145 at 80 percent of its maximum landing weight.

These two EMAS alternatives were combined with two retaining wall alternatives, which extended the area beyond Runway 05 by 100 and 200 feet. These lengths are determined by practical construction considerations. The slope beyond the Runway 05 end **has two level areas or "benches" that provide areas where** construction equipment can easily be staged to build a retaining wall. These two benches provide the most feasible construction locations for extensions of 100 feet and 200 feet respectively. Intermediate locations are more complex to construct. Exhibit 8-9, *Retaining Wall to Support 100-Foot Extension*, and Exhibit 8-10, *Retaining Wall to Support 200-Foot Extension*, show the location of the retaining wall that provides 100 feet and 200 feet of additional land on the hillside, respectively. In providing the EMAS with this configuration, it was assumed that 10 feet of the extended area provides an access corridor to the far end of the EMAS bed.

Exhibit 8-9  
RETAINING WALL TO SUPPORT 100-FOOT EXTENSION ON  
Yeager Airport



Source: Schnabel Engineering and Landrum & Brown analysis.

Exhibit 8-10  
RETAINING WALL TO SUPPORT 200-FOOT EXTENSION ON  
Yeager Airport



Source: Schnabel Engineering and Landrum & Brown analysis.

Table 8-4, *Refined EMAS Alternatives*, shows the combinations of EMAS lengths and retaining wall locations considered.

Table 8-4  
REFINED EMAS ALTERNATIVES  
Yeager Airport

RUNWAY 05 RSA EXTENSIONS	180-FOOT EMAS	352-FOOT EMAS
100-Foot Extension	Alternatives 6 and 7	Alternative 8
200-Foot Extension	Not evaluated – supports longer EMAS	Alternative 9

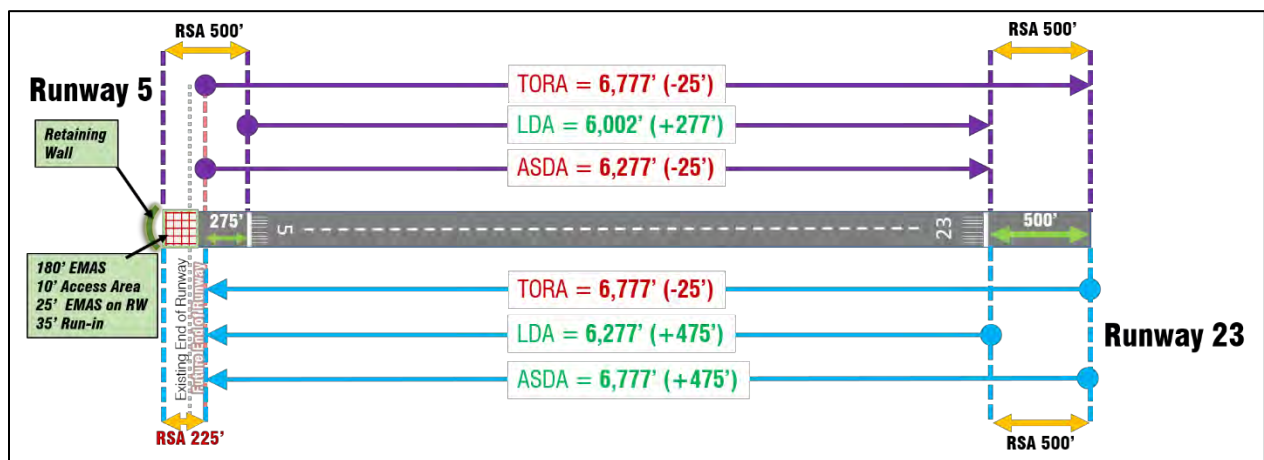
Notes: 1. 180-foot EMAS bed provides a 215-foot RSA length.  
2. 352-foot EMAS bed provides a 387-foot RSA length.

The 180 foot EMAS with the 200-foot extension was not evaluated since the area provided by the 200-foot extension supports a longer EMAS without reducing existing runway length.

### 8.6.1 ALTERNATIVE 6: 180-FOOT EMAS WITH 100-FOOT EXTENSION AND RETAINING WALL

Alternative 6, shown in Exhibit 8-11, *Alternative 6: 180-Foot EMAS with 100-Foot Extension and Retaining Wall*, utilizes a retaining wall to gain an additional 100 feet of length on the Runway 05 end, and reduces the EMAS bed length to 180 feet. The 180-foot EMAS bed and 35-foot run-in area take up only 25 feet of the existing runway pavement, compared to Alternative 5 which takes up 150 feet. This alternative meets all of the RSA goals, all of the LDA goals, and comes within 23 feet of meeting the Runway 05 and Runway 23 ASDA goals. This alternative requires the relocation of the Runway 05 glide slope. The four airlines operating at CRW (United, Delta, American, and Spirit) confirmed that the loss of 23 feet does not affect their planned flight loads.

Exhibit 8-11  
 ALTERNATIVE 6: 180-FOOT EMAS WITH 100-FOOT EXTENSION AND RETAINING WALL  
 Yeager Airport



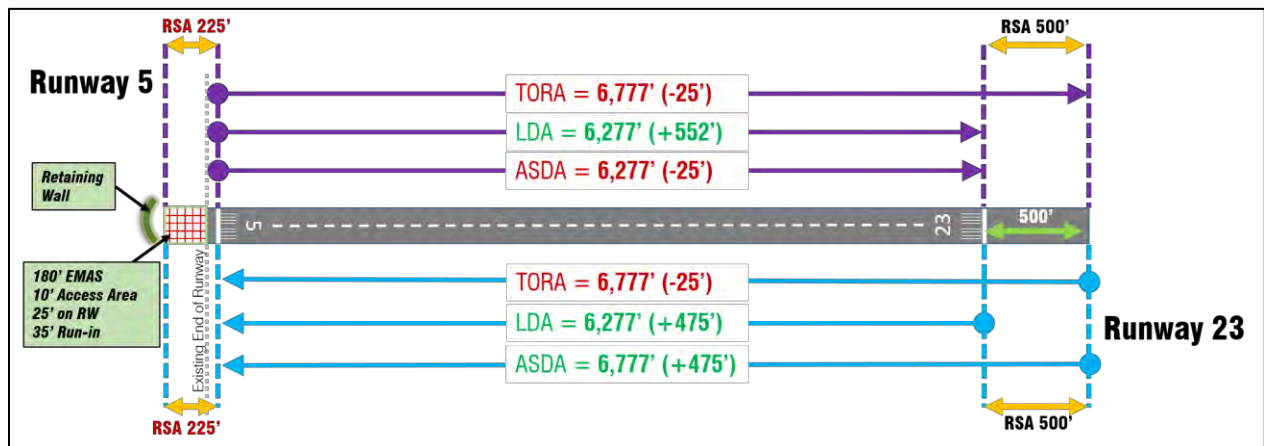
Note: Distances are compared to existing conditions

Source: Landrum & Brown analysis.

8.6.2 ALTERNATIVE 7: 180-FOOT EMAS – RETAIN RUNWAY 05 GLIDE SLOPE

Alternative 7, shown in Exhibit 8-12, *Alternative 7: 180-Foot EMAS – Retain Runway 05 Glide Slope*, is the same as Alternative 6 with the exception of the Runway 05 threshold, which is located just 25 feet from the original (pre-slope failure) location. Due to the Runway 05 threshold being so close to its original position, it is anticipated that the Runway 05 glide slope could be reconfigured, rather than relocated. (Further studies would be needed to confirm this finding.) The ASDA for Runways 05 and 23 are the same as Alternative 6, just 23 feet short of the goal. The LDA in both directions meets the goal. Moving the threshold back results in a shorter Runway 05 undershoot RSA of 225 feet, which is lower than the goal.

Exhibit 8-12  
 ALTERNATIVE 7: 180-FOOT EMAS – RETAIN RUNWAY 05 GLIDE SLOPE  
 Yeager Airport



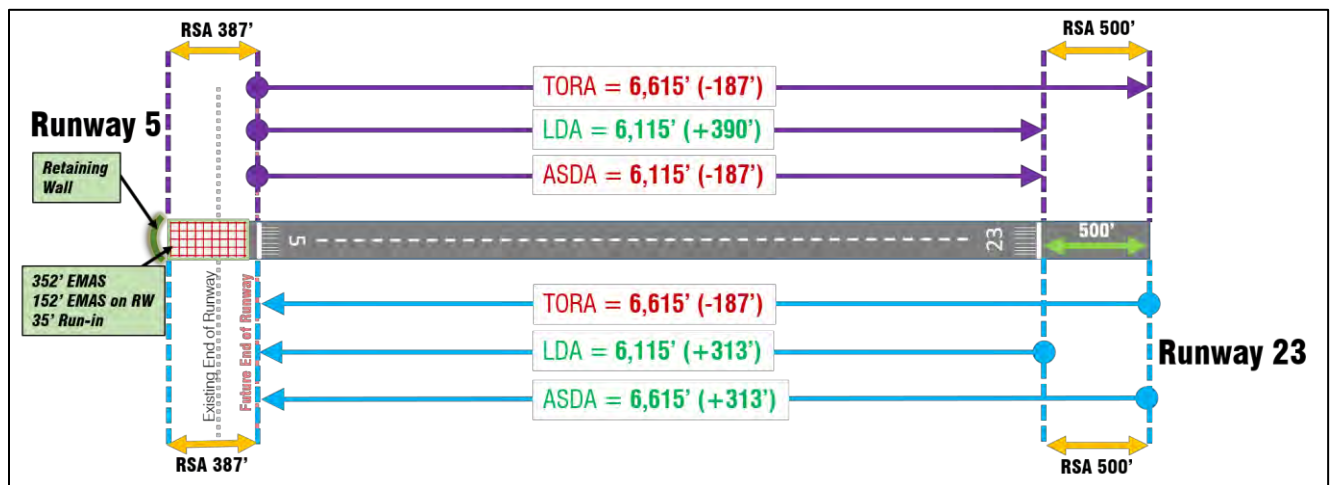
Note: Distances are compared to existing conditions

Source: Landrum & Brown analysis.

### 8.6.3 ALTERNATIVE 8: 352-FOOT EMAS WITH STANDARD LENGTH RUNWAY 5 RSA AND 100-FOOT EXTENSION

Based on FAA input, Alternative 8, shown in Exhibit 8-13, *Alternative 8: 352-Foot EMAS with Standard Length Runway 05 RSA and 100-Foot Extension*, was developed to focus on safety rather than operational capabilities. This alternative includes the same retaining wall supporting a 100-foot extension as Alternatives 6 and 7. This alternative aims to restore the same level of safety to the Runway 05 end that was in place prior to the slope failure. It provides a standard 70-knot, 352-foot EMAS on the Runway 05 end. The Runway 23 undershoot and overrun RSAs are 500 feet for this alternative. Due to the increase in RSA length, the total runway length is reduced to 6,615 feet. The LDA for both directions meets the runway length goals. The Runway 05 ASDA is reduced to 6,115 feet, which does not meet the ASDA goal. The Runway 23 ASDA is 6,615 feet which also does not meet the ASDA goal. This alternative requires the relocation of the Runway 05 glide slope.

Exhibit 8-13  
 ALTERNATIVE 8: 352-FOOT EMAS WITH STANDARD LENGTH RUNWAY 05  
 RSA AND 100-FOOT EXTENSION  
 Yeager Airport



- Notes:
1. Distances are compared to existing conditions.
  2. Length of EMAS is based on Zodiac Aerospace modeling of EMB 145.

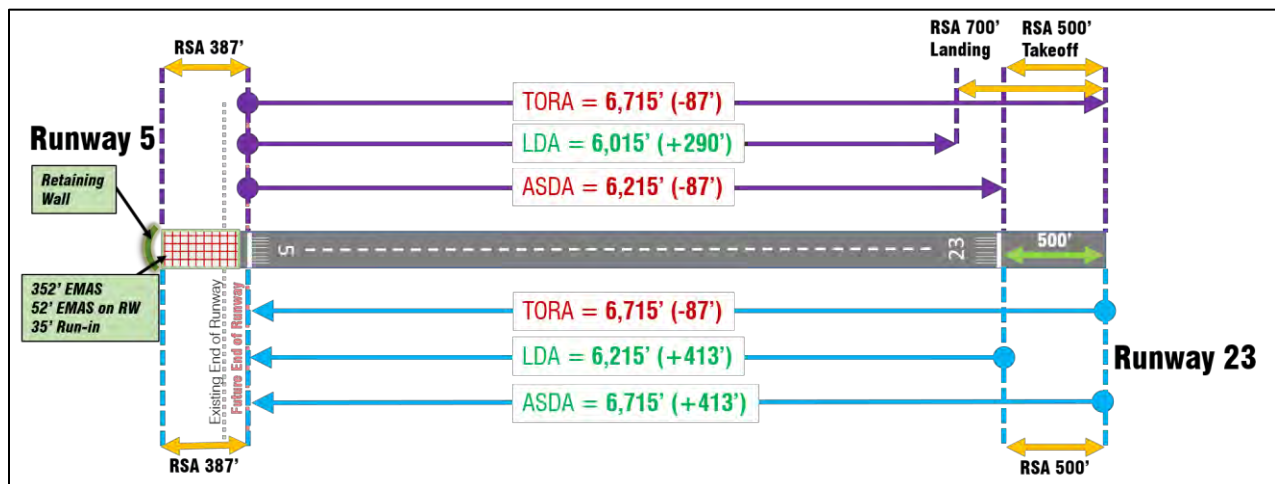
Source: Landrum & Brown analysis.



### 8.6.4 ALTERNATIVE 9: 352-FOOT EMAS WITH STANDARD LENGTH RUNWAY 5 RSA AND 200-FOOT EXTENSION

Based on FAA input, Alternative 9 was created with the intent of improving safety as in Alternative 8 but also adding additional runway length. This alternative considers a retaining wall to support a 200-foot extension. This alternative provides an EMAS capable of stopping all the critical aircraft from 70 knots or more, and provides greater operational capability. Alternative 9 is shown in Exhibit 8-14, *Alternative 9: 352-Foot EMAS with Standard Length Runway 05 RSA and 200-Foot Extension*. The Runway 23 end undershoot and takeoff overrun RSAs are 500 feet for this alternative. The Runway 05 LDA was reduced to 6,015 feet in order to increase the overrun safety area for a Runway 5 landing to 700 feet. The LDA for both directions meets the runway length goals. The Runway 05 ASDA is reduced to 6,215 feet, which does not quite meet the ASDA goal. The Runway 23 ASDA is 6,715 feet which also does not meet the ASDA goal. The proposed LDA and ASDA lengths for this alternative were reviewed by the four airlines operating at CRW (United, Delta, American, and Spirit) and they confirmed that the proposed declared distances had minimal effects on their aircraft payloads. This alternative is anticipated to retain the existing location of the Runway 05 glide slope.

Exhibit 8-14  
 ALTERNATIVE 9: 352-FOOT EMAS WITH STANDARD LENGTH RUNWAY 05  
 RSA AND 200-FOOT EXTENSION  
 Yeager Airport



- Notes:
- Distances are compared to existing conditions.
  - Length of EMAS is based on Zodiac Aerospace modeling of EMB 145.

Source: Landrum & Brown analysis.

## 8.7 EVALUATION OF REFINED ALTERNATIVES

The refined alternatives were evaluated based on the same criteria as the initial alternatives. Because the alternatives are different, the comparative evaluation shown in Table 8-5, *Refined Alternatives Evaluation Matrix*, also varied as follows:

- **Achievement of Aircraft Performance Objectives:** If the alternative is within one percent of the LDA and ASDA goals in both directions (6,000 feet of LDA and 6,300 feet of ASDA for Runway 05 and 6,800 feet of ASDA for Runway 23), the alternative was shaded green in the matrix. If the alternative is within three percent of the LDA/ASDA goals, it was shaded yellow. If the alternative is more than three percent lower than the LDA/ASDA goals, it was shaded red.
- **Achievement of Runway Safety Objectives:** If the alternative meets undershoot and overrun RSA goals in both directions it was shaded green in the matrix. If the alternative comes within 10 percent of the goal, it was shaded yellow. If the alternative RSAs are more than 10 percent less than the goal, it was shaded red.
- **Ability to Restore Vertical Guidance to Runway 05 Approach:** If the alternative restores vertical guidance without requiring the relocation of the glide slope, it was shaded green. If the alternative restores vertical guidance but requires the relocation of the glide slope, it was shaded yellow. If the alternative does not restore vertical guidance, it was shaded red.
- **Construction Time:** **The alternatives were assigned a "short," "medium," or "long" construction time frame ranking based on the complexity of construction.** Alternatives with an EMAS were assumed to have a medium construction time frame and were shaded yellow. Alternatives with EMAS and the retaining wall/fill were assumed to have a long construction time frame and were shaded red.
- **Cost:** Order of magnitude cost estimates were developed for each alternative and compared against each other.<sup>11</sup> **The alternatives were assigned a "low," "medium," or "high" cost ranking based on the cost estimates.** Alternatives with total costs of less than \$13 million were considered "low" and shaded green. Alternatives with costs of at least \$13 million to less than \$16 million were considered "medium" and shaded yellow. Alternatives with costs of \$16 million or greater were considered high and shaded red.

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<sup>11</sup> Order of magnitude cost estimates were developed for comparison purposes only. Costs include a 35 percent contingency factor.

Table 8-5  
REFINED EMAS ALTERNATIVES EVALUATION  
Yeager Airport

Evaluation Criteria	EMAS Alternatives				
	Original Alternative 5 215' EMAS w/ No Fill and No Wall Relocate GS	Alternative 6 180' EMAS w/ 100' Fill and Wall Relocate GS	Alternative 7 180' EMAS w/ 100' Fill and Wall Retain Existing GS	Alternative 8 352' EMAS w/ 100' Fill and Wall Relocate GS	Alternative 9 352' EMAS w/ 200' Fill and Wall Retain Existing GS
Achievement of Aircraft Performance Objectives	RW 5 LDA: 6,002' ASDA <b>6,152'</b> RW 23 LDA: 6,152' ASDA 6,652'	RW 5 LDA: 6,002' ASDA <b>6,227'</b> RW 23 LDA: 6,227' ASDA 6,727'	RW 5 LDA: 6,002' ASDA <b>6,277'</b> RW 23 LDA: 6,277' ASDA 6,777'	RW 5 LDA: 6,115' ASDA <b>6,115'</b> RW 23 LDA: 6,115' ASDA 6,615'	RW 5 LDA: 6,015' ASDA 6,215' RW 23 LDA: 6,215' ASDA 6,715'
Achievement of Runway Safety Objectives	RW5 Under/Over RSA: 400'/500' RW23 Under/Over RSA: 500'/250' EMAS	RW5 Under/Over RSA: <b>450'</b> /500' RW23 Under/Over RSA: 500'/225' EMAS	RW5 Under/Over RSA: 500'/500' RW23 Under/Over RSA: 500'/225' EMAS	RW5 Under/Over RSA: 387'/500' RW23 Under/Over RSA: 500'/387' EMAS	RW5 Under/Over RSA: 387'/700' RW23 Under/Over RSA: 500'/387' EMAS
Ability to Restore Vertical Guidance to the Runway 05 Approach	Yes with relocated Runway 05 GS antenna	Yes with relocated Runway 05 GS antenna	Yes with existing Runway 05 GS antenna	Yes with relocated Runway 05 GS antenna	Yes with existing Runway 05 GS antenna
Construction Time	<b>Med:</b> EMAS construction	<b>Long:</b> EMAS and retaining wall construction	<b>Long:</b> EMAS and retaining wall construction	<b>Long:</b> EMAS and retaining wall construction	<b>Long:</b> EMAS and retaining wall construction
Cost	<b>Low:</b> EMAS construction <b>\$9.7 Million</b>	<b>Low:</b> EMAS and retaining wall construction <b>\$10.2 Million</b>	<b>Low:</b> EMAS and retaining wall construction <b>\$11.2 Million</b>	<b>Low:</b> EMAS and retaining wall construction <b>\$18.9 Million</b>	<b>High:</b> EMAS and retaining wall construction <b>\$22.7 Million</b>
					<b>Recommended: Provides Best Balance of Operational and Safety Objectives</b>

Legend:

	= Meets Goal
	= Partially Meets Goal
	= Does not Meet Goal

- Notes:
1. **Red text** indicates the LDA, ASDA, or RSA number that does not meet the goal.
  2. GS=Glide Slope.
  3. Costs are shown in 2016 dollars. The costs are order of magnitude estimates for comparison purposes only. Costs for Alternative 9 reflect refinements made as part of the design process.

Source: ADCI, Schnabel Engineering, and Landrum & Brown analysis.

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All of the refined alternatives prioritize safety with the use of an EMAS. Alternatives 6 and 7 utilize a 180-foot EMAS, and take up only 25 feet of the existing runway pavement. Alternative 7 focuses on providing a 500-foot undershoot RSA for Runway 05, resulting in a Runway 05 LDA of 6,002 feet. Alternative 7 calls for a reduced Runway 05 undershoot RSA of 225 feet, allowing the Runway 05 LDA to increase to 6,277 feet. The primary difference between Alternatives 6 and 7 is the ability to retain the existing Runway 05 glide slope. By providing an undershoot RSA of 500 feet, Alternative 6 requires the relocation of the existing glide slope. With a reduced undershoot RSA of 225 feet, Alternative 7 has the capability of retaining the Runway 05 glide slope in its existing location. The recently initiated Master Plan will most likely recommend an extension off of the Runway 23 end to meet future aircraft runway length needs and provide a standard RSA. That study will determine the ultimate location of the Runway 05 threshold, which could be in a different location than what this RSA Study recommends. It does not make sense to move the glide slope twice so Alternative 7 is preferred over Alternative 6.

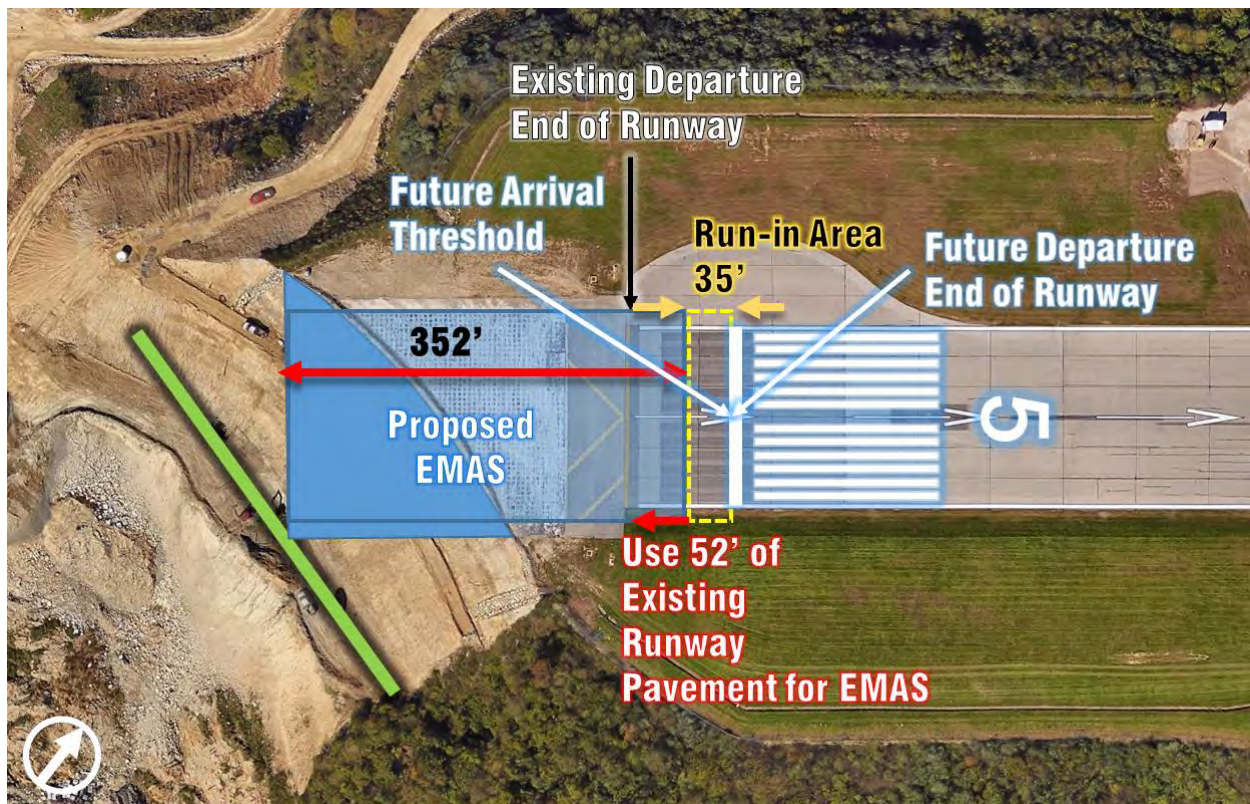
Alternatives 8 and 9 provide the longest RSA lengths among all alternatives, with a standard EMAS and 500-foot long RSAs or EMAS in lieu of a 500-foot long RSA. With Alternative 8, however, the total runway length is reduced to 6,615 feet, and the Runway 05 ASDA is reduced to 6,115 feet. The operational impacts of Alternative 8 are important, especially in poor weather conditions. Many of the aircraft operating at CRW have a critical runway length requirement within 500 feet of the actual runway available. With a Runway 05 ASDA of only 6,002 feet, the critical aircraft (EMB 145) requires a five-knot headwind just to take off. Otherwise, this aircraft will use Runway 23. With a Runway 23 ASDA of 6,615 feet, the EMB-145 can only accept a tailwind of three knots, which is essentially calm winds. It becomes apparent that this is the reason United is applying a one to five passenger penalty on its Houston flight. When wind variability is taken into account, the Runway 05 ASDA needs to be much closer to 6,300 feet. For these reasons, Alternative 8 was not recommended.

Alternative 9 is the preferred interim solution for CRW because it provides the best balance of improved safety and operational needs. It provides an EMAS that will stop the critical aircraft from 70 knots or more. It provides the required LDA in both directions, and is within one percent of providing the required ASDA in both the Runway 05 and 23 directions. The airlines have confirmed that the proposed declared distances allow them to restore virtually all of the capability lost with the slope failure. Although it does not meet the undershoot RSA goal on the Runway 05 end, it does restore vertical guidance for Runway 05 arrivals immediately which reduces the risk of an undershoot on that end. Alternative 9 is an integral first step that will be part **of the Airport's permanent solution for Runway 05-23.**

## 9. RECOMMENDED INTERIM SOLUTION

The recommended alternative on the Runway 05 end is considered to be an interim solution. It is the first step towards the long-term goal of achieving a standard RSA and meeting future runway length needs by extending Runway 23. The interim Runway 05 solution is an integral part of the final plan for the final geometry. Exhibit 9-1, *Alternative 9 Detail*, provides a detailed illustration of the preferred alternative on the Runway 05 end.

Exhibit 9-1  
 ALTERNATIVE 9 DETAIL  
 Yeager Airport



DECLARED DISTANCES	RUNWAY 5	RUNWAY 23
TORA	6,715'	6,715'
LDA	6,015'	6,215'
ASDA	6,215'	6,715'

Source: Schnabel Engineering and Landrum & Brown analysis.

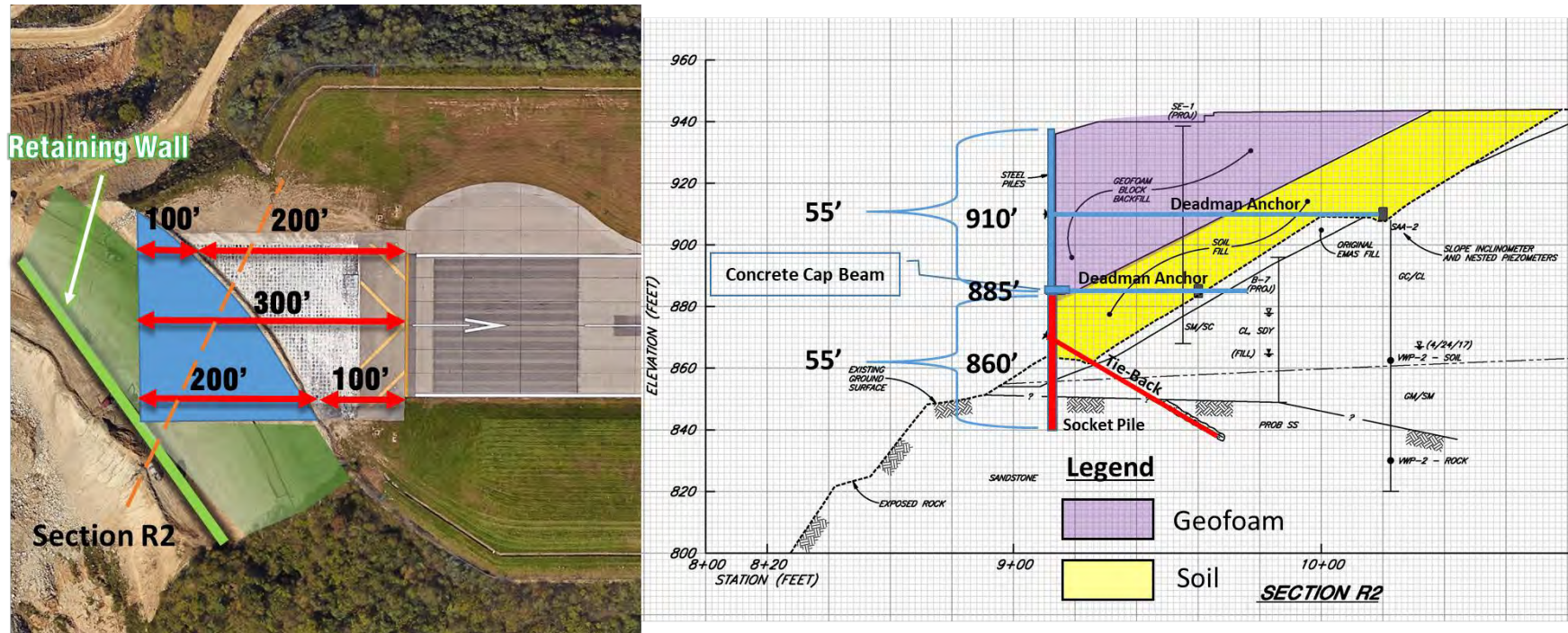
## 9.1 RETAINING WALL FOR PREFERRED ALTERNATIVE

It is important to understand the details of the retaining wall supporting this development. The 82-foot structure supporting the 200-foot extension is a soldier pile wall. Due to extensive weight load that would be exerted on the retaining wall, the use of lightweight geofoam instead of dirt was considered for the fill. Geofoam has been used at multiple airports in the U.S., most notably Louis Armstrong New Orleans International Airport, where it was used under newly widened sections of taxiway filets. The wall is to be built in a west-east orientation, tangent to the southern-most corner of the EMAS bed. The top of the retaining wall is to be positioned two feet below the elevation of the end of Runway 05. The details and dimensions of the retaining wall are shown in Exhibit 9-2, *Retaining Wall Detail*.

## 9.2 IMPLEMENTATION SCHEDULE

Given the February 2017 overrun incident (which ended with no injuries or fatalities) and the May 2017 accident, which tragically resulted in two deaths, CWVRAA is proposing an aggressive schedule to deliver an interim project that will increase safety over existing conditions as soon as possible. Exhibit 9-3, *Proposed Implementation Schedule*, shows an implementation schedule with National Environmental Policy Act (NEPA) analysis conducted using emergency procedures, and compressed design and construction.

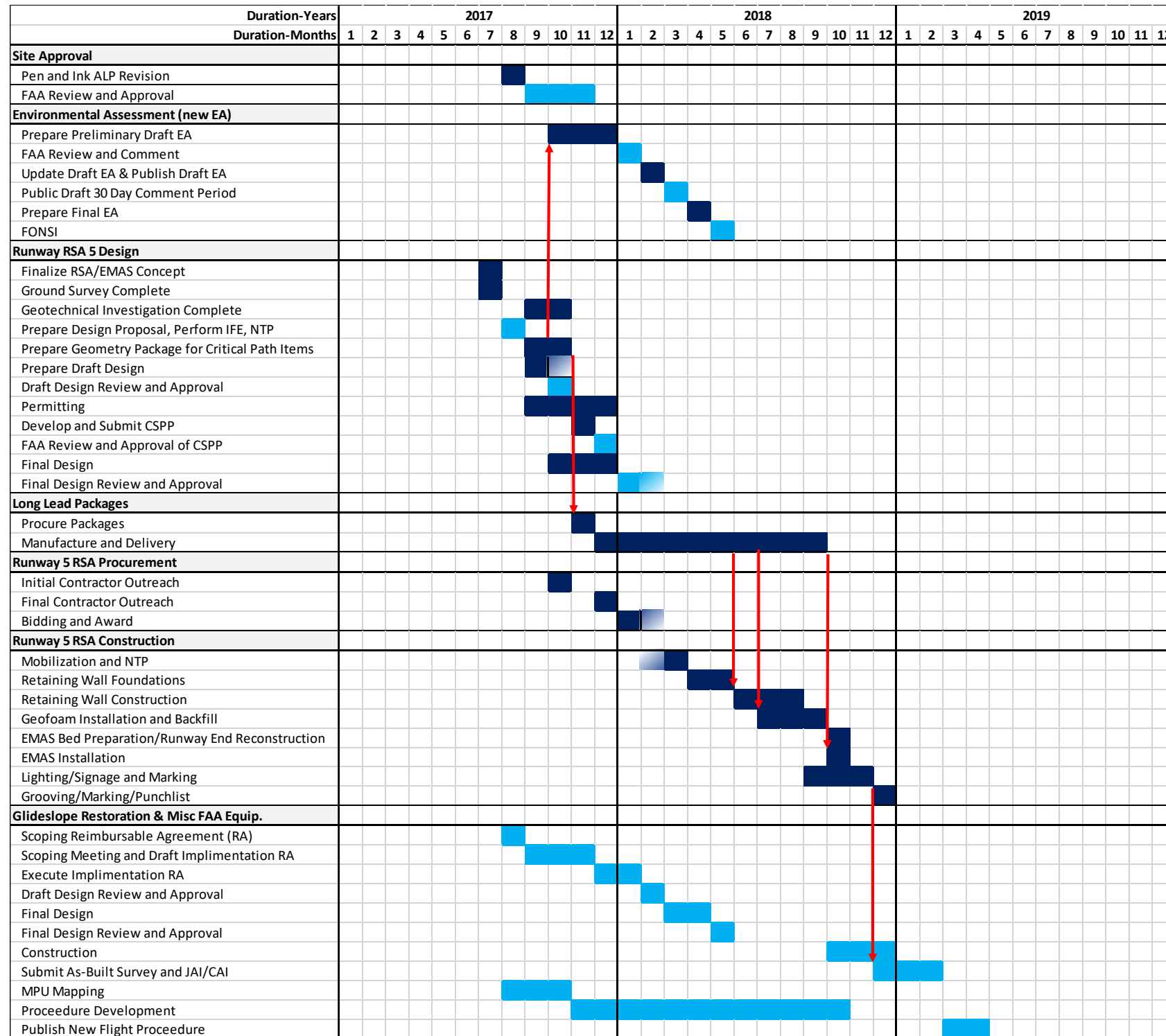
Exhibit 9-2  
 RETAINING WALL DETAIL  
 Yeager Airport



Source: Schnabel Engineering.



Exhibit 9-3  
PROPOSED IMPLEMENTATION SCHEDULE  
Yeager Airport



- Notes:
1. Assumes September 2017 notice to proceed.
  2. Assumes an emergency National Environmental Policy Act (NEPA) process and no FAA grant funding timing delays.
  3. Assumes an accelerated and compressed design, permitting, and construction process.

Source: ADCI, Schnabel Engineering, and Landrum & Brown analysis.

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### 9.3 PROJECT COST

Alternative 9 was estimated to cost \$22.2 million as shown in Table 9-1, *Alternative 9 Project Cost*.

Table 9-1  
 ALTERNATIVE 9 PROJECT COST  
 Yeager Airport

PROJECT COMPONENT	AMOUNT
Pre-Construction Costs	
ALP	\$10,000
Environmental Documentation and Permitting	\$150,000
Reimbursable Agreement	\$100,000
Wall/RSA/Runway Design	<u>\$1,400,000</u>
Pre-Construction Subtotal	\$1,660,000
Construction Costs	
Wall/RSA Construction	\$6,700,000
EMAS Blocks	\$5,800,000
EMAS Installation	\$1,160,000
Paving/Lighting/Marking/Signing	\$600,000
NAVAID Relocation (if needed)	<u>\$660,000</u>
Construction Subtotal	\$14,920,000
30% Contingency	<u>\$4,480,000</u>
Construction with Contingency Subtotal	\$19,400,000
Other Costs	
Independent Technical Design Review	\$100,000
Grant Administration/Construction Management	<u>\$1,000,000</u>
Other Subtotal	\$1,100,000
<b>TOTAL PROJECT COST</b>	<b>\$22,160,000</b>

Sources: Zodiac Aerospace, Schnabel Engineering, ADCI, and Landrum & Brown analysis.

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# APPENDIX A

## RUNWAY LENGTH: OPERATOR CORRESPONDENCE DATABASE

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# SECTION ONE

## INTRODUCTION

As part of the review of the Yeager Airport (CRW) existing Interim Runway Safety Area (RSA) situation on both runway ends, it was pertinent to include stakeholder input during this RSA Study in order ensure that the appropriate operational expertise and experience has informed the needs, analysis process, and decision-making for the runway length need at CRW.

As mentioned in the RSA Study, Airport stakeholders were not consulted regarding the impacts of the declared distances that were implemented following the slope failure in 2015. Immediate action was needed to restore runway capabilities at that time. As a result, the operational impacts to airlines, cargo operators, military operations, and general aviation pilots were not considered. However, this RSA Study will take stakeholder impacts into account to ensure operator needs are accounted for and documented.

This appendix was created in order to identify the current needs of all major operators at CRW and document the impact of the slope failure on each major operator. Operator correspondence included phone calls, meetings, and emails to all of the airlines, cargo operators, major general aviation tenants, and the West Virginia Air National Guard (WVANG). These operators were asked a number of questions about historical and current operational capabilities and hindrances at CRW. The correspondence was then documented in the following database, Table 1, *Operator Correspondence Database*.

The database identifies the following columns of information:

- Operator: Includes the name of the operator at CRW.
- Operational Issues Defined by Operators: Includes any documented operational runway issues experienced either historically or currently occurring at CRW.
- Airport Follow-up Questions: Includes any correspondence requested as follow-up questions or concerns to each operator, either in regards to the runway issues or the ongoing RSA Study.
- Operator Response: Includes any initial response from operators on the Airport follow-up discussions.

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## SECTION TWO OPERATOR CORRESPONDENCE DATABASE

Table 1  
 OPERATOR CORRESPONDENCE DATABASE  
 Yeager Airport

OPERATOR TYPE	OPERATOR	OPERATIONAL ISSUES DEFINED BY OPERATORS	FOLLOW-UP QUESTIONS	OPERATOR RESPONSE
PAX	American Airlines	-Landing weights limited when runway is wet for multiple aircraft -Could be restricted to 58 passengers depending on fuel reserve	<ul style="list-style-type: none"> <li>• According to your email of October 24, 2016 to Nick Keller, the CR7R and CR7N are weight limited for landings in wet conditions at CRW, which you said translates to a passenger restriction of 58-62. Is this a per flight restriction? American does not operate this aircraft frequently at CRW. Is the runway length restriction the reason?</li> <li>• We see that American also operates DASH8s and the CRJ200 at CRW. Do either of these aircraft have any weight restrictions due to runway length?</li> </ul>	<ul style="list-style-type: none"> <li>• Yes, CR7R and CR7N per flight restriction and due to the landing length of 5724 FT &amp; 5802 FT (WET).</li> <li>• American provided CRJ200 fleet type. The CRJ200 shows less than MTOW structural available but still can obtain 100% passenger load factor to CLT. CRJ200 is okay landing 6,000' or greater Dry &amp; Wet. No DASH8 data provided since are phasing out that fleet type. Departure Existing conditions, Runway 05, the ASDA did not change. Did not see any difference in the payload. For Runway 23, ASDA did decrease 500ft (6,802ft to 6,302ft) however the amount of payload change was minimal. For the E145 we saw a reduction of 2 to 6 passengers with ASDA reduction on runway 23. Landing Existing conditions limited the CRJ-700 when landing on a WET runway. Restrictions incurred when operating CRJ-700 on a WET runway. All American Eagle fleet types could achieve MLW when landing on a DRY runway.</li> </ul>
PAX	Delta	-B737-700 largest aircraft can be scheduled -Would benefit from longer LDA -CRJ200 departure weights less than MTOW -CRW designated as a Special Winter Operations Airport (SWOA). Any airport receiving 4 points or more--points earned for elevation, weather ops, incidents, lack of guidance or lighting, etc.--has SWOA designation. Recent visit shows CRW was given 4 points (1 for elevation and 3 for runway length) -Delta will usually have a flight at least 1 or 2 times a week that might fall in a weight in balance.... This happens more often as the weather gets hotter for the flights going to Atlanta. In the summer time it is not unusual for this to happen several times a week. <u>Details:</u> -Used to schedule B737-800, which replaced smaller 737-700s. -Airline would like to have more flexibility in fleet at CRW	<p>To Peter Hanson at Delta (Mainline)</p> <ul style="list-style-type: none"> <li>• Delta explains CRJ200 is departure weight limited when below MTOW. Can you tell us if you have to restrict passengers or cargo when departing to ATL? How often does this occur and what is the penalty?</li> <li>• Do you take any weight penalties on CRJ900? How often and what is the penalty? Do you accrue summer weight penalties? What's the takeoff weight when flying to ATL from CRW (full load)?</li> </ul> <p>To Carolyn Bowen at Delta (Connection)</p> <ul style="list-style-type: none"> <li>• B737-800 was previously scheduled at CRW but was later swapped out for the B737-700. Can you verify that the reduced runway length is cause? Did the 737-800 take weight penalties? If so, how often?</li> <li>• From Stephanie Finnvik's email of November 9, 2016: the 737-700 has no weight restrictions with the currently available runway distances. What about the 717 or A319?</li> <li>• What version of the A319 is used at CRW? What is the MTOW for the version you are using?</li> <li>• Is the B717 used at CRW the base model or the high gross weight model?</li> <li>• Do you know the MTOW for the B737-800 that was used to operate out of CRW?</li> </ul>	<p>3/17/17 from Peter Hanson (Mainline)</p> <ul style="list-style-type: none"> <li>• Assumes CRW arrival restrictions to be more prevalent than CRW departure restrictions (to and from ATL) due to the 5/23 landing distances.</li> <li>• The most significant payload risk for a CRJ-900 driven by landing weight limitations on 5/23 for flights into CRW (as noted above for the CRJ-200). These limitations could be significant. For CRW departures to ATL not to expect routine passenger restrictions except as noted above. For CRW departures to ATL with a max payload, a takeoff weight in the range of 75-78 Klb is expected.</li> </ul> <p>No response from Carolyn (Connection)</p>

OPERATOR TYPE	OPERATOR	OPERATIONAL ISSUES DEFINED BY OPERATORS	FOLLOW-UP QUESTIONS	OPERATOR RESPONSE
PAX	Spirit	None	Follow-up not needed	N/A
PAX	United	-64 weight and balance delays from Jan. 2016 to Jan. 2017 -Delays from 4-65 min, removals of 0-14 pax	What is the impact on the CRW-IAH route?	-Due to the short runway length, have planned held seats in place on CRW-IAH depending on the month and time of day. United uses an extended-range E145 on the route, and we hold between 1 and 5 seats from April to August.
PAX-Potential	JetBlue	-Airport was supposed to handle A320 and notified by JetBlue they could not land due to the LDA less than 6,000' Details: 6,000 is requirement for landing distance for JetBlue	Follow-up not needed	N/A
PAX	Miami Air	-Charter flight canceled, found out LDA was less than 6,000' Details: 6,000' requirement for landing distance for Miami Air	Follow-up not needed	N/A
PAX-Potential	Allegiant	-Current A/C types can't operate at CRW -Would reopen analysis if changes made -Unfavorable items include terrain, short rwy lengths, obstacles, weather factors, unfavorable night ops, no PAPIs, and marginal vertical guidance on RWY 5 -Amongst list above, worst is LDA due to DT Details: Allegiant doesn't operate at any airport with less than 6,000' usable runway. Airline recommends extending rwy length and improved glide path info to reconsider.	Follow-up not needed	N/A
CARGO	Ameristar Air Cargo, Inc.	-Dry conditions, the DC-9 can land at 81,700 pounds. If runway is contaminated, lose 10,000 pounds capacity.	<ul style="list-style-type: none"> <li>Ameristar indicated that the DC-9 loses 10,000 pounds of capacity during contaminated runway conditions. How frequently are you seeing this occur at CRW?</li> <li>What model of the DC-9 operates at CRW (the -15, -15F, -21, -32, -33F, -41, or -51)?</li> </ul>	3/17/17: Ameristar has no way to answer this first question due to on-demand and service use of CRW. In past 12 months, landed one Falcon 20 there and picked up from CRW 7 times. They operate the DC-9-15 series.
CARGO	USA Jet Airlines	-Could increase the amount of freight carried per aircraft from 800 to nearly 3,500 lbs. Details: Compiled data on how much extra freight could take if the usable runway was increased from 5700' to 6000'. DC-9 10 Series : +1,700 lbs. for Rwy 23 +800 lbs. for Rwy 5 DC-9 30 Series: +2,200 lbs. for Rwy 23 +1,000 lbs. for Rwy 5 MD83 : +2,900 lbs. for Rwy 23 +3,000 lbs. for Rwy 5 B-727: +3,270 lbs. for Rwy 23 +3,480 lbs. for Rwy 5	<ul style="list-style-type: none"> <li>USA Jet said they could increase the amount of freight if the landing distance increased to 6,000'. Have there been weight restrictions when flying into CRW?</li> <li>Are the takeoff distances sufficient or does that also lead to weight penalties? How often they occur? What aircraft do USA Jet operate at CRW?</li> </ul>	3/17/17: No data on how much freight they've had to leave behind. Also, the allowable weights supplied were based on takeoff weight, not landing weight. Operating in the last year: 18 DC-9's, 5 DA-20's, and 3 727's
GA	GA Operator-Joe Cooke	-Sold aircraft due to airfield inefficiencies with 15 operations effected since July 2015 due to runway length Details: A larger aircraft would be considered again in future if capabilities increase. Contaminated runway requires 5,800 feet for LDA in perfect conditions	Follow-up not needed	N/A
GA	Professional Aeronautical Services	-During certain conditions, Cessna Citation used by the operator is limited in passengers, bags, and/or fuel. Runway length needed coupled with recommissioning of ILS Glide Path and VASI on RWY 5	Follow-up not needed	N/A

OPERATOR TYPE	OPERATOR	OPERATIONAL ISSUES DEFINED BY OPERATORS	FOLLOW-UP QUESTIONS	OPERATOR RESPONSE
GA	FBO-Executive Air	-FBO receives frequent complaints of insufficient runway length. Aircraft also not coming to CRW due to runway length, expressed by FBO	Follow-up not needed	N/A
MIL	WVANG	-The 130th Operations Group conducts C-130 training sorties at KCRW. Part of our annual training requirements includes touch-and-go landings for pilot currency and proficiency. <b>To comply with the Air Force's C-130 flying regulation a 6000' runway is required</b> for some touch-and-go landings.	Follow-up not needed	N/A

Source: Landrum & Brown analysis, 2017.

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## SECTION THREE OPERATOR CORRESPONDENCE LETTERS

Section three displays the correspondence letters from the operators that have been summarized in Table 1-1, shown in Section 2. The letters include communication trails between the Airport, Airport consultants, and operators. Correspondence letters are displayed in alphabetical order.

## Allegiant

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### Nick Keller

---

**From:** West, Lance (Manchin) <Lance\_West@manchin.senate.gov>  
**Sent:** Wednesday, March 30, 2016 8:37 AM  
**To:** Nick Keller; Terry Sayre  
**Subject:** FW: Contact Info Allegiant

Hi Nick and Terry,  
Please see the email I received from Allegiant late yesterday. I would be interested to hear your thoughts after you read through it, my direct is 202-228-6688. Thanks!  
-lance

Lance West, Jr  
Office of Senator Joe Manchin III  
202.224.3954

---

**From:** Eric Fletcher [mailto:Eric.Fletcher@allegiantair.com]  
**Sent:** Tuesday, March 29, 2016 6:48 PM  
**To:** West, Lance (Manchin) <Lance\_West@manchin.senate.gov>  
**Subject:** RE: Contact Info Allegiant

Lance,

The review from the Allegiant Flight Standards Board and Flight Safety concluded that Allegiant cannot safely operate into the airport with regular commercial service with our current aircraft types. Their analysis takes into account a number of risk factors, and is then scaled into an overall risk assessment, with high risk airports being disqualified. Below are some details from their report.

If improvements to the airport could make our Flight Standards Board and Flight Safety groups comfortable, we would reopen analysis into CRW as a potential Allegiant market, but presently that analysis has not gone forward. Hope this helps. Thanks.

---

The resulting risk assessment score was high due to multiple factors, which include:

- Terrain
- **Short takeoff and landing distance – Usable landing length is 5724 for runway 5 and 5802 for runway 23**
- FAA obstacle departure procedure
- Weather factors which include windshear/updraft/downdraft conditions
- FAA-designated Airport Qualification per 14 CFR 121.445
- Potential night operations
- Marginal vertical guidance to runway 5

The primary concern is limited landing distance due to displaced thresholds and shortened available landing distance. When you factor the localized winds on the approach end of both runways, due in part to terrain, the risk is that the approach will become unstabilized in terms of airspeed or vertical flight path. An unstabilized approach profile is a key factor in a safe landing, particularly on a short runway. Should the profile become high and/or fast, the potential for a runway overrun and excursion increases. Contaminated runways will further increase this risk. **Allegiant does not currently operate at any airports with under 6,000 feet of useable runway.**

Allegiant (continued)

Complicating the approach stabilization concern is the fact that runway 5 is served by a LOC approach, which does not include an electronic glidepath, and the visual glidepath – a VASI – is not optimum for transport category aircraft as it does not provide as precise an indication of vertical glidepath as a PAPI or electronic glide slope.

Mitigations for these concerns are outside the airline's direct control. To make service possible we would suggest that the useable runway lengths be extended, coupled with improved glidepath information will help to achieve a configuration suitable for transport category aircraft.

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Eric Fletcher Esq. | Manager, Airports  
Allegiant Travel Company  
1201 North Town Center Drive, Las Vegas, NV 89144  
Direct: 702.830.8161  
[eric.fletcher@allegiantair.com](mailto:eric.fletcher@allegiantair.com) | [www.allegiant.com](http://www.allegiant.com)

---

**From:** West, Lance (Manchin) [[mailto:Lance\\_West@manchin.senate.gov](mailto:Lance_West@manchin.senate.gov)]  
**Sent:** Tuesday, March 29, 2016 1:53 PM  
**To:** Eric Fletcher <[Eric.Fletcher@allegiantair.com](mailto:Eric.Fletcher@allegiantair.com)>  
**Subject:** RE: Contact Info Allegiant

Hi Eric,  
I would like to follow up on our call a couple weeks ago, and see if the information you were going to share with our office regarding the Charleston, WV airport is available? Thank you, and I look forward to hearing from you.  
-lance

Lance West, Jr  
Office of Senator Joe Manchin III  
202.228.6688

---

**From:** Eric Fletcher [<mailto:Eric.Fletcher@allegiantair.com>]  
**Sent:** Thursday, March 17, 2016 1:37 PM  
**To:** West, Lance (Manchin) <[Lance\\_West@manchin.senate.gov](mailto:Lance_West@manchin.senate.gov)>  
**Cc:** Eric Fletcher <[Eric.Fletcher@allegiantair.com](mailto:Eric.Fletcher@allegiantair.com)>  
**Subject:** Contact Info Allegiant



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American Airlines

**Nick Keller**

**From:** Starkey, Bruce <Bruce.Starkey@aa.com>  
**Sent:** Monday, October 24, 2016 12:30 PM  
**To:** Nick Keller  
**Subject:** RE: CRW Declared Distances

Here is the landing weight for the current and proposed distances.

LDA	Runway 05				Runway 23			
	Current		New		Current		New	
	DRY	WET	DRY	WET	DRY	WET	DRY	WET
	5724		6000		5802		6078	
E140	41220	41220	41220	41220	41220	41220	41220	41220
E145	43650	43650	43650	43650	43650	43650	43650	43650
CR7R	67000	63909	67000	67000	67000	65119	67000	67000
CR7N	67000	63798	67000	67000	67000	64966	67000	67000
E175	74950	74950	74950	74950	74950	74950	74950	74950

As you can see the landing weight can be limited when the runway is WET. This would translate into a passenger restriction of between 58-62, depending on the reserve fuel required that day. Using the longer length, there is no restriction. Thanks and sorry for the misunderstanding. Bruce

**From:** Nick Keller [mailto:Nick@yeagerairport.com]  
**Sent:** Monday, October 24, 2016 11:23 AM  
**To:** Starkey, Bruce  
**Subject:** RE: CRW Declared Distances

Thank you sir. Just to be clear this is for the proposed declared distances? Can you tell me if American has any current operational impact with the current landing distance of 5,724 on Rwy 5 and 5,802 LDA on Rwy 23? We have to show the FAA what impacts to current operations are before they will let us make the change. Thanks!

**Nick Keller** | Assistant Airport Director

Central West Virginia Regional Airport Authority  
 100 Airport Rd. Suite 175, Charleston, WV 25311  
 W: 304.344.8033 F: 304.344.8034





American Airlines (continued)

**Nick Keller**

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**From:** N31LJ <n31lj@aol.com>  
**Sent:** Monday, October 24, 2016 5:43 PM  
**To:** Nick Keller  
**Subject:** Re: RSA

Hello Nick, That will make a significant improvement in aircraft operations. Sometimes it only takes a few more feet. That would let the jets with higher landing speeds operate within the required FAA margins. It would still impact operations during contamination periods but a significant improvement. Thanks for continuing to improve runway distance. Joe

-----Original Message-----

From: Nick Keller <Nick@yeagerairport.com>  
To: n31lj <n31lj@aol.com>  
Sent: Mon, Oct 24, 2016 5:25 pm  
Subject: FW: RSA

Joe,

Thanks for your very detailed description of the operational impacts you currently face. If the Airport is successful in getting approval from the FAA to change the landing distance available to 6,001 on Rwy 5 and 6,079 on Rwy 23 can you tell me how this may improve your operations?

We can definitely use the other information in our master plan update that will determine our runway length and extension possibilities. We hope the displaced threshold move and LDA change can bring about at least some relief for operations in the short-term. Thanks.

**Nick Keller** | Assistant Airport Director

Central West Virginia Regional Airport Authority  
100 Airport Rd. Suite 175, Charleston, WV 25311  
W: 304.344.8033 F: 304.344.8034



**From:** Plante & Associates [<mailto:mike@planteandassociates.com>]  
**Sent:** Thursday, October 20, 2016 9:54 AM  
**To:** Nick Keller <[Nick@yeagerairport.com](mailto:Nick@yeagerairport.com)>; Terry Sayre <[t\\_sayre@yeagerairport.com](mailto:t_sayre@yeagerairport.com)>  
**Subject:** Fwd: RSA

Sent from my iPhone

Begin forwarded message:

American Airlines (continued)

**Lisa M. Schafer**

**From:** Leitner, Jay <Jay.Leitner@aa.com>  
**Sent:** Friday, March 24, 2017 9:44 AM  
**To:** Michelle Gallo  
**Cc:** Starkey, Bruce; Millis, Scott  
**Subject:** RE: Runway Length and RSA Proposal for Yeager Airport

Michelle,

The proposed declared distances are very helpful to American Eagles operations at CRW. Regaining the 6,000ft of LDA allows our operations to operate unrestricted in both DRY and WET conditions once again.

Takeoff

- Prior to the Slope Failure
  - all of our American Eagle fleet types, with the exception of the E145, could operate all of our current routes out of CRW unrestricted. For the E145 operated on the CRW-CLT routing we took a 3 to 5 passenger restriction dependent upon season.
- Existing Conditions
  - Runway 05: As the ASDA did not change we did not see any difference in the payload uplift.
  - Runway 23: The ASDA did decrease 500ft (6,802ft to 6,302ft) however the amount of payload change was minimal. Once again the only American Eagle fleet impacted by the ASDA reduction was the E145. For the E145 we saw a reduction of 2 to 6 passengers with this ASDA reduction on runway 23.
- Proposed Conditions
  - Runway 05: While there is a slight reduction in all of the declared distances, TORA/TODA/ASDA, the reduction is small enough that there is no change for our takeoff payloads.
  - Runway 23: The increase of ASDA, up to 6,742ft, allows American Eagle to once again match our payloads prior to the slope failure.

Overall the 'Proposed Conditions' will allow American Eagle to operate as we had previously done prior to the slope failure. In this condition only the E145 is slightly restricted on the CRW-CLT routing.

Landing

- Prior to the Slope Failure
  - All fleet types could achieve Maximum Landing Weight (MLW) with 6,302ft LDA. No inbound payload restrictions for DRY or WET runways.
- Existing Conditions
  - In this condition the CRJ-700 fleet was limited when landing on a **WET** runway. The table restrictions we would incur when operating the CRJ-700 on a **WET** runway.
  - All American Eagle fleet types could achieve MLW when landing on a **DRY** runway.
- Proposed Conditions
  - Increasing the LDA back to greater than 6,000ft would allow all of our American Eagle fleet to achieve MLW. No inbound payload restrictions for DRY or WET runways.

Please feel free to contact me if you should have any additional questions and/or concerns.

Thank you,



American Airlines (continued)

Jay Leitner  
 Operations Engineering  
 817-931-6676 Office



EQUIPMENT	ORG-DST	SEASON	Before Slope Failure				WET RUNWAY Landing - Run			
			PAX	CARGO	LF%	LIMIT	Existing Conditions			
							PAX	CARGO	LF%	LI
CRJ/CRJ-700*	CLT-CRW	W	65	2055	100	MZFW	61	0	93	N
		P	65	2640	100	MZFW	63	0	96	N
		S	65	2640	100	MZFW	63	0	96	N
		F	65	2055	100	MZFW	61	0	93	N
CRJ/CRJ-700*	DCA-CRW	W	65	2055	100	MZFW	61	0	93	N
		P	65	2640	100	MZFW	63	0	96	N
		S	65	2640	100	MZFW	63	0	96	N
		F	65	2055	100	MZFW	61	0	93	N
CRJ/CRJ-700*	PHL-CRW	W	65	2055	100	MZFW	61	0	93	N
		P	65	2640	100	MZFW	63	0	96	N
		S	65	2640	100	MZFW	63	0	96	N
		F	65	2055	100	MZFW	61	0	93	N

EQUIPMENT	ORG-DST	SEASON	Before Slope Failure				WET RUNWAY Landing - Run			
			PAX	CARGO	LF%	LIMIT	Existing Conditions			
							PAX	CARGO	LF%	LI
CRJ/CRJ-700*	CLT-CRW	W	65	2055	100	MZFW	65	321	100	N
		P	65	2640	100	MZFW	65	906	100	N
		S	65	2640	100	MZFW	65	906	100	N
		F	65	2055	100	MZFW	65	321	100	N
CRJ/CRJ-700*	DCA-CRW	W	65	2055	100	MZFW	65	321	100	N
		P	65	2640	100	MZFW	65	906	100	N
		S	65	2640	100	MZFW	65	906	100	N
		F	65	2055	100	MZFW	65	321	100	N
CRJ/CRJ-700*	PHL-CRW	W	65	2055	100	MZFW	65	321	100	N
		P	65	2640	100	MZFW	65	906	100	N
		S	65	2640	100	MZFW	65	906	100	N
		F	65	2055	100	MZFW	65	321	100	N

**From:** Starkey, Bruce  
**Sent:** Thursday, March 23, 2017 10:22 AM  
**To:** Millis, Scott  
**Cc:** Leitner, Jay  
**Subject:** FW: Runway Length and RSA Proposal for Yeager Airport

Below 1500 feet.

American Airlines (continued)

**From:** Michelle Gallo [<mailto:mgallo@landrum-brown.com>]  
**Sent:** Wednesday, March 22, 2017 9:12 AM  
**To:** Starkey, Bruce  
**Cc:** Nick Keller; Monica Geygan; Matt Lee  
**Subject:** Runway Length and RSA Proposal for Yeager Airport

Mr. Starkey,  
 I wanted to follow up on my email of March 9 in regards to Yeager Airport's RSA proposal. We would appreciate any feedback you can provide on the proposed changes to the declared distances. Below is the proposal, more detailed information is provided in the attached PowerPoint.

The Airport would like your airline's opinion on whether this solution materially improves your operation capability. The landing distance available (LDA) increases to at least 6,000 feet in both directions. The takeoff run available (TORA) and takeoff distance available (TODA) are reduced by 60 feet in both directions. The accelerate-stop distance available (ASDA) is decreased by 60 feet in the Runway 5 direction but increased by 440 feet in the Runway 23 direction. A table is provided below which shows the declared distances before the slope failure, after the slope failure (existing), and with this proposal. A PowerPoint presentation is attached which shows more detail about the proposal. Please let us know if the reduction in TORA/TODA and Rwy 5 ASDA are acceptable and if the increase in ASDA and Rwy 23 LDA is sufficient to improve your operational performance from CRW. If you have any questions about the proposal, please feel free to contact me.

Declared Distances	Before Slope Failure		Existing Condition		Proposed Condition	
	Rwy 5	Rwy 23	Rwy 5	Rwy 23	Rwy 5	Rwy 23
TORA	6,802	6,802	6,802	6,802	6,742	6,742
TODA	6,802	6,802	6,802	6,802	6,742	6,742
ASDA	6,302	6,802	6,302	6,302	6,242	6,742
LDA	6,302	6,302	5,725	5,802	6,002	6,242

Note: Green numbers indicate an increase from the previous condition. Red indicates a decrease.

Thank you for your time and attention to this matter.

**Michelle L. Gallo** → Landrum & Brown  
 11279 Cornell Park Drive Cincinnati, OH 45242  
 P: 513.530.1212 | F: 513.530.2207 | C: 513.324.2828

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 For additional company and industry information please visit our website at [www.Landrum-Brown.com](http://www.Landrum-Brown.com)

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Ameristar Air Cargo, Inc.

**Lisa M. Schafer**

---

**To:** Michelle Gallo  
**Subject:** RE: General Contact Form Nick Keller

**From:** Stacy Muth <[SMuth@AmeristarJet.com](mailto:SMuth@AmeristarJet.com)>  
**Date:** February 15, 2017 at 7:32:32 PM EST  
**To:** "[nick@yeagerairport.com](mailto:nick@yeagerairport.com)" <[nick@yeagerairport.com](mailto:nick@yeagerairport.com)>  
**Subject:** FW: General Contact Form Nick Keller

Mr. Keller,

Thank you for your inquiry. Under dry conditions, the DC-9 can land at 81,700 pounds. IF the runway is contaminated, we lose 10,000 pounds capacity, which is pretty limiting for us.

Kind regards,

Stacy Muth

Stacy L. Muth  
Vice President  
Ameristar Jet Charter, Inc.  
Ameristar Air Cargo, Inc.  
(972) 725-9009 direct  
(972) 725-9039 facsimile

-----Original Message-----

**From:** [admin@ameristarjet.com](mailto:admin@ameristarjet.com) [<mailto:admin@ameristarjet.com>]  
**Sent:** Wednesday, February 15, 2017 6:03 PM  
**To:** info  
**Subject:** General Contact Form Nick Keller  
**Importance:** High

Following is a general inquiry from the Ameristar web site

**Name:** Nick Keller

**Title:** Assistant Director

**Company:** Yeager Airport

**Address:** 100 Airport Road  
Suite 175

Ameristar Air Cargo, Inc. (continued)

City, State, Zip: Charleston, WV 25311

Phone: 304-561-5481

Fax:

E-mail Address: [nick@veagerairport.com](mailto:nick@veagerairport.com)

Comments:

Hello,

I am the assistant director of Yeager Airport (CRW) in Charleston, WV. Your jets frequently fly into our airport for cargo flights. We are currently updating our master plan and looking at a runway extension. I was told you have weight restrictions for the DC-9 due to our runway length. Will you please have contact me who can detail those restrictions? Thanks

Ameristar Air Cargo, Inc. (continued)

**Lisa M. Schafer**

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**To:** Lisa M. Schafer  
**Subject:** RE: CRW - Runway Length

**From:** Stacy Muth [<mailto:SMuth@AmeristarJet.com>]  
**Sent:** Tuesday, March 14, 2017 11:00 AM  
**To:** Andrew Benoit <[abenoit@landrum-brown.com](mailto:abenoit@landrum-brown.com)>  
**Cc:** Michelle Gallo <[mgallo@landrum-brown.com](mailto:mgallo@landrum-brown.com)>; Monica Geygan <[mgeygan@landrum-brown.com](mailto:mgeygan@landrum-brown.com)>; Matt Lee <[mlee@landrum-brown.com](mailto:mlee@landrum-brown.com)>  
**Subject:** RE: CRW - Runway Length

Mr. Benoit,

We have no way to answer the first question. If wx doesn't permit, we just operate to a different airport. As we are on-demand, it's not possible to even estimate the number of opportunities to use CRW. In the last 12 months, we landed one Falcon 20 there and picked up from CRW seven times.

We are operating -15 DC-9s.

Stacy

Stacy L. Muth  
Vice President  
Ameristar Jet Charter, Inc.  
Ameristar Air Cargo, Inc.  
(972) 725-9009 direct  
(972) 725-9039 facsimile

---

**From:** Andrew Benoit [<mailto:abenoit@landrum-brown.com>]  
**Sent:** Tuesday, March 14, 2017 8:49 AM  
**To:** Stacy Muth  
**Cc:** Michelle Gallo; Monica Geygan; Matt Lee  
**Subject:** FW: CRW - Runway Length

Ms. Muth,

Please see email below. Landrum & Brown is currently trying to document any issues related to **Runway Length at CRW Airport** and we would greatly appreciate your feedback on the following questions, listed below. If you could respond to the questions below by the end of the week, it would definitely help our efforts on the current RSA/Runway Length study we are conducting.

Thank you!

**Andrew Benoit | Landrum & Brown**  
11279 Cornell Park Drive Cincinnati, OH 45242

Ameristar Air Cargo, Inc. (continued)

P: 513.530.1246 | F: 513.530.2240 | C: 513.310.7059

**From:** Andrew Benoit

**Sent:** Friday, March 3, 2017 4:07 PM

**To:** [SMuth@AmeristarJet.com](mailto:SMuth@AmeristarJet.com)

**Cc:** Monica Geygan <[mgeygan@landrum-brown.com](mailto:mgeygan@landrum-brown.com)>; Michelle Gallo <[mgallo@landrum-brown.com](mailto:mgallo@landrum-brown.com)>; Matt Lee <[mlee@landrum-brown.com](mailto:mlee@landrum-brown.com)>; Lisa M. Schafer <[lschafer@landrum-brown.com](mailto:lschafer@landrum-brown.com)>; [nick@yeagerairport.com](mailto:nick@yeagerairport.com)

**Subject:** CRW - Runway Length

Ms. Muth,

My name is Andrew Benoit and I work for Landrum & Brown, an aviation consultancy firm. We are currently working with CRWVAA Staff on an RSA/Runway Length Analysis to address the reduced runway lengths at CRW due to the slope failure in 2015. You had some communications with Nick Keller last month and we had some follow up questions regarding runway length needs and other requirements of your operation at CRW as it stands today. Below is a list of questions we have prepared to help us gain some insight into your current operations at CRW. We would appreciate if you could provide feedback as soon as possible.

- According to your email correspondence with Nick Keller, you indicated that the DC-9 loses 10,000 pounds of capacity during contaminated runway conditions. How frequently are you seeing this occur at CRW?
- Can you also tell us what model of the DC-9 is being operated at CRW (the -15, -15F, -21, -32, -33F, -41, or -51)? We need this information in order to conduct the FAA required takeoff runway length analysis for the Airport.

You can respond to these questions via email or you can call me at 513.530.1246

Thank you in advance for your cooperation.

**Andrew Benoit | Landrum & Brown**

11279 Cornell Park Drive Cincinnati, OH 45242

P: 513.530.1246 | F: 513.530.2240 | C: 513.310.7059



## Charters

### **Lisa M. Schafer**

---

**To:** Michelle Gallo  
**Subject:** RE: Charters 2014 to Date

**From:** Nick Keller [<mailto:Nick@yeagerairport.com>]  
**Sent:** Wednesday, January 18, 2017 10:18 AM  
**To:** Matt Lee <[mlee@landrum-brown.com](mailto:mlee@landrum-brown.com)>; Monica Geygan <[mgevgan@landrum-brown.com](mailto:mgevgan@landrum-brown.com)>; Michelle Gallo <[mgallo@landrum-brown.com](mailto:mgallo@landrum-brown.com)>  
**Cc:** Terry Sayre <[t\\_sayre@yeagerairport.com](mailto:t_sayre@yeagerairport.com)>; Kevin Price <[kevin@yeagerairport.com](mailto:kevin@yeagerairport.com)>  
**Subject:** FW: Charters 2014 to Date

Here is the data for charters. As you can see the number of charters has declined considerably compared to 2014. Miami Air operated after the failure but has now notified us they will not due to landing distance available.

**Nick Keller** | Assistant Airport Director

Central West Virginia Regional Airport Authority  
100 Airport Rd. Suite 175, Charleston, WV 25311  
W: 304.344.8033 F: 304.344.8034



---

**From:** Travis Ryan  
**Sent:** Thursday, December 8, 2016 10:57 AM  
**To:** Nick Keller <[Nick@yeagerairport.com](mailto:Nick@yeagerairport.com)>  
**Subject:** Charters 2014 to Date

I went back to 2014 on this one so this is a good three-year snapshot.

Travis

---

**From:** Travis Ryan  
**Sent:** Thursday, December 08, 2016 10:07 AM  
**To:** Nick Keller <[Nick@yeagerairport.com](mailto:Nick@yeagerairport.com)>  
**Subject:** Charters Since March 2015

Nick this is the charters since the slope failure not counting the canceled ones.

Charters (continued)

CRW Charters 2014 to Current

Operating Dates		Carrier	A/C Type	
12/31/2013	1/2/2014	Republic	E-190	Gambling
2/22/2014	2/24/2014	Republic	E-190	Gambling
3/27/2014	3/30/2014	Express-Jet	E-145	Baseball
4/4/2014	4/6/2014	Republic	E-190	Gambling
6/14/2014	6/16/2014	Republic	E-190	Gambling
6/18/2014	No Return	Republic	E-175	Diversion-AA
7/19/2014	7/22/2014	Republic	E-190	Gambling
8/30/2014	9/1/2014	Republic	E-190	Gambling
10/11/2014	10/13/2014	Republic	E-190	Gambling
10/24/2014	No Return	JetBlue	A320	Football
11/12/2014	11/15/2014	Republic	E-190	Gambling
12/5/2014	No Return	Allegiant	757	Football/Band
12/5/2014	No Return	Xtra Airways	737-400	Football
12/13/2014	12/15/2014	Republic	E-190	Gambling
1/13/2015	No Return	USA Jet	DC-9-15	Cargo
2/16/2015	No Return	SouthWest	737-700	Disney on ice
3/21/2015	3/23/2015	Republic	E-190	Gambling
6/5/2015	6/7/2015	Republic	E-190	Gambling
8/27/2015	8/29/2015	Republic	E-190	Gambling
9/5/2015	No Return	Miami Air	737-800	Football
9/5/2015	No Return	Miami Air	737-800	Football
10/25/2015	No Return	SouthWest	737-700	Football
2/22/2016	No Return	Miami Air	737-800	Disney on ice
8/25/2016	8/28/2016	Sun Country	737-700	Gambling
10/12/2016	10/15/2016	Xtra Airways	737-400	Gambling
11/16/2016	11/19/2016	Xtra Airways	737-400	Gambling

Delta

**Nick Keller**

---

**From:** Dan Cohn <Dan@aviationplanning.com>  
**Sent:** Friday, December 2, 2016 2:01 PM  
**To:** Nick Keller; Michael Plante  
**Subject:** FW: CRW question

Nick, below is the email from Delta.

Dan

---

**From:** Bowen, Carolyn [mailto:Carolyn.Bowen@delta.com]  
**Sent:** Friday, December 02, 2016 10:27 AM  
**To:** Dan Cohn; Grisham, Murphy  
**Subject:** RE: CRW question

Hi Dan,

From a Network Scheduling perspective, you are correct, the 737-700 is the largest aircraft Delta can schedule.

I'm not aware of weight penalties, but will see if I can find an answer for you.

Brgds,

Carolyn

---

**From:** Dan Cohn [mailto:Dan@aviationplanning.com]  
**Sent:** Friday, December 02, 2016 11:23 AM  
**To:** Grisham, Murphy; Bowen, Carolyn  
**Subject:** CRW question

Murphy/Carolyn,

I'm not sure you are the correct contact for this type of question, but it is somewhat time sensitive so thought I'd start with you and if you are not the correct contact perhaps you can point me in the right direction.

CRW is currently working with the FAA to allow them to change the runway displaced threshold distance in order to give them 6,001 feet for take-off. The FAA requires them to show that they are being negatively impacted by the current set up. Can you confirm that there is still an aircraft curfew limiting the largest aircraft Delta can use to a 737-700. Also, were there any weight penalties for landing or takeoff with the A319, 717, CR7, or CR9?

Thanks very much for your help. Any guidance you could give would be very much appreciated!

Thanks,  
Dan

Dan Cohn

Delta (continued)



**John E. Laughter**  
Senior Vice President  
Corporate Safety,  
Security and Compliance

**Delta Air Lines, Inc.**  
P.O. Box 20706  
Atlanta, Georgia 30320  
T. +1 404.714.0126  
F. +1 404.715.2680  
John.E.Laughter@delta.com

October 10, 2016

Terry Sayre  
100 Airport Rd  
Suite 175  
Charleston, WV 25311

Dear Terry Sayre:

With the winter season fast approaching us, Delta Air Lines is conducting our annual review of our northern tier airports. As part of this process, we want to ensure that your airport meets Delta's stringent requirements for winter flight operations. Winter operations on a contaminated runway increase the risk of a runway excursion event. This risk may be due to a large increase in required stopping distances and/or potential degradation of aircraft directional control, especially in crosswind conditions. Accurate measurement and reporting of runway friction coefficient readings and taxiway condition reports are an important factor in safe operations of large jet aircraft.

Delta Air Lines and its Delta Connection Carriers use a matrix to evaluate an airport's risk for a runway excursion during winter conditions. Some of the criteria used include: runway length, airport elevation, annual snowfall amount, airport history of events, airport friction measuring equipment, etc. The result is that your airport has been designated as a "Special Winter Operations Airport". Delta Air Lines requires timely and accurate field condition reports on the runways, taxiways, and ramps. Specifically, the following conditions must be met in order to operate at your airport when snow, ice, or slush exists on the runway of intended takeoff or landing, or if snow/freezing precipitation is falling and accumulating on the runway.

- A Runway Condition Code (RwyCC) determined by the Runway Condition Assessment Matrix (RCAM) for each 1/3 of the runway less than 1 hour old is required, but should be updated more frequently if weather conditions dictate, e.g. moderate or heavy snow. The measurements of type and depth of contamination should be taken on each 1/3 of the runway surface; averaging is not acceptable.
- Cleared and treated runway to the conditions outlined in the FAA AC 150/5200-30D (e.g. Snow, ice, and slush should be removed as expeditiously as possible to maintain runways, high speed turnoffs, and taxiways in a "no worse than wet" condition.)
- Additional restrictions as appropriate to aircraft type may apply.

When winter conditions exist, be aware that Delta and Delta Connection dispatchers and pilots will be extra vigilant in asking the airport and the station manager for updated FICON and runway friction test data.

Delta Air Lines and its Delta Connection carriers desire to operate our aircraft at the highest possible level of safety. We want to create a partnership between airport operators and Delta station personnel and would appreciate your support and continued attention to this matter. By acceptance of this letter, your support and compliance to its requirements are assumed. If you have any questions, please feel free to contact me at 404-714-0126 or Bill Klein, Director Flight Safety at 404-715-0338. Thank you for your continued cooperation.

Sincerely,

A handwritten signature in black ink that reads "Laughter".

John E. Laughter  
Sr. Vice President  
Corporate Safety, Security, and Compliance

Cc: Captain Steve Dickson, Sr. Vice President – Flight Operations  
David Holtz, Vice President – Operations Control  
Bill Lentsch, Sr. Vice President – Airport Customer Service  
Erik Snell, Vice President – Delta Connection  
Captain Bill Klein, Director – Flight Safety

Delta (continued)

**Nick Keller**

---

**From:** Bowen, Carolyn <Carolyn.Bowen@delta.com>  
**Sent:** Thursday, November 10, 2016 8:22 AM  
**To:** Hanson, Peter J; Finnvik, Stephanie K; Nick Keller  
**Cc:** Taylor, Clyde; Randall, Tom; Hill, Christopher W; Fowler, Wil; Christiansen, Tyler L  
**Subject:** RE: CRW Operations [Runway distance/aircraft restrictions]

Thanks for the information. I am copying in Nick Keller from CRW to coordinate.

Brgds,  
Carolyn

---

**From:** Hanson, Peter J  
**Sent:** Thursday, November 10, 2016 6:36 AM  
**To:** Finnvik, Stephanie K; Bowen, Carolyn  
**Cc:** Taylor, Clyde; Randall, Tom; Hill, Christopher W; Fowler, Wil; Christiansen, Tyler L  
**Subject:** RE: CRW Operations [Runway distance/aircraft restrictions]

For DC I currently only see CRJ200's at CRW which are not landing weight limited with the current distances. CRJ200 departure weights are limited below MTOW.

Thanks

Peter Hanson

Peter Hanson | Technical Specialist - Delta Connection | Delta Air Lines | 404-677-7930 (o) | 470-755-2860 (c) | [peter.hanson@delta.com](mailto:peter.hanson@delta.com)

---

**From:** Finnvik, Stephanie K  
**Sent:** Wednesday, November 09, 2016 4:32 PM  
**To:** Bowen, Carolyn  
**Cc:** Taylor, Clyde; Randall, Tom; Hill, Christopher W; Fowler, Wil; Hanson, Peter J  
**Subject:** RE: CRW Operations [Runway distance/aircraft restrictions]

Hi Carolyn,

We are currently operating the 737-7 on Mainline and there are no weight restrictions with the current distances. Though an LDA extension does not change any weight restrictions, any extension to the declared distance is always a benefit nonetheless.

I have looped in Peter Hanson to provide any feedback from Delta Connection.

Regards,  
Stephanie

Stephanie Finnvik  
Engineer – Performance Engineering  
Delta Air Lines

Delta (continued)

**Lisa M. Schafer**

---

**From:** Nick Keller <Nick@yeagerairport.com>  
**Sent:** Monday, May 1, 2017 4:33 PM  
**To:** Terry Sayre; Matt Lee; Michelle Gallo; Monica Geygan  
**Subject:** Fwd: SWOA designation

Some more info below  
Sent from my iPhone

Nick Keller  
Assistant Airport Director  
Yeager Airport  
100 Airport Road  
Suite 175  
Charleston, WV 25311  
(304) 344-8033

Begin forwarded message:

**From:** Kevin Price <kevin@yeagerairport.com>  
**Date:** May 1, 2017 at 1:26:59 PM EDT  
**To:** Nick Keller <Nick@yeagerairport.com>  
**Subject:** FW: SWOA designation

Nick  
Check this out when you get a minute this answers some of our questions with Delta.

Thanks

**Kevin Price** | Operations Manager

Central West Virginia Regional Airport Authority  
100 Airport Rd. Suite 175, Charleston, WV 25311  
W: 304.344.8033 F: 304.344.8034



---

**From:** Renee [mailto:Reneelinbb1@aol.com]  
**Sent:** Saturday, April 29, 2017 12:29 PM  
**To:** Kevin Price <kevin@yeagerairport.com>  
**Subject:** SWOA designation

Delta (continued)

Hello Mr. Price,  
 I am sending a photo taken of the SWOA designation point system Delta has created. Any airport receiving 4 points or more--points earned for elevation, weather ops, incidents, lack of guidance or lighting, etc.--has a SWOA designation. CRW squeaked in at only 4 points, one due to your elevation and three for runway length according to my paperwork. Some fields are as high as 12!  
 I hope this alleviates any concern you have of my visit; merely a meet and greet at fields with weather ops, and I am passing along all the data you provided me to Delta.  
 Thank you,  
 Renee Bowman  
 952-212-8258

Total Control Panel

[Login](#)

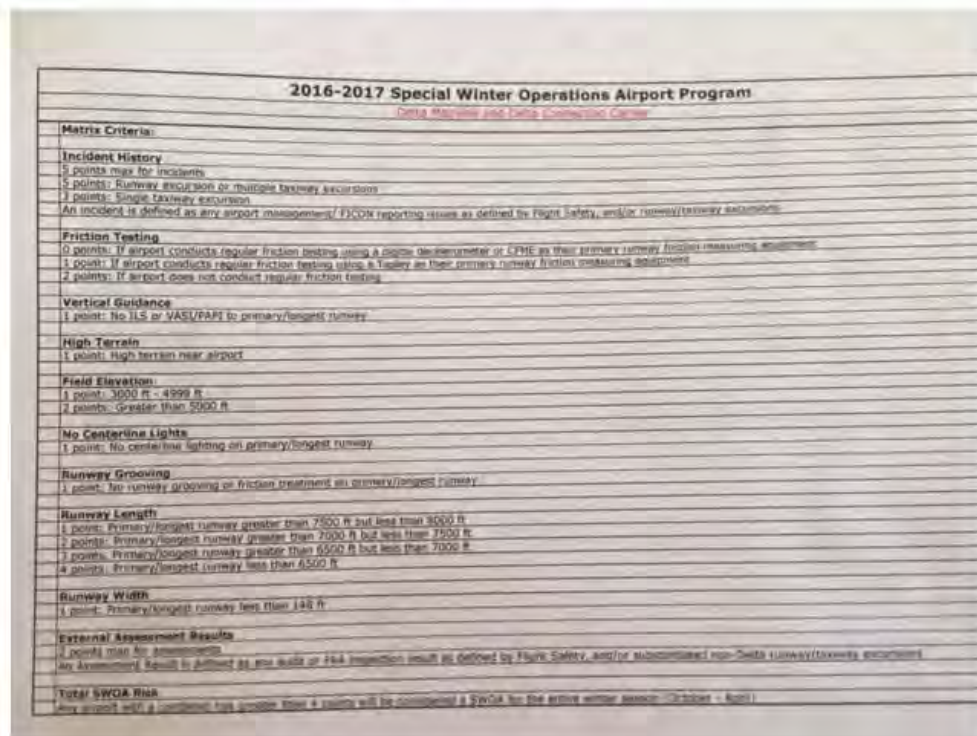
To: [kevin@yeagerairport.com](mailto:kevin@yeagerairport.com)  
 From: [reneelinbb1@aol.com](mailto:reneelinbb1@aol.com)

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Delta (continued)

**Lisa M. Schafer**

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**From:** Nick Keller <Nick@yeagerairport.com>  
**Sent:** Wednesday, January 25, 2017 12:01 PM  
**To:** Monica Geygan; Michelle Gallo; Matt Lee; Terry Sayre; Nate Koepsel; Kevin Price  
**Subject:** Fwd: Aircraft Penalty Log

I think this is great. ATL is removing passengers at least 1-2 times per week plus more in the summer. We're talking over 100 operations since the threshold move.

Sent from my iPhone

Nick Keller  
Assistant Airport Director  
Yeager Airport  
100 Airport Road  
Suite 175  
Charleston, WV 25311  
(304) 344-8033

Begin forwarded message:

**From:** "Casto, Eva G" <[eva.casto@delta.com](mailto:eva.casto@delta.com)>  
**Date:** January 25, 2017 at 11:48:58 AM EST  
**To:** "[nick@yeagerairport.com](mailto:nick@yeagerairport.com)" <[nick@yeagerairport.com](mailto:nick@yeagerairport.com)>  
**Cc:** "Madden, Lisa" <[Lisa.Madden@delta.com](mailto:Lisa.Madden@delta.com)>, "Mullins, Terry L" <[terry.mullins@delta.com](mailto:terry.mullins@delta.com)>, "Paul, Dustin L" <[dustin.paul@delta.com](mailto:dustin.paul@delta.com)>, "McVey, Stacy" <[stacy.mcvev@delta.com](mailto:stacy.mcvev@delta.com)>  
**Subject:** Aircraft Penalty Log

Nick

I wanted to clarify when I mention weight and balance on a flight it means that we are not able to take all passengers and or bags.. Our policy is that if we remove the passenger we also remove their bag.

With the information that was given to you earlier I would like to add that was only flights that had actually taken a delay.. There are times that we might not be able to take the full passenger load and we know prior to and have been able to move passengers to another flight before the time of the original departure.

Delta will usually have a flight at least 1 or 2 times a week that might fall in a weight in balance .... This happens more often as the weather gets hotter for the flights going to Atlanta. In the



Delta (continued)

summer time it is not unusual for this to happen several times a week.

United.... Commut Air at least 3 times a week will not be able to take full passenger load....  
Express Jet has same issue in warmer months for flights going to Houston...

I hope that this information has helped and we will be keeping a better log daily so that we have  
a more accurate count for any and all flights that may have any issues.

Eva Casto

Performance Supervisor CRW

DAL Global Services

Delta (continued)

**Lisa M. Schafer**

---

**From:** Hanson, Peter J <peter.hanson@delta.com>  
**Sent:** Tuesday, March 7, 2017 2:17 PM  
**To:** Andrew Benoit  
**Cc:** Cox, Damon A; Christiansen, Tyler L; Marcoux, James; Boss, Patricia; Cox, Jonathan; Hanson, Peter J  
**Subject:** RE: CRW - Runway Length

Andrew,

Below are a few performance related comments in red concerning the noted aircraft types operating out of CRW (notes do not apply to other than noted aircraft type). These comments only address payload performance. Also I have included James Marcoux on this e-mail from the DL Network department. He will have to answer any questions concerning aircraft scheduling etc.

Thanks

Peter Hanson

Peter Hanson | Technical Specialist - Delta Connection | Delta Air Lines | 404-677-7930 (o) | 470-755-2860 (c) | [peter.hanson@delta.com](mailto:peter.hanson@delta.com)

---

**From:** Andrew Benoit [<mailto:abenoit@landrum-brown.com>]  
**Sent:** Friday, March 03, 2017 3:10 PM  
**To:** Hanson, Peter J  
**Cc:** Monica Geygan; Michelle Gallo; Matt Lee; Lisa M. Schafer; [nick@yeagerairport.com](mailto:nick@yeagerairport.com)  
**Subject:** CRW - Runway Length

Mr. Hanson,

My name is Andrew Benoit and I work for Landrum & Brown, an aviation consultancy firm. We are currently working with CRWVAA Staff on an RSA/Runway Length Analysis to address the reduced runway lengths at CRW due to the slope failure in 2015. You had some communications with Nick Keller in 2016 and we had some follow up questions regarding runway length needs and other requirements of your operation at CRW as it stands today. Below is a list of questions we have prepared to help us gain some insight into your current operations at CRW. We would appreciate if you could provide feedback as soon as possible.

- Your email of November 10, 2016 indicated that the CRJ200 is departure weight limited when below MTOW. Can you please tell us if you have to restrict the number of passengers or cargo on the aircraft when departing to ATL? If so, how often does this occur and what is the penalty (in terms of number of passengers or amount of cargo)?  
*I would not expect routine passenger restrictions on CRW-ATL with a CRJ-200, but adverse or extreme Wx conditions may drive periodic restrictions. I would expect CRW arrival restrictions to be more prevalent than CRW departure restrictions (to and from ATL) due to the 5/23 landing distances.*
- We also see that you operate the CRJ900 to ATL during the winter months. Do you take any weight penalties on this aircraft? If so, generally how often and what is the penalty? Do you not use this aircraft in the summer due

Delta (continued)

to weight penalties? Can you also tell us what the typical takeoff weight is for this aircraft when flying to ATL from CRW with a full passenger load?

The most significant payload risk for a CRJ-900 would be driven by landing weight limitations on 5/23 for flights into CRW (as noted above for the CRJ-200). These limitations could be very significant. For CRW departures to ATL I would not expect routine passenger restrictions except as noted above. For CRW departures to ATL with a max payload, a takeoff weight in the range of 75-78 Klb could be expected.

You can respond to these questions via email or you can call me at 513.530.1246

Thank you in advance for your cooperation.

**Andrew Benoit | Landrum & Brown**

11279 Cornell Park Drive Cincinnati, OH 45242  
P: 513.530.1246 | F: 513.530.2240 | C: 513.310.7059

Executive Air- FBO



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November 18, 2016

Mr. Terry Sayer  
Director  
100 Eagle Mountain Road  
Yeager Airport  
Charleston, West Virginia 25311

Dear Mr. Sayer

As the operator of the Fixed Based Operation at Yeager Airport we frequently receive feedback from pilots on the insufficient landing and/or takeoff distance available for jet aircraft. Due in part to the shortened runway length which occurred with the declared distance change in 2015 some of these aircraft cannot take the fuel required for their destination due to performance issues and therefore must make a fuel stop ordinarily not required. Aircraft are also excluding Yeager as their alternate as well.

We have reviewed the proposed short-term change to declared distances and fully support the proposal. In the long-term, we believe a rebuild of the safety area and runway extension may be necessary. In the interim, providing additional landing distance available will immediately reduce operational impacts on our customers who operate general aviation jet aircraft.

Thank you for your consideration.

Sincerely,

A handwritten signature in blue ink that reads "Scott Miller".

Scott Miller  
President

Telephone 304/343-8818 • Fax 304/343-8828

GA Operator-Joe Cooke

**Nick Keller**

---

**From:** N31LJ <n31lj@aol.com>  
**Sent:** Monday, October 24, 2016 5:43 PM  
**To:** Nick Keller  
**Subject:** Re: RSA

Hello Nick, That will make a significant improvement in aircraft operations. Sometimes it only takes a few more feet. That would let the jets with higher landing speeds operate within the required FAA margins. It would still impact operations during contamination periods but a significant improvement. Thanks for continuing to improve runway distance. Joe

-----Original Message-----

From: Nick Keller <Nick@yeagerairport.com>  
To: n31lj <n31lj@aol.com>  
Sent: Mon, Oct 24, 2016 5:25 pm  
Subject: FW: RSA

Joe,

Thanks for your very detailed description of the operational impacts you currently face. If the Airport is successful in getting approval from the FAA to change the landing distance available to 6,001 on Rwy 5 and 6,079 on Rwy 23 can you tell me how this may improve your operations?

We can definitely use the other information in our master plan update that will determine our runway length and extension possibilities. We hope the displaced threshold move and LDA change can bring about at least some relief for operations in the short-term. Thanks.

**Nick Keller** | Assistant Airport Director

Central West Virginia Regional Airport Authority  
100 Airport Rd. Suite 175, Charleston, WV 25311  
W: 304.344.8033 F: 304.344.8034



**From:** Plante & Associates [<mailto:mike@planteandassociates.com>]  
**Sent:** Thursday, October 20, 2016 9:54 AM  
**To:** Nick Keller <[Nick@yeagerairport.com](mailto:Nick@yeagerairport.com)>; Terry Sayre <[t\\_sayre@yeagerairport.com](mailto:t_sayre@yeagerairport.com)>  
**Subject:** Fwd: RSA

Sent from my iPhone

Begin forwarded message:

GA Operator-Joe Cooke (continued)

**From:** N31LJ <n31lj@aol.com>  
**Date:** October 19, 2016 at 6:23:15 PM EDT  
**To:** [mike@planteandassociates.com](mailto:mike@planteandassociates.com)  
**Subject:** Re: RSA

Gentleman, I am responding to a query from Mr Mike Plante in regards to runway operations by high performance jet aircraft. Presently the status of Runway two three is 6302 runway available for accelerate and stop. This will suffice for standard aircraft operations at low gross take off weights. The landing distance is 5802 on Runway 23. This too is sufficient for low weight landings. The problem is these numbers are for Part 91 operations on a dry runway. We are at this time in the process of selling our aircraft due in part to runway length. We cannot fully fuel the Bombardier Learjet 60 and fly to maximum range from Yeager Airport. That requires at temperatures in the high seventy's and eighty's six thousand eight hundred to seven thousand feet.

The landing requirement is about three thousand seven hundred on a normal day and minimum landing weight. The bigger problem occurs when we have a contaminated runway. Any contamination liquid or solid frozen requires a re computation. The value on this aircraft is a landing distance of five thousand eight hundred feet. That is the exact number of a runway 23 operation. You would have to be perfect each landing. The runway available on runway 5 is insufficient for operations.

The point is not our aircraft. It is commercial operations at Yeager. Part 135 and 121 rules are more restrictive . They require operations within sixty percent of available runway. Takeoff runway would require it to be accomplished within 3781 feet. Landing within 3481 feet. This makes a commercial operation with this jet impossible unless you take off with minimum and go to Huntington or Beckley. I am sure the RJ aircraft seating more then fifty passengers operations would be prohibitive . I can not speak for specific airline operations, but I can for business jet operations. The original distance with the EMASS was sufficient but it was just a number. The Pilot must realize that after decision speed a stop would likely result in a damaged (best case) or destroyed aircraft. The EMASS is designed to stop and aircraft not necessarily with zero damage. I know I am not allowed a vote but any Aviator will tell you( REAL RUNWAY) is better then a mechanical or physical barrier. The later case is a taxi or walk back to the terminal. I understand your problems presently. If a runway extension is possible I believe the airlines and corporate operations will be better served with the increased safety at Yeager Airport.

Respectfully Joe E Cooke  
Chief Pilot Segal law

-----Original Message-----

**From:** Michael Plante <[mike@planteandassociates.com](mailto:mike@planteandassociates.com)>  
**To:** Joey Cook <[n31lj@aol.com](mailto:n31lj@aol.com)>  
**Sent:** Wed, Oct 19, 2016 10:44 am  
**Subject:** RSA

Joey,

Can you put together some thoughts on how the current configuration of the airport negatively effects operations for commercial pilots/aircraft?

Many Thanks,

Mike

Michael Plante  
[mike@planteandassociates.com](mailto:mike@planteandassociates.com)

GA Operator-Joe Cooke (continued)

**Lisa M. Schafer**

**To:** Nick Keller  
**Subject:** RE: Runway

**From:** N31LJ [mailto:n31lj@aol.com]  
**Sent:** Saturday, January 21, 2017 8:20 AM  
**To:** Nick Keller <Nick@yeagerairport.com>  
**Subject:** Fwd: Runway

[Nick@yeagerairport.com](mailto:Nick@yeagerairport.com)

-----Original Message-----

From: N31LJ <n31lj@aol.com>  
To: n31lj <n31lj@aol.com>  
Sent: Sat, Jan 21, 2017 8:19 am  
Subject: Re: Runway

Nick, I looked at the data and it was in excess of 15 times. Because of the inability to use the aircraft it was recently sold. The runway length especially landing in contaminated conditions made it impossible to comply with FAR requirements and Manufacturers published data. We are in the process of acquiring a smaller aircraft that can utilize the existing runway. We liked the aircraft but, it became unfeasible to use it at Charleston under present conditions. I was told that if conditions change in the future a large aircraft again will be acquired. You can verify this with Bill. Thanks for your continued efforts Nick. Any help I can provide I will be happy to assist. Joe

-----Original Message-----

From: N31LJ <n31lj@aol.com>  
To: Nick Keller <Nick@yeagerairport.com>  
Sent: Wed, Jan 18, 2017 2:16 pm  
Subject: Re: Runway

I will check and get that information for you Nick. Joe

Sent from my iPad

On Jan 18, 2017, at 09:27, Nick Keller <Nick@yeagerairport.com> wrote:

Joe,

The Airport has engaged Landrum & Brown to complete an interim Runway Safety Area determination and a Master Plan update. As part of the process the FAA is requesting the number of affected/missed operations caused by the current runway length. Will you please provide us the number of times your operations have been affected since July 2015? Thanks

**Nick Keller** | Assistant Airport Director

Central West Virginia Regional Airport Authority  
100 Airport Rd. Suite 175, Charleston, WV 25311  
W: 304.344.8033 F: 304.344.8034

<image001.png>

JetBlue



Date: Thursday, August 25, 2016

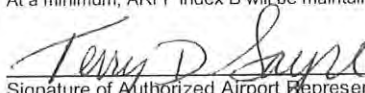
Attn: Airport Manager/Director  
 Airport: CRW - Yeager Airport, Charleston, West Virginia, USA


JetBlue Airways is planning to operate an A320 passenger aircraft into your airport for a collegiate football team charter pursuant to the following schedule:

10/14/16	Friday	9501	A320	0	Ferry	JFK	09:27	PBI	11:42	2:25	Eastern	Eastern	0.00	Florida Atlantic University
10/14/16	Friday	9502	A320	1	Live	FBI	12:45	CRW	16:00	2:25	Eastern	Eastern	0.00	Florida Atlantic University
10/14/16	Friday	9502	A320	0	Ferry	CRW	17:15	HIS	18:15	1:00	Eastern	Eastern	0.00	Florida Atlantic University
10/15/16	Saturday	9501	A320	1	Live	HIS	20:00	PBI	22:30	2:50	Eastern	Eastern	0.00	Florida Atlantic University
10/15/16	Saturday	9504	A320	0	Ferry	PBI	23:45	MCO	00:45	1:00	Eastern	Eastern	0.00	Florida Atlantic University

**Kindly confirm the following:**

- Prior Permission Requirement (PPR) has been satisfied and permission is granted to operate charters in and out of the airport facility pursuant to the proposed schedule herein as well as any revisions thereto. PPR# is: NA (Enter "GRANTED" in lieu of a number if your airport does not issue PPR numbers or "NA" if a PPR is NOT required).
- All runways with minimum dimensions of 6,000ft x 148ft length and width are capable of supporting aircraft with dual wheel landing gear at a gross landing weight of 146,000 pounds; and a total gross aircraft weight of 173,000 pounds. A waiver to operate an A320 with a landing weight of up to 146,000 pounds and total gross aircraft weight of 173,000 pounds is hereby granted for all runways whereby the published load bearing capacity is below 173,000 pounds pursuant to the proposed schedule herein as well as any revisions thereto.
- At a minimum, ARFF index B will be maintained at all times during charter operations.

  
 Signature of Authorized Airport Representative  
 Airport Director  
 Title

  
 Printed Name  
 8/29/16  
 Date

Please return this signed and completed form via email: [info@airplanning.com](mailto:info@airplanning.com) or via fax: 603-890-0033. We appreciate your assistance. If you have any questions contact Kassie Parker, Senior Account Executive, Air Planning, LLC at [Kparker@airplanning.com](mailto:Kparker@airplanning.com) or 603-685-2175.

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JetBlue (continued)

**From:** Kassie Parker  
**Sent:** Friday, October 21, 2016 2:04 PM  
**To:** 'travis@yeagerairport.com'  
**Cc:** Jason Thomas  
**Subject:** JetBlue charters

Good afternoon Travis,

JetBlue had intended to fly into your airport per the schedule below with the Florida Atlantic Football team. Unfortunately, due to your current runway restrictions we are unable to use your airport and have switched to HTS. We will be required to use HTS (even if a team requests your airport) until the runway is restored to its full length as 6,000 LDA is a required minimum for JetBlue's 200+ fleet of aircraft.

10/14/16	Friday	8502	A320	147	Live	PBI	14:45	CRW	17:00	2.25	Eastern	Eastern	0.00
10/14/16	Friday	9502	A320	0	Ferry	CRW	18:15	HTS	19:15	1.00	Eastern	Eastern	0.00
10/15/16	Saturday	8501	A320	147	Live	HTS	23:59	PBI	02:30	2.52	Eastern	Eastern	0.00

Thank you,

*Kassie Parker* Senior Account Executive

Miami Air

**Nick Keller**

---

**From:** Travis Ryan  
**Sent:** Thursday, November 17, 2016 2:08 PM  
**To:** Nick Keller  
**Subject:** FW: JetBlue charters

---

**From:** Kassie Parker [mailto:kparker@airplanning.com]  
**Sent:** Tuesday, November 01, 2016 12:38 PM  
**To:** Travis Ryan <travis@yeagerairport.com>  
**Subject:** RE: JetBlue charters

FYI we had another flight booked into your airport with Miami air that is now switching to HTS for the same reasons.

Thank you,

*Kassie Parker*

Air Planning, LLC

603-685-2175

---

**From:** Kassie Parker  
**Sent:** Friday, October 21, 2016 2:04 PM  
**To:** 'travis@yeagerairport.com'  
**Cc:** Jason Thomas  
**Subject:** JetBlue charters

Good afternoon Travis,

JetBlue had intended to fly into your airport per the schedule below with the Florida Atlantic Football team. Unfortunately, due to your current runway restrictions we are unable to use your airport and have switched to HTS. We will be required to use HTS (even if a team requests your airport) until the runway is restored to its full length as 6,000 LDA is a required minimum for JetBlue's 200+ fleet of aircraft.

10/14/16	Friday	8502	A320	147	Live	PBI	14:45	CRW	17:00	2:25	Eastern	Eastern	0.00	Florida
10/14/16	Friday	9502	A320	0	Ferry	CRW	18:15	HTS	19:15	1:00	Eastern	Eastern	0.00	Florida
10/15/16	Saturday	8501	A320	147	Live	HTS	23:59	PBI	02:30	2:52	Eastern	Eastern	0.00	Florida

Thank you,

*Kassie Parker Senior Account Executive*

Miami Air (continued)



*"a referral is the greatest compliment one can give"*

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*Aircraft Management • Consulting • Crew Services*

Charleston, West Virginia 25302  
pasaml@frontier.com

14 December 2016

Nathan Koepsel  
Badging and Training Office  
Central West Virginia Regional Airport Authority  
100 Airport Road Suite 175  
Charleston, WV 25311

Dear Mr. Koepsel:

Thank you for contacting me concerning your proposed changes to Runway 5 at Yeager Airport and asking for my comments. The proposed relocation of the displaced threshold which would increase the Runway 5 Landing Distance Available to 6,000 feet is a significant operational improvement.

I presently fly a Cessna Citation three with a 20,000 pound landing weight. Under certain conditions, such as high temperatures, contaminated runway, the current distance available reduces that weight limit to the point that planning short distance flight forces me limit passenger, bags, and/or buy fuel at out station airports instead of tankering fuel. Having been a pilot for Eastern Air Lines, I am certain that airlines, cargo carriers, and large corporate aircraft serving the Kanawha Valley region face the same issues in determining passenger and cargo loads bound for Charleston.

The proposed relocation of the threshold is a vital part of rehabbing Runway 5 and making it more usable for the airlines and corporate operators. It must be coupled with re-commissioning the Instrument Landing System Glide Path guidance and VASI system. Without these two other components, the benefit of the relocation will be lost in inclement weather and the Runway will remain primarily a Visual Approach runway.

Again, thank you for allowing me to convey my thoughts. If I can be of any further assistance, please ask.

Very Respectfully,

A. Mark Lowdermilk,  
President

CC: N. Daniels  
S. Miller

United

**Lisa M. Schafer**

**From:** Nick Keller <Nick@yeagerairport.com>  
**Sent:** Tuesday, February 7, 2017 3:56 PM  
**To:** Matt Lee; Monica Geygan; Michelle Gallo  
**Cc:** Nate Koepsel; Terry Sayre  
**Subject:** FW: Emailing: United Airline WB Report 2017  
**Attachments:** United Airline WB Report 2017.pdf

Delta Global Services was finally able to figure out how to quantify the weight and balance issues after Nate talked with the right person. As you can see there were 64 weight and balance affected operations since January 2016. Hope this helps.

Nick Keller | Assistant Airport Director

Central West Virginia Regional Airport Authority  
100 Airport Rd. Suite 175, Charleston, WV 25311  
W: 304.344.8033 F: 304.344.8034

-----Original Message-----

From: Kevin Price  
Sent: Tuesday, February 7, 2017 3:31 PM  
To: Nick Keller <Nick@yeagerairport.com>  
Cc: Nate Koepsel <nate@yeagerairport.com>  
Subject: Emailing: United Airline WB Report 2017

Nick  
Please find attached the report from United Airlines for W/B issues.

Thanks

Kevin Price | Operations Manager

Central West Virginia Regional Airport Authority  
100 Airport Rd. Suite 175, Charleston, WV 25311  
W: 304.344.8033 F: 304.344.8034

Your message is ready to be sent with the following file or link attachments:

United Airline WB Report 2017

United (continued)

UNITED AIRLINE ETC REPORT											
PAX NAME	ISSUE DATE	@	TRACK#	STN	AC	FLT#	FLT DATE	ORG	DST	ISSUE AMT	Reason/Remarks
z	1-Jan-16	I	15031800	CRW	UA	5011	1-Jan-16	CRW	IAD		Weight Restriction
	1-Jan-16	I	15031793	CRW	UA	5011	1-Jan-16	CRW	IAD		Weight Restriction
	21-Feb-16	R	15257089	CRW	UA	4076	21-Feb-16	CRW	IAH		OVS turned into Weight
	21-Feb-16	R	15257060	CRW	UA	4076	21-Feb-16	CRW	IAH		OVS turned into Weight
	25-Mar-16	I	15384201	CRW	UA	4946	25-Mar-16	CRW	IAD		Oversold flight - volunteer
	24-Mar-16	R	15381317	CRW	UA	4076	24-Mar-16	CRW	IAH		Rebooked on next flight
	4-Mar-16	R	15301126	CRW	UA	3999	4-Mar-16	CRW	ORD		Delayed
	4-Mar-16	V	15300913	CRW	UA	3999	4-Mar-16	CRW	ORD		Delayed
	17-Apr-16	I	15475585	CRW	UA	4003	17-Apr-16	CRW	ORD		Weight Balance Max 35 Passengers
	1-Apr-16	R	15415817	CRW	UA	4076	1-Apr-16	CRW	IAH		Weight Balance Max 42
	1-Apr-16	R	15415809	CRW	UA	4076	1-Apr-16	CRW	IAH		Weight Balance Max 42
	18-May-16	R	15592228	CRW	UA	3999	18-May-16	CRW	ORD		WEIGHT BALANCE DUE TO MUST RIDE & CARGO
	18-May-16	R	15592191	CRW	UA	3999	18-May-16	CRW	ORD		WEIGHT BALANCE DUE TO MUST RIDE & CARGO
	12-May-16	I	15570619	CRW	UA	3999	12-May-16	CRW	ORD		W/B Issues
	6-May-16	I	15549138	CRW	UA	3999	6-May-16	CRW	ORD		OVS
	6-May-16	I	15549164	CRW	UA	3999	6-May-16	CRW	ORD		OVS
	6-May-16	I	15548744	CRW	UA	3999	6-May-16	CRW	ORD		VOLUNTEER OVERSALE UA3999
	6-May-16	R	15549137	CRW	UA	3999	6-May-16	CRW	ORD		OVS
	24-Jun-16	I	15749674	CRW	UA	3999	24-Jun-16	CRW	ORD		OVS NO SPLIT
	24-Jun-16	I	15749670	CRW	UA	3999	24-Jun-16	CRW	ORD		OVS NO SPLIT
	22-Jun-16	I	15742500	CRW	UA	4076	22-Jun-16	CRW	IAH		Weight Restriction
	18-Jun-16	I	15721454	CRW	UA	4946	18-Jun-16	CRW	IAD		W/B 2 Passengers Removed
	18-Jun-16	I	15721450	CRW	UA	4946	18-Jun-16	CRW	IAD		W/B 2 Passengers Removed
	17-Jun-16	I	15715829	CRW	UA	3999	17-Jun-16	CRW	ORD		Weight Restriction
	17-Jun-16	I	15715884	CRW	UA	3999	17-Jun-16	CRW	ORD		Weight Restriction
	27-Sep-16	I	16214868	CRW	UA	4946	28-Sep-16	CRW	IAD		CANCELLED FLIGHT REISSUE TICKET
	26-Sep-16	I	16209185	CRW	UA	4946	26-Sep-16	CRW	IAD		OVS
	23-Sep-16	I	16198385	CRW	UA	4946	23-Sep-16	CRW	IAD		W/B
	16-Sep-16	I	16166090	CRW	UA	4946	16-Sep-16	CRW	IAD		W/B
	11-Sep-16	R	16138833	CRW	UA	3999	11-Sep-16	CRW	ORD		OVS
	13-Oct-16	I	16285228	CRW	UA	4076	13-Oct-16	CRW	IAH		W/B
	13-Oct-16	I	16285311	CRW	UA	4056	13-Oct-16	CRW	ORD		Oversold flight
	13-Oct-16	I	16285310	CRW	UA	4056	13-Oct-16	CRW	ORD		Oversold flight
	13-Oct-16	R	16264310	CRW	UA	4946	13-Oct-16	CRW	IAD		United 4946 oversold by 1.
	25-Nov-16	I	16484561	CRW	UA	3999	25-Nov-16	CRW	ORD		OVS
	22-Nov-16	I	16457580	CRW	UA	4076	22-Nov-16	CRW	IAH		WEIGHT AND BALANCE

United (continued)

UNITED AIRLINE ETC REPORT											
PAX NAME	ISSUE DATE	@	TRACK#	STN	AC	FLT#	FLT DATE	ORG	DST	ISSUE AMT	Reason/Remarks
	22-Nov-16	I	16457694	CRW	UA	4076	22-Nov-16	CRW	IAH		Weight Restricted
	22-Nov-16	I	16457695	CRW	UA	4076	22-Nov-16	CRW	IAH		Weight Restricted
	22-Nov-16	I	16457713	CRW	UA	4076	22-Nov-16	CRW	IAH		WEIGHT AND BALANCE
	22-Nov-16	I	16457631	CRW	UA	4076	22-Nov-16	CRW	IAH		WEIGHT AND BALANCE
	22-Nov-16	I	16457637	CRW	UA	4076	22-Nov-16	CRW	IAH		WEIGHT AND BALANCE
	22-Nov-16	P	16457593	CRW	UA	4076	22-Nov-16	CRW	IAH		Weight Restricted
	22-Nov-16	R	16457692	CRW	UA	4076	22-Nov-16	CRW	IAH		Weight Restricted
	22-Nov-16	R	16457717	CRW	UA	4076	22-Nov-16	CRW	IAH		WEIGHT AND BALANCE
	22-Nov-16	R	16457825	CRW	UA	4076	22-Nov-16	CRW	IAH		WEIGHT AND BALANCE
	22-Nov-16	R	16457832	CRW	UA	4076	22-Nov-16	CRW	IAH		Weight Restricted
	22-Nov-16	R	16457851	CRW	UA	4076	22-Nov-16	CRW	IAH		Weight Restricted
	22-Nov-16	R	16457546	CRW	UA	4076	22-Nov-16	CRW	IAH		WEIGHT AND BALANCE
	21-Nov-16	I	16450971	CRW	UA	4076	20-Nov-16	DCA	IAH		Weight and Balance
	20-Nov-16	I	16447424	CRW	UA	4076	20-Nov-16	CRW	IAH		Weight and Balance
	20-Nov-16	R	16447443	CRW	UA	4076	20-Nov-16	CRW	IAH		Weight and Balance
	19-Nov-16	I	16442701	CRW	UA	3999	19-Nov-16	CRW	ORD		Weight and Balance
	19-Nov-16	I	16443860	CRW	UA	4946	19-Nov-16	CRW	IAD		Weight and Balance
	4-Nov-16	I	16380525	CRW	UA	4946	4-Nov-16	CRW	IAD		weight and balance UA 4946
	4-Nov-16	I	16380499	CRW	UA	4946	4-Nov-16	CRW	IAD		Weight Balance
	29-Dec-16	I	16610450	CRW	UA	4929	29-Dec-16	CRW	IAD		WEIGHT AND BALANCE
	29-Dec-16	I	16610449	CRW	UA	4929	29-Dec-16	CRW	IAD		WEIGHT AND BALANCE
	29-Dec-16	I	16610443	CRW	UA	4929	29-Dec-16	CRW	IAD		WEIGHT AND BALANCE
	27-Dec-16	I	16596347	CRW	UA	4929	27-Dec-16	CRW	IAD		WEIGHT AND BALANCE SELECTED ON PAX BUT AERO PROCESSED BOTH PAX FORGOT TO SPLIT RECORD BEFORE PROCESS
	27-Dec-16	I	16596352	CRW	UA	4929	27-Dec-16	CRW	IAD		WEIGHT AND BALANCE SELECTED AND PROCESSED 1 PAX BUT AERO PROCESSED BOTH FORGOT TO SPLIT RECORD BEFORE PROCESSING
	26-Dec-16	I	16593060	CRW	UA	4929	26-Dec-16	CRW	IAD		WEIGHT AND BALANCE
	18-Dec-16	I	16556607	CRW	UA	4929	18-Dec-16	CRW	IAD		WEIGHT/BALANCE UA4929
	18-Dec-16	I	16556680	CRW	UA	4929	19-Dec-16	CRW	IAD		WEIGHT AND BALANCE THIS PAX WAS VDB
	15-Dec-16	I	16547389	CRW	UA	4929	16-Jan-17	CRW	IAD		Weight Balance
	14-Dec-16	I	16540268	CRW	UA	4929	14-Dec-16	CRW	IAD		WEIGHT AND BALANCE

United (continued)

UNITED AIRLINE ETC REPORT											
PAX NAME	ISSUE DATE	@	TRACK#	STN	AC	FLT#	FLT DATE	ORG	DST	ISSUE AMT	Reason/Remarks
	14-Dec-16	I	16540276	CRW	UA	4929	14-Dec-16	CRW	IAD		WEIGHT AND BALANCE
	13-Dec-16	R	16537610	CRW	UA	4946	13-Dec-16	CRW	IAD		WEIGHT AND BALANCE
	13-Dec-16	R	16537676	CRW	UA	4946	13-Dec-16	CRW	IAD		vol for oversell
	8-Dec-16	I	16520394	CRW	UA	4946	8-Dec-16	CRW	IAD		Volunteered for Weight Balance
	14-Jan-17	I	16698138	CRW	UA	4946	14-Jan-17	CRW	IAD		weight restricted volunteered
	14-Jan-17	I	16698112	CRW	UA	4946	14-Jan-17	CRW	IAD		flight weight restricted pax volunteered
	8-Jan-17	I	16662217	CRW	UA	4946	8-Jan-17	CRW	IAD		weight restricted volunteered
	8-Jan-17	I	16662222	CRW	UA	4946	8-Jan-17	CRW	IAD		flight weight restricted
	8-Jan-17	I	16662308	CRW	UA	4946	8-Jan-17	CRW	IAD		weight restricted
	8-Jan-17	R	16662229	CRW	UA	4946	8-Jan-17	CRW	IAD		flight weight restricted
	6-Jan-17	I	16655021	CRW	UA	4946	6-Jan-17	CRW	IAD		weight and balance
	6-Jan-17	I	16655020	CRW	UA	4946	6-Jan-17	CRW	IAD		weight and balance
	2-Jan-17	I	16628938	CRW	UA	4946	2-Jan-17	CRW	IAD		weight and balance
	2-Jan-17	I	16628913	CRW	UA	4946	2-Jan-17	CRW	IAD		weight and balance
	2-Jan-17	R	16628951	CRW	UA	4946	2-Jan-17	CRW	IAD		weight and balance
	2-Jan-17	R	16628924	CRW	UA	4946	2-Jan-17	CRW	IAD		weight and balance
	2-Jan-17	R	16628935	CRW	UA	4946	2-Jan-17	CRW	IAD		weight and balance

(64) M/B



United (continued)

**Lisa M. Schafer**

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**To:** Johns, William  
**Subject:** RE: Runway Length and RSA Proposal for Yeager Airport

**From:** Nick Keller [<mailto:Nick@yeagerairport.com>]  
**Sent:** Thursday, November 03, 2016 9:49 AM  
**To:** Johns, William  
**Cc:** Newland, David; Novkov, Ted; Kremer, Thomas; Kahn, Philip  
**Subject:** Re: CRW Operations

Thank you. We appreciate the response.

Sent from my iPhone

Nick Keller  
Assistant Airport Director  
Yeager Airport  
100 Airport Road  
Suite 175  
Charleston, WV 25311  
(304) 344-8033

On Nov 3, 2016, at 10:34 AM, Johns, William <[William.Johns@united.com](mailto:William.Johns@united.com)> wrote:

Hi Nick,

Due to the short runway length, we have planned held seats in place on CRW-IAH depending on the month and time of day. We use an extended-range E145 on the route, and we hold between 1 and 5 seats from April to August.

As far as contaminated surface issues, diversions, etc., I'll reach out to the ExpressJet Engineering team for operational details. They can also provide insight on if/how a 6,000 foot runway would ease these operational concerns.

Thanks—hope your week is going well,  
Will

USA Jet Airlines

**Lisa M. Schafer**

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**To:** Michelle Gallo  
**Subject:** RE: Flights into KCRW

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**From:** Nick Keller [<mailto:Nick@yeagerairport.com>]  
**Sent:** Thursday, February 16, 2017 12:14 PM  
**To:** Monica Geygan <[mgevgan@landrum-brown.com](mailto:mgevgan@landrum-brown.com)>; Michelle Gallo <[mgallo@landrum-brown.com](mailto:mgallo@landrum-brown.com)>; Matt Lee <[mlee@landrum-brown.com](mailto:mlee@landrum-brown.com)>  
**Cc:** Terry Sayre <[t\\_sayre@yeagerairport.com](mailto:t_sayre@yeagerairport.com)>; Nate Koepsel <[nate@yeagerairport.com](mailto:nate@yeagerairport.com)>  
**Subject:** FW: Flights into KCRW

More good info. These operations are in addition to the 21 the broker had mentioned earlier today.

**Nick Keller** | Assistant Airport Director

Central West Virginia Regional Airport Authority  
100 Airport Rd. Suite 175, Charleston, WV 25311  
W: 304.344.8033 F: 304.344.8034



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**From:** Nolan Short [<mailto:nshort@usajet.aero>]  
**Sent:** Thursday, February 16, 2017 10:44 AM  
**To:** Nick Keller <[Nick@yeagerairport.com](mailto:Nick@yeagerairport.com)>  
**Cc:** FlightFollowers <[flightfollowers@activeaero.com](mailto:flightfollowers@activeaero.com)>  
**Subject:** Flights into KCRW

Hi Nick,

It appears we have flown into KCRW a total of 27 times in the last 2 years. The bulk of these (67%) were flown in March of 2016. We are an on demand carrier and have no idea when or where we will be flying, so these numbers may or may not be indicative of what we will fly in the future.

As far as the runway length is concerned, I've compiled some data on how much extra freight we would be able to carry out of there if the usable runway was increased from 5700' to 6000'.

DC-9 10 Series	+1,700 lbs for Rwy 23	+800 lbs for Rwy 5
DC-9 30 Series	+2,200 lbs for Rwy 23	+1,000 lbs for Rwy 5
MD83	+2,900 lbs for Rwy 23	+3,000 lbs for Rwy 5
B-727	+3,270 lbs for Rwy 23	+3,480 lbs for Rwy 5

I hope this answers your questions,

USA Jet Airlines (continued)



Nolan Short | Flight Follower  
P: 734-547-8780 | F: 734-547-7258  
Willow Run Airport | 2068 E Street | Belleville, MI 48111

USA Jet Airlines (continued)

**Lisa M. Schafer**

**From:** Nolan Short <nshort@usajet.aero>  
**Sent:** Monday, March 6, 2017 8:58 AM  
**To:** Andrew Benoit  
**Cc:** Monica Geygan; Michelle Gallo; Matt Lee; Lisa M. Schafer; nick@yeagerairport.com  
**Subject:** RE: CRW - Runway Length

Good morning,

In the last year I've had 18 DC-9's, 5 DA-20's, and 3 727's into KCRW. I don't have any data on how much freight we've ever had to leave behind. Also, the allowable weights that I supplied were based on takeoff weight, not landing weight. Runway length will always have more of an effect on takeoff than on landing.

Please let me know if you have any more questions



Nolan Short | Flight Follower  
P: 734-547-8780 | F: 734-547-7258  
Willow Run Airport | 2068 E Street | Belleville, MI 48111

**From:** Andrew Benoit [mailto:abenoit@landrum-brown.com]  
**Sent:** Friday, March 03, 2017 4:06 PM  
**To:** Nolan Short <nshort@usajet.aero>  
**Cc:** Monica Geygan <mgeygan@landrum-brown.com>; Michelle Gallo <mgallo@landrum-brown.com>; Matt Lee <mlee@landrum-brown.com>; Lisa M. Schafer <lschafer@landrum-brown.com>; nick@yeagerairport.com  
**Subject:** CRW - Runway Length

Mr. Short,

My name is Andrew Benoit and I work for Landrum & Brown, an aviation consultancy firm. We are currently working with CRW/VAA Staff on an RSA/Runway Length Analysis to address the reduced runway lengths at CRW due to the slope failure in 2015. You had some communications with Nick Keller last month and we had some follow up questions regarding runway length needs and other requirements of your operation at CRW as it stands today. Below is a list of questions we have prepared to help us gain some insight into your current operations at CRW. We would appreciate if you could provide feedback as soon as possible.

- According to your email correspondence with Nick Keller, you indicated that you could increase the amount of freight if the landing distance increased to 6,000'. Can you tell us if you have had to restrict weights when flying into CRW.
- Is the takeoff distance sufficient or does that also lead to weight penalties? If you are taking weight penalties can you tell us how often they occur? Can you also tell us what aircraft you operate at CRW?

You can respond to these questions via email or you can call me at 513.530.1246

Thank you in advance for your cooperation.

WVANG



DEPARTMENT OF THE AIR FORCE  
130<sup>TH</sup> AIRLIFT WING (AMC)  
1679 COONSKIN DRIVE  
CHARLESTON, WV 25311-5000

December 12, 2016

MEMORANDUM FOR: CENTRAL WEST VIRGINIA REGIONAL AIRPORT AUTHORITY  
ATTENTION: MR. MATTHEW DIGIULIAN

FROM: 130<sup>TH</sup> AIRLIFT WING

SUBJECT: DISPLACED THRESHOLD CHANGE

1. The 130<sup>th</sup> Operations Group conducts C-130 training sorties at KCRW. Part of our annual training requirements includes touch-and-go landings for pilot currency and proficiency. To comply with the Air Force's C-130 flying regulation a 6000' runway is required for some touch-and-go landings.
2. Since the 578 foot displaced threshold was implemented at KCRW in July 2015 our crews have use other qualified airfields to fulfill some of their touch-and-go training requirements. This required more time and fuel to accomplish the training sortie leaving less time to accomplish other required training events.
3. Approval of the proposed 277 foot change to the displaced threshold would decrease the amount of time and fuel required to meet the 130<sup>th</sup> Operations Group's training requirements.
4. Please feel free to contact me at DSN 366-6130 or [johnny.m.rvan3.mil@mail.mil](mailto:johnny.m.rvan3.mil@mail.mil)

//Signed//  
JOHNNY RYAN, COL, WVANG  
130<sup>TH</sup> WING COMMANDER

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## SECTION FOUR OPERATOR CORRESPONDENCE LETTERS FOR PREFERRED ALTERNATIVE

Section Four displays the correspondence letters that include communication trails between the Airport consultants and operators. These letters correspond to the preferred alternative and how it may affect airline operations. Correspondence letters are displayed in alphabetical order.

American

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**From:** Starkey, Bruce  
**To:** [Lisa M. Schafer](mailto:Lisa.M.Schafer)  
**Subject:** RE: CRW: Runway Length and RSA Study- Alternative  
**Date:** Tuesday, July 25, 2017 4:33:37 PM

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Lisa,  
We do not see any seat restrictions for our CRJ-200 operations out of CRW to PHL, DCA and CLT with the proposed distances.  
No issues for AAL.  
Thanks for asking.  
Bruce

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**From:** Lisa M. Schafer [mailto:[lschafer@landrum-brown.com](mailto:lschafer@landrum-brown.com)]  
**Sent:** Tuesday, July 25, 2017 2:54 PM  
**To:** Starkey, Bruce  
**Subject:** RE: CRW: Runway Length and RSA Study- Alternative

Bruce,

Have you had a chance to take a look at the newly proposed declared distances for the alternative mentioned below? We have been prompted to have a call with the FAA at the end of the week for discussion and we were hoping you could provide input by then, if possible. I apologize for this pressing need. I will plan to give you a call tomorrow morning if I do not hear back from you by then.

Thanks again,

**Lisa Schafer** → **Landrum & Brown**  
11279 Cornell Park Drive Cincinnati, OH 45242  
P: 513.530.1238 | F: 513.530.2238 | C: 219.916.0130

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**From:** Lisa M. Schafer  
**Sent:** Thursday, July 20, 2017 11:42 AM  
**To:** 'Starkey, Bruce' <[Bruce.Starkey@aa.com](mailto:Bruce.Starkey@aa.com)>  
**Subject:** CRW: Runway Length and RSA Study- Alternative

Good Morning Bruce,

Thank you for your assistance thus far with the CRW studies and your timely responses to our previous emails. As you already know, Landrum & Brown has been retained by Yeager Airport to prepare a Runway Safety Area Study. This study addresses the slope failure that occurred on the Runway 5 end in March of 2015, resulting in the loss of the EMAS and a reduction in declared landing and departure distances for Runway 5-23. Several airlines and corporate jet operators have communicated that the reduced distances have resulted in material operational restrictions, particularly from the reduced arrival length. We have been asked by the FAA to come up with an additional alternative that conforms with a 70-knot EMAS at the end of Runway 5 (separate from the alternative you saw in March). This new alternative would result in



American (continued)

approximately 50 feet less usable runway than the previous alternative from March.

If you could, please take a look at the declared distances below in the table and let me know how this affects the operational capability of your fleet at CRW? Would your fleet incur weight penalties, if so can you quantify these in any way?

	Runway 5	Runway 23
TORA	6,715'	6,715'
LDA	6,215'	6,215'
ASDA	6,215'	6,715'

We are trying to come up with a safe and operationally efficient solution and appreciate your input. If you have any questions, please feel free to contact me.

**Lisa Schafer** → **Landrum & Brown**  
11279 Cornell Park Drive Cincinnati, OH 45242  
P: 513.530.1238 | F: 513.530.2238 | C: 219.916.0130

<![endif]-->

NOTICE: This email and any attachments are for the exclusive and confidential use of the intended recipient(s). If you are not an intended recipient, please do not read, distribute, or take action in reliance upon this message. If you have received this in error, please notify me immediately by return email and promptly delete this message and its attachments from your computer.

Delta

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**From:** Hanson, Peter J  
**To:** [Lisa M. Schafer](mailto:Lisa.M.Schafer@landrum-brown.com)  
**Cc:** [Philip Long](mailto:Philip.Long@delta.com); [Christiansen, Tyler J.](mailto:Christiansen.Tyler.J@delta.com)  
**Subject:** RE: Runway Length and RSA Study- Alternative  
**Date:** Wednesday, July 26, 2017 7:40:43 AM

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Good Morning Lisa,

As a follow up, the below noted 50 foot reduction in runway length does not materially change our previously communicated responses concerning aircraft performance to/from the proposed CRW runway 5/23 lengths.

Please let us know if you have additional questions etc.

Thanks

Peter Hanson

Peter Hanson | Technical Specialist - Delta Connection | Delta Air Lines | 404-677-7930 (o) | 470-755-2860 (c) | [peter.hanson@delta.com](mailto:peter.hanson@delta.com)

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**From:** Lisa M. Schafer [<mailto:lschafer@landrum-brown.com>]  
**Sent:** Tuesday, July 25, 2017 4:31 PM  
**To:** Hanson, Peter J  
**Subject:** RE: Runway Length and RSA Study- Alternative

Thanks, Peter.

This project has been expedited so I appreciate your quick responses so far and apologize for any inconvenience this causes with your workload. I look forward to hearing your opinions on this alternative.

**Lisa Schafer** → **Landrum & Brown**  
11279 Cornell Park Drive Cincinnati, OH 45242  
P: 513.530.1238 | F: 513.530.2238 | C: 219.916.0130

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**From:** Hanson, Peter J [<mailto:peter.hanson@delta.com>]  
**Sent:** Tuesday, July 25, 2017 4:04 PM  
**To:** Lisa M. Schafer <[lschafer@landrum-brown.com](mailto:lschafer@landrum-brown.com)>  
**Subject:** RE: Runway Length and RSA Study- Alternative

Hello Lisa,

Delta (continued)

Sorry, I have not yet had a chance to review. I will try to get a bit of time tomorrow.

Thanks

Peter Hanson

Peter Hanson | Technical Specialist - Delta Connection | Delta Air Lines | 404-677-7930 (o) | 470-755-2860 (c) | [peter.hanson@delta.com](mailto:peter.hanson@delta.com)

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**From:** Lisa M. Schafer [<mailto:lschafer@landrum-brown.com>]  
**Sent:** Tuesday, July 25, 2017 3:55 PM  
**To:** Hanson, Peter J  
**Subject:** RE: Runway Length and RSA Study- Alternative

Peter,

Have you had a chance to take a look at the newly proposed declared distances for the alternative mentioned below? We have been prompted to have a call with the FAA at the end of the week for discussion and we were hoping you could provide input by then, if possible. I apologize for this pressing need. I will plan to give you a call tomorrow morning if I do not hear back from you by then.

Thanks again,

**Lisa Schafer** → **Landrum & Brown**  
11279 Cornell Park Drive Cincinnati, OH 45242  
P: 513.530.1238 | F: 513.530.2238 | C: 219.916.0130

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**From:** Lisa M. Schafer  
**Sent:** Thursday, July 20, 2017 11:38 AM  
**To:** 'Hanson, Peter J' <[peter.hanson@delta.com](mailto:peter.hanson@delta.com)>  
**Subject:** Runway Length and RSA Study- Alternative

Good Morning Peter,

Thank you for your assistance thus far with the CRW studies. As you already know, Landrum & Brown has been retained by Yeager Airport to prepare a Runway Safety Area Study. This study addresses the slope failure that occurred on the Runway 5 end in March of 2015, resulting in the loss of the EMAS and a reduction in declared landing and departure distances for Runway 5-23. Several airlines and corporate jet operators have communicated that the reduced distances have resulted in material operational restrictions, particularly from the reduced arrival length. We have been asked by the FAA to come up with an additional alternative that conforms with a 70-knot EMAS at the end of Runway 5 (separate from the alternative you saw in March). This new alternative would result in approximately 50 feet less usable runway than the previous alternative from March.

Delta (continued)

If you could, please take a look at the declared distances below in the table and let me know how this affects the operational capability of your fleet at CRW? Would your fleet incur weight penalties, if so can you quantify these in any way?

	Runway 5	Runway 23
TORA	6,715'	6,715'
LDA	6,215'	6,215'
ASDA	6,215'	6,715'

We are trying to come up with a safe and operationally efficient solution and appreciate your input. If you have any questions, please feel free to contact me.

**Lisa Schafer** → **Landrum & Brown**  
11279 Cornell Park Drive Cincinnati, OH 45242  
P: 513.530.1238 | F: 513.530.2238 | C: 219.916.0130

Delta (continued)

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**From:** Bowen, Carolyn  
**To:** [Finnvik, Stephanie K](#)  
**Cc:** [Lisa M. Schafer](#)  
**Subject:** RE: CRW: Runway Length and RSA Study- Alternative  
**Date:** Tuesday, July 25, 2017 4:05:50 PM

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Hi Lisa,

This request goes more in the direction of our performance engineering department.

Stephanie,

Would you be able to help Lisa out regarding this issue or let us know with whom we might check?

Thanks in advance.

Carolyn

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**From:** Lisa M. Schafer [mailto:[lschafer@landrum-brown.com](mailto:lschafer@landrum-brown.com)]  
**Sent:** Tuesday, July 25, 2017 3:54 PM  
**To:** Bowen, Carolyn  
**Subject:** RE: CRW: Runway Length and RSA Study- Alternative

Carolyn,

Have you had a chance to take a look at the newly proposed declared distances for the alternative mentioned below? We have been prompted to have a call with the FAA at the end of the week for discussion and we were hoping you could provide input by then, if possible. I apologize for this pressing need. I will plan to give you a call tomorrow morning if I do not hear back from you by then.

Thanks again,

**Lisa Schafer** → **Landrum & Brown**  
11279 Cornell Park Drive Cincinnati, OH 45242  
P: 513.530.1238 | F: 513.530.2238 | C: 219.916.0130

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**From:** Lisa M. Schafer  
**Sent:** Thursday, July 20, 2017 11:39 AM  
**To:** 'Carolyn.bowen@delta.com' <[Carolyn.bowen@delta.com](mailto:Carolyn.bowen@delta.com)>  
**Subject:** CRW: Runway Length and RSA Study- Alternative

Good Morning Carolyn,

Thank you for your assistance thus far with the CRW studies. As you already know, Landrum & Brown has been retained by Yeager Airport to prepare a Runway Safety Area Study. This study addresses the slope failure that occurred on the Runway 5 end in March of 2015, resulting in the loss of the EMAS and a reduction in declared landing and departure distances for Runway 5-23. Several airlines and corporate jet operators have communicated that the reduced distances have resulted in material operational restrictions, particularly from the reduced arrival length. We have been asked by the FAA to come up with an

Delta (continued)

additional alternative that conforms with a 70-knot EMAS at the end of Runway 5 (separate from the alternative you saw in March). This new alternative would result in approximately 50 feet less usable runway than the previous alternative from March.

If you could, please take a look at the declared distances below in the table and let me know how this affects the operational capability of your fleet at CRW? Would your fleet incur weight penalties, if so can you quantify these in any way?

	Runway 5	Runway 23
TORA	6,715'	6,715'
LDA	6,215'	6,215'
ASDA	6,215'	6,715'

We are trying to come up with a safe and operationally efficient solution and appreciate your input. If you have any questions, please feel free to contact me.

**Lisa Schafer** → Landrum & Brown  
11279 Cornell Park Drive Cincinnati, OH 45242  
P: 513.530.1238 | F: 513.530.2238 | C: 219.916.0130

Spirit

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**From:** James Brenson [<mailto:James.Brenson@spirit.com>]  
**Sent:** Tuesday, August 1, 2017 9:59 AM  
**To:** Lisa M. Schafer <[lschafer@landrum-brown.com](mailto:lschafer@landrum-brown.com)>  
**Cc:** Gregory Christopher <[Gregory.Christopher@spirit.com](mailto:Gregory.Christopher@spirit.com)>  
**Subject:** RE: CRW- Spirit's Runway Length Requirements

Good morning Lisa,

After reviewing the numbers, we have determined the following:

1. The new declared distances will have minimal impact on our load going to MYR with our A319s, but may affect our load on our A320s.
2. Runway 5-23 at CRW is already one of the shortest we operate to. Reducing the distances may further limit our options for any potential future destinations such as FLL or MCO, especially with our A320 fleet.

Please let me know if you need anything else.

Regards,

**James Brenson**  
Performance Engineer | Spirit Airlines  
2800 Executive Way, Miramar, FL 33025  
(w) 954.628.4862  
(c) 954.225.1043

---

**From:** Lisa M. Schafer [<mailto:lschafer@landrum-brown.com>]  
**Sent:** Thursday, July 27, 2017 2:59 PM  
**To:** James Brenson  
**Cc:** Gregory Christopher  
**Subject:** RE: CRW- Spirit's Runway Length Requirements

Thank you, I appreciate it.

**Lisa Schafer** → **Landrum & Brown**  
11279 Cornell Park Drive Cincinnati, OH 45242  
P: 513.530.1238 | F: 513.530.2238 | C: 219.916.0130

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**From:** James Brenson [<mailto:James.Brenson@spirit.com>]  
**Sent:** Thursday, July 27, 2017 2:43 PM  
**To:** Lisa M. Schafer <[lschafer@landrum-brown.com](mailto:lschafer@landrum-brown.com)>  
**Cc:** Gregory Christopher <[Gregory.Christopher@spirit.com](mailto:Gregory.Christopher@spirit.com)>  
**Subject:** RE: CRW- Spirit's Runway Length Requirements

Spirit (continued)

Hi Lisa,

Let me review the numbers. I'll send over a response to your questions below as soon as my analysis is complete.

Regards,

**James Brenson**

**Performance Engineer | Spirit Airlines**  
2800 Executive Way, Miramar, FL 33025  
(w) 954.628.4862  
(c) 954.225.1043

---

**From:** Gregory Christopher  
**Sent:** Thursday, July 27, 2017 2:09 PM  
**To:** Lisa M. Schafer; James Brenson  
**Subject:** Re: CRW- Spirit's Runway Length Requirements

Afternoon Lisa,

I have included James. He is our engineer and can help provide information for Spirit ops.

Regards,

Greg Christopher  
Spirit Airlines

On Jul 27, 2017, at 13:13, Lisa M. Schafer <[lschafer@landrum-brown.com](mailto:lschafer@landrum-brown.com)> wrote:

Mr. Christopher,

Landrum & Brown has been retained by Yeager Airport (CRW) to prepare a Runway Safety Area Study. Your contact was provided to us by the client as a good point of contact on this matter. This study addresses the slope failure that occurred on the Runway 5 end in March of 2015, resulting in the loss of the EMAS and a reduction in declared landing and departure distances for Runway 5-23. Some airlines and corporate jet operators have communicated that the reduced distances have resulted in material operational restrictions, particularly from the reduced arrival length. We have been asked by the FAA to come up with an additional alternative that conforms with a 70-knot EMAS at the end of Runway 5 (separate from the alternative you saw in March). This new alternative would result in the following declared distances for Runway 5/23 in the below table.

Could you please take a look at the declared distances and let us know if 1.) these distances will affect your load currently going to MYR and 2.) do these distances affect any future potential destinations that Spirit may be thinking about (ie...FLL or MCO)?



Spirit (continued)

	Runway 5	Runway 23
TORA	6,715'	6,715'
LDA	6,215'	6,215'
ASDA	6,215'	6,715'

Thank you for your time, we appreciate your response in this matter.

**Lisa Schafer** → **Landrum & Brown**  
11279 Cornell Park Drive Cincinnati, OH 45242  
P: 513.530.1238 | F: 513.530.2238 | C: 219.916.0130

United

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**From:** Johns, William  
**To:** [Lisa M. Schafer](#), [Steen, James](#)  
**Cc:** [Steen, James](#)  
**Subject:** RE: Runway Length and RSA Study- Alternative  
**Date:** Monday, July 24, 2017 10:42:28 AM

---

Hi Lisa,

I have passed this along to a regional partner and will advise when I hear back.

Thanks,  
Will

---

**From:** Lisa M. Schafer [mailto:[lschafer@landrum-brown.com](mailto:lschafer@landrum-brown.com)]  
**Sent:** Thursday, July 20, 2017 10:40 AM  
**To:** Steen, James  
**Cc:** Johns, William  
**Subject:** CRW: Runway Length and RSA Study- Alternative

Good Morning James and William,

Thank you for your assistance thus far with the CRW studies. As you already know, Landrum & Brown has been retained by Yeager Airport to prepare a Runway Safety Area Study. This study addresses the slope failure that occurred on the Runway 5 end in March of 2015, resulting in the loss of the EMAS and a reduction in declared landing and departure distances for Runway 5-23. Several airlines and corporate jet operators have communicated that the reduced distances have resulted in material operational restrictions, particularly from the reduced arrival length. We have been asked by the FAA to come up with an additional alternative that conforms with a 70-knot EMAS at the end of Runway 5 (separate from the alternative you saw in March). This new alternative would result in approximately 50 feet less usable runway than the previous alternative from March.

If you could, please take a look at the declared distances below in the table and let me know how this affects the operational capability of your fleet at CRW? Would your fleet incur weight penalties, if so can you quantify these in any way?

	Runway 5	Runway 23
TORA	6,715'	6,715'
LDA	6,215'	6,215'
ASDA	6,215'	6,715'

We are trying to come up with a safe and operationally efficient solution and appreciate your input. If you have any questions, please feel free to contact me.

United (continued)

---

**From:** Johns, William  
**To:** [Lisa M. Schafer](#); [Steen, James](#)  
**Cc:** [Starnes, James](#)  
**Subject:** RE: Runway Length and RSA Study- Alternative  
**Date:** Wednesday, July 26, 2017 10:29:48 AM  
**Attachments:** [07262017\\_EV\\_CRW.xls](#)

---

Hi Lisa,

Attached is the data from the regional partner (the 07262017 tab is the proposal from last week, while the 04052017 tab is the proposal from several months back.) There are no major differences between the two—the maximum difference in payload amounts to 1-2 held seats.

Thanks,  
Will

---

**From:** Lisa M. Schafer [mailto:[lschafer@landrum-brown.com](mailto:lschafer@landrum-brown.com)]  
**Sent:** Wednesday, July 26, 2017 7:56 AM  
**To:** Johns, William; Steen, James  
**Cc:** Starnes, James  
**Subject:** RE: Runway Length and RSA Study- Alternative

Thank you, we will keep this timeline in mind in the future. I appreciate the expedited analysis.

**Lisa Schafer** → **Landrum & Brown**  
11279 Cornell Park Drive Cincinnati, OH 45242  
P: 513.530.1238 | F: 513.530.2238 | C: 219.916.0130

---

**From:** Johns, William [mailto:[William.Johns@united.com](mailto:William.Johns@united.com)]  
**Sent:** Tuesday, July 25, 2017 5:22 PM  
**To:** Lisa M. Schafer <[lschafer@landrum-brown.com](mailto:lschafer@landrum-brown.com)>; Steen, James <[james.steen02@united.com](mailto:james.steen02@united.com)>  
**Cc:** Starnes, James <[James.Starnes@united.com](mailto:James.Starnes@united.com)>  
**Subject:** RE: Runway Length and RSA Study- Alternative

Hi Lisa,

The partner advises that they should have the analysis done midday tomorrow, and I will pass it along.

Thanks,  
Will

---

**From:** Johns, William  
**Sent:** Tuesday, July 25, 2017 3:44 PM  
**To:** 'Lisa M. Schafer'; Steen, James  
**Cc:** Starnes, James  
**Subject:** RE: Runway Length and RSA Study- Alternative

United (continued)

Hi Lisa,

I just followed up with the partner to try to expedite the process. If there are future proposals, more lead time would be greatly appreciated as our regional partners generally need a couple weeks to provide a payload analysis.

Thanks,  
Will

---

**From:** Lisa M. Schafer [<mailto:lschafer@landrum-brown.com>]  
**Sent:** Tuesday, July 25, 2017 3:28 PM  
**To:** Johns, William; Steen, James  
**Cc:** Starnes, James  
**Subject:** RE: Runway Length and RSA Study- Alternative

Will,

Thanks again. Do you have the contact info for this individual? The FAA is knocking at our door for airline responses to move forward and we are having discussions with them and the Airport this week. This project has been expedited so I appreciate your quick responses so far and apologize for any inconvenience this causes with your workload.

Thanks,

**Lisa Schafer** → **Landrum & Brown**  
11279 Cornell Park Drive Cincinnati, OH 45242  
P: 513.530.1238 | F: 513.530.2238 | C: 219.916.0130

---

**From:** Lisa M. Schafer  
**Sent:** Monday, July 24, 2017 11:05 AM  
**To:** 'Johns, William' <[William.Johns@united.com](mailto:William.Johns@united.com)>; Steen, James <[james.steen02@united.com](mailto:james.steen02@united.com)>  
**Cc:** Starnes, James <[James.Starnes@united.com](mailto:James.Starnes@united.com)>  
**Subject:** RE: Runway Length and RSA Study- Alternative

Thanks, Will.

We have a meeting with the FAA at the end of the week so any information prior to then will assist with that discussion.

**Lisa Schafer** → **Landrum & Brown**  
11279 Cornell Park Drive Cincinnati, OH 45242  
P: 513.530.1238 | F: 513.530.2238 | C: 219.916.0130

---

**From:** Johns, William [<mailto:William.Johns@united.com>]  
**Sent:** Monday, July 24, 2017 10:42 AM

United (continued)

**To:** Lisa M. Schafer <[lschafer@landrum-brown.com](mailto:lschafer@landrum-brown.com)>; Steen, James <[james.steen02@united.com](mailto:james.steen02@united.com)>  
**Cc:** Starnes, James <[James.Starnes@united.com](mailto:James.Starnes@united.com)>  
**Subject:** RE: Runway Length and RSA Study- Alternative

Hi Lisa,

I have passed this along to a regional partner and will advise when I hear back.

Thanks,  
Will

---

**From:** Lisa M. Schafer [<mailto:lschafer@landrum-brown.com>]  
**Sent:** Thursday, July 20, 2017 10:40 AM  
**To:** Steen, James  
**Cc:** Johns, William  
**Subject:** CRW: Runway Length and RSA Study- Alternative

Good Morning James and William,

Thank you for your assistance thus far with the CRW studies. As you already know, Landrum & Brown has been retained by Yeager Airport to prepare a Runway Safety Area Study. This study addresses the slope failure that occurred on the Runway 5 end in March of 2015, resulting in the loss of the EMAS and a reduction in declared landing and departure distances for Runway 5-23. Several airlines and corporate jet operators have communicated that the reduced distances have resulted in material operational restrictions, particularly from the reduced arrival length. We have been asked by the FAA to come up with an additional alternative that conforms with a 70-knot EMAS at the end of Runway 5 (separate from the alternative you saw in March). This new alternative would result in approximately 50 feet less usable runway than the previous alternative from March.

If you could, please take a look at the declared distances below in the table and let me know how this affects the operational capability of your fleet at CRW? Would your fleet incur weight penalties, if so can you quantify these in any way?

	Runway 5	Runway 23
TORA	6,715'	6,715'
LDA	6,215'	6,215'
ASDA	6,215'	6,715'

We are trying to come up with a safe and operationally efficient solution and appreciate your input. If you have any questions, please feel free to contact me.

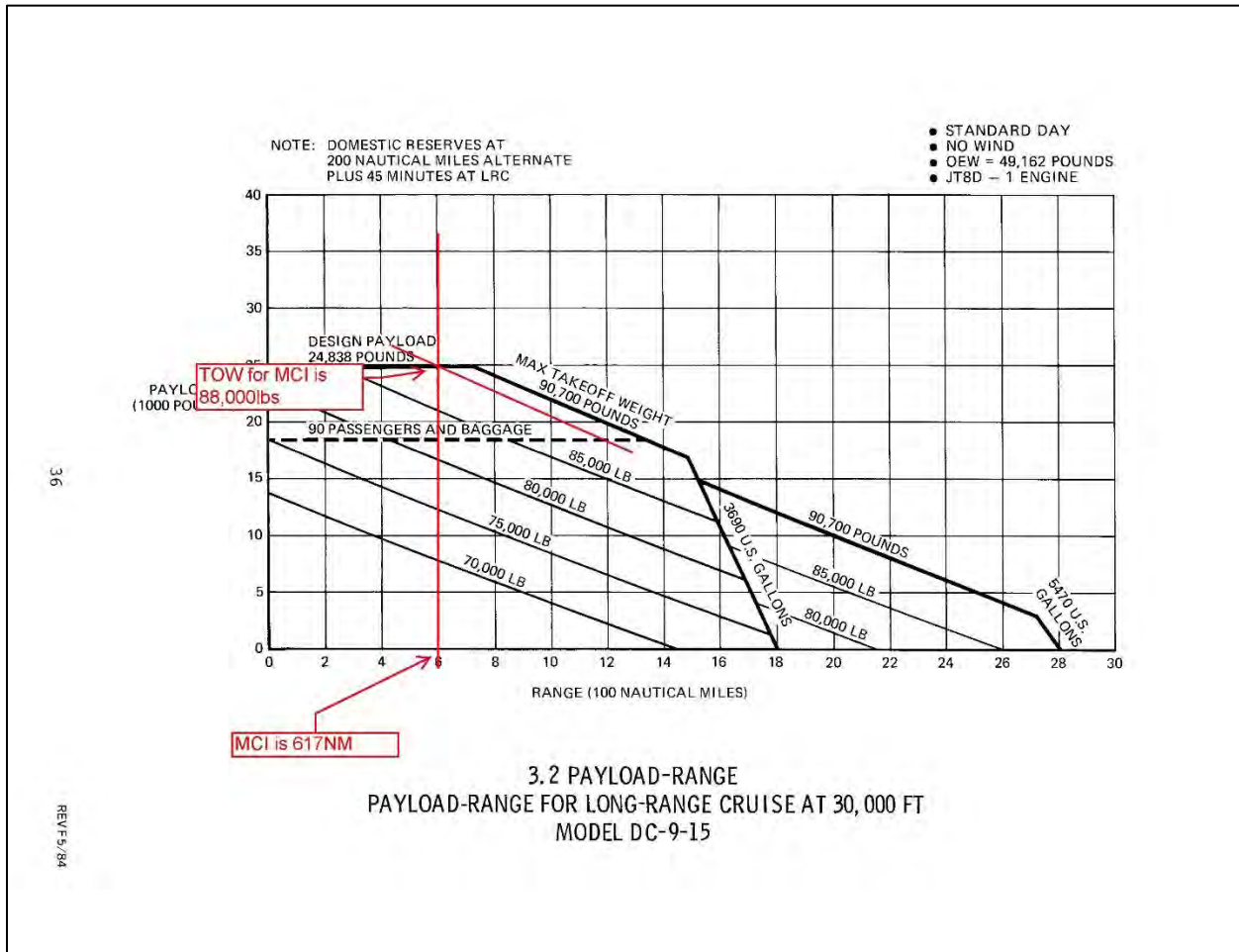
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## APPENDIX B RUNWAY LENGTH CHARTS

This appendix presents the runway length calculations for the Yeager Airport (CRW) *Interim Runway Safety Area Study*. The runway length requirements were developed in accordance with Federal Aviation Administration (FAA) Advisory Circular 150/5325-4B, *Runway Length Requirements for Airport Design*.

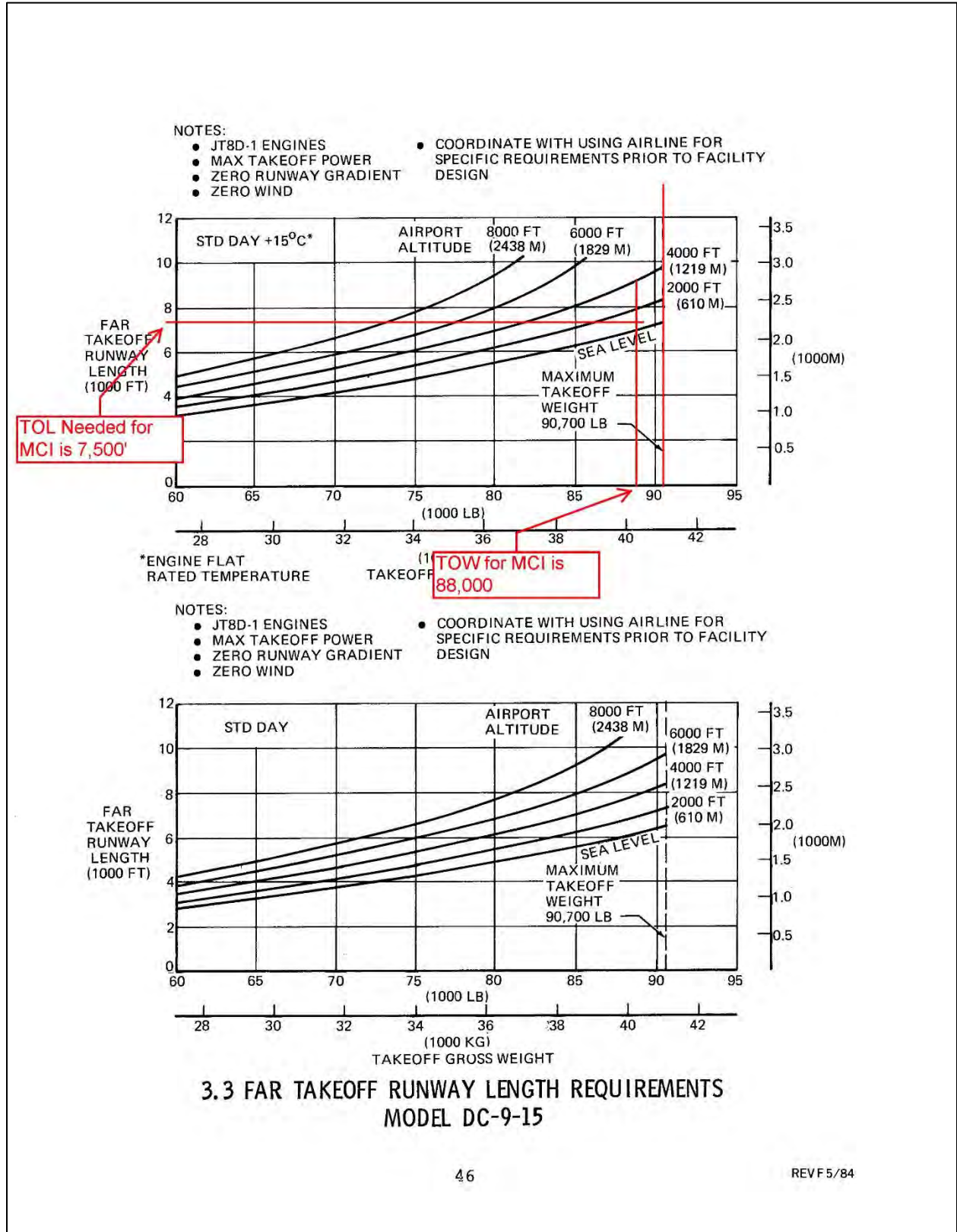
**The payload/range and runway length charts from the aircraft manufacturers' manuals were used to calculate the takeoff and landing runway length requirements. These charts are presented on the following pages.**

DC-9 PAYLOAD/RANGE CHART

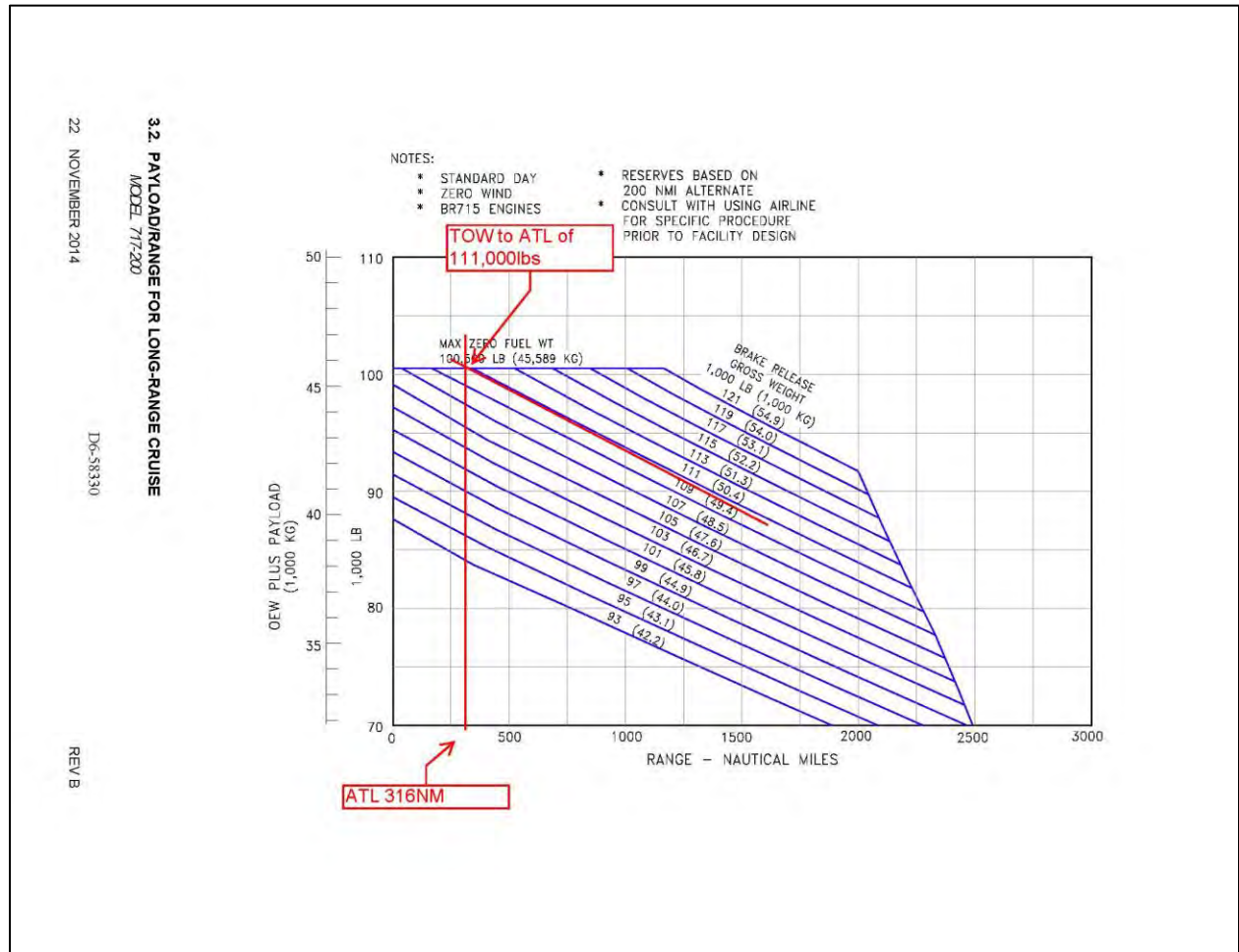




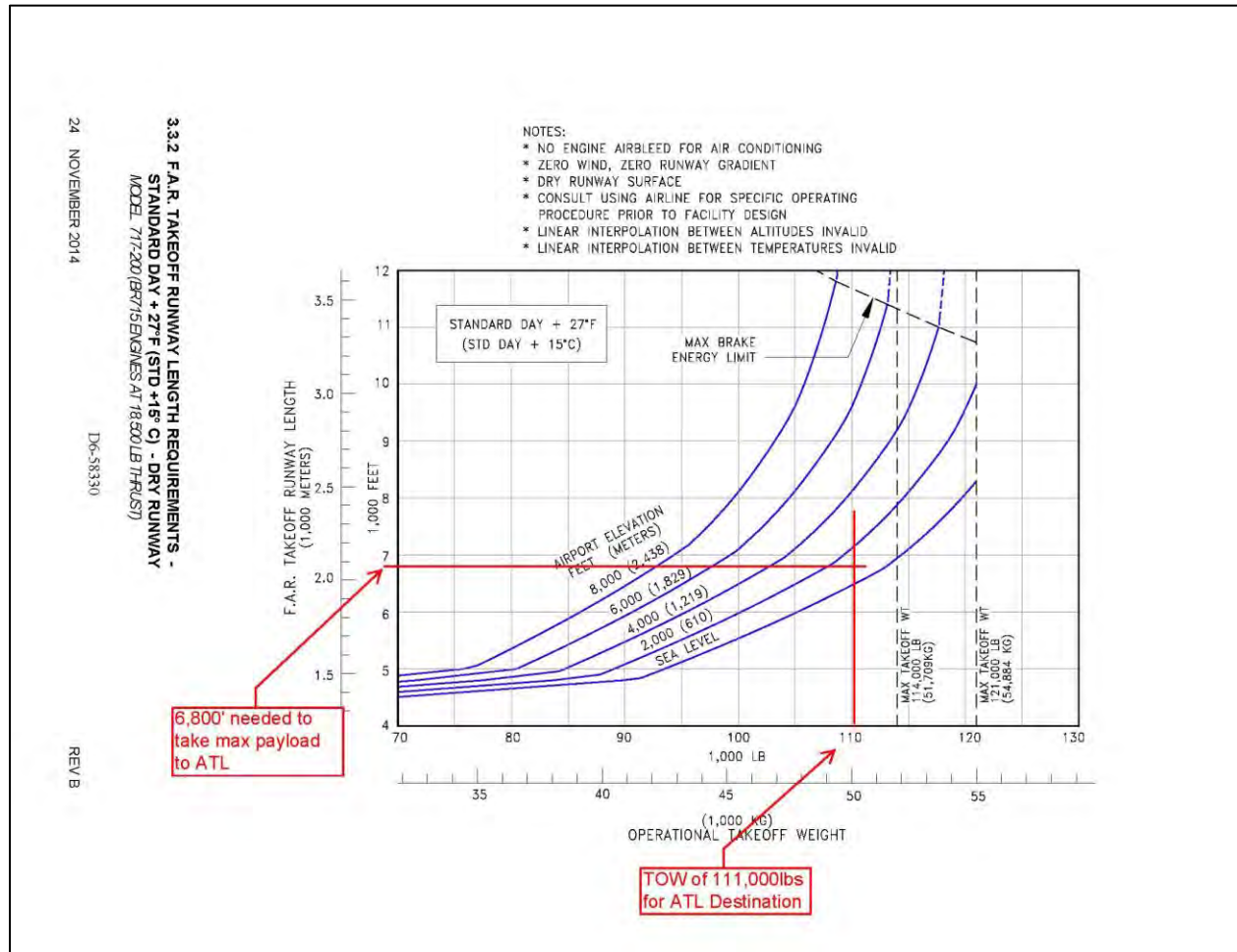
DC-9 TAKEOFF RUNWAY LENGTH REQUIREMENT



B717 PAYLOAD/RANGE CHART



B717 TAKEOFF RUNWAY LENGTH REQUIREMENT

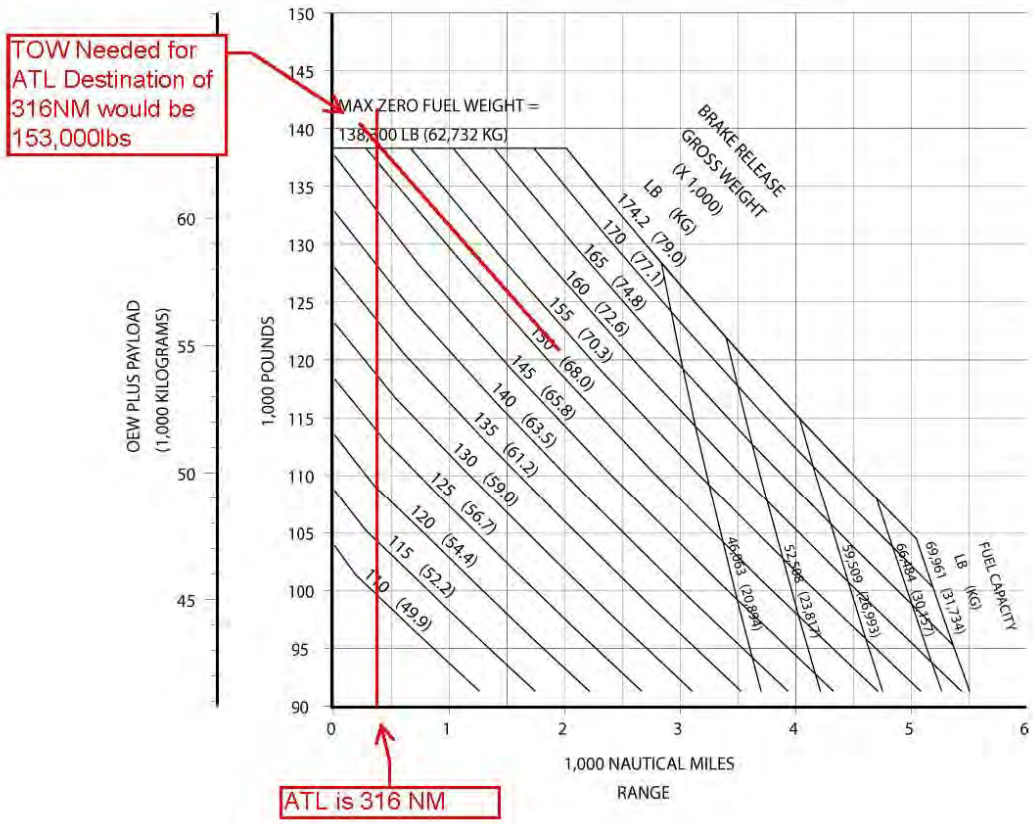


B737-800 PAYLOAD/RANGE CHART

DO NOT USE FOR DISPATCH

Payload/Range  
 737-800/800W/BBJ2 (CFM56-7B Series)

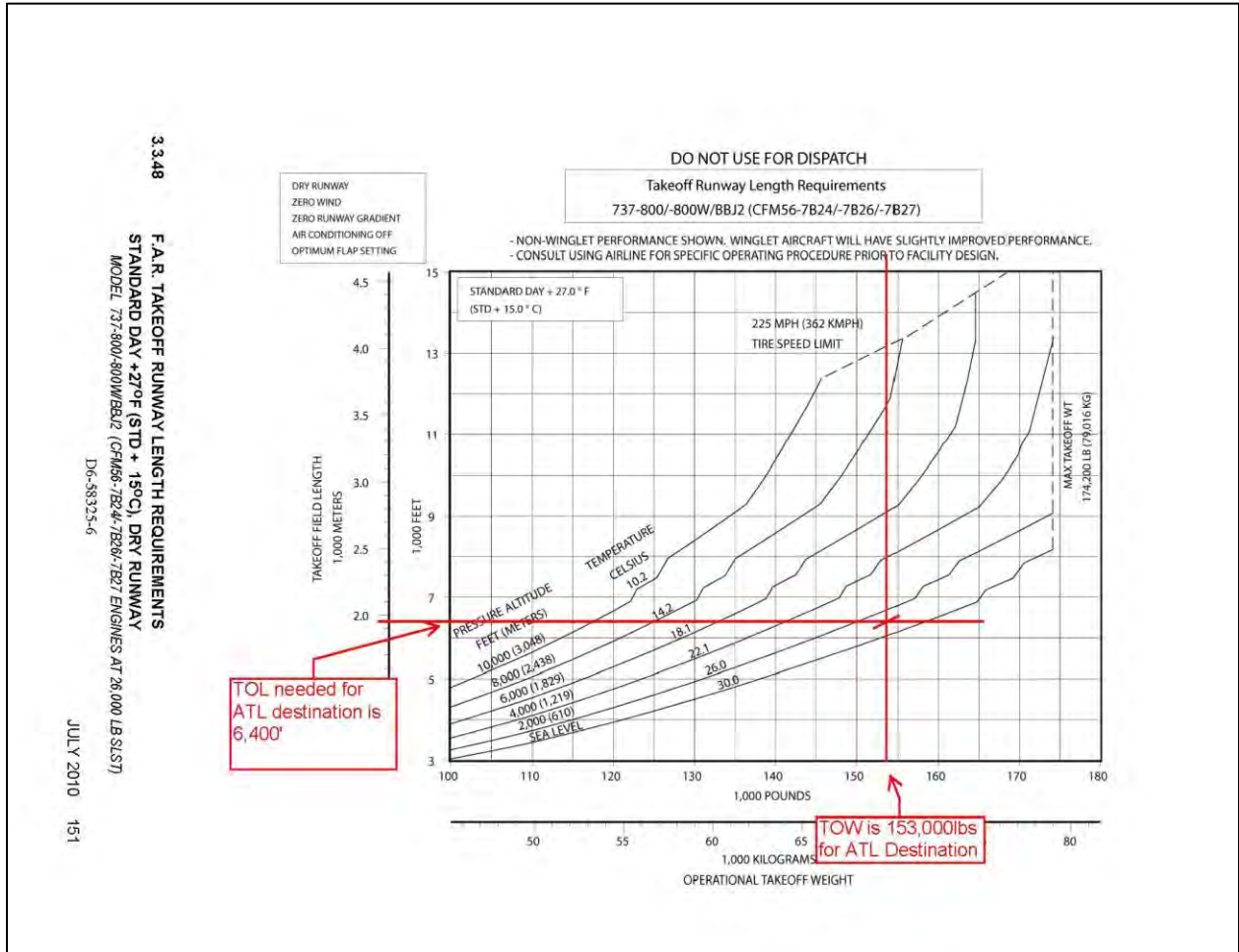
- STANDARD DAY, ZERO WIND
- CRUISE MACH = LRC
- NORMAL POWER EXTRACTION AND AIR CONDITIONING BLEEDS
- TYPICAL MISSION RULES
- NON-WINGLET PERFORMANCE SHOWN. WINGLET AIRCRAFT WILL HAVE SLIGHTLY GREATER RANGE.
- CONSULT USING AIRLINE FOR SPECIFIC OPERATING PROCEDURE AND OEW PRIOR TO FACILITY DESIGN.



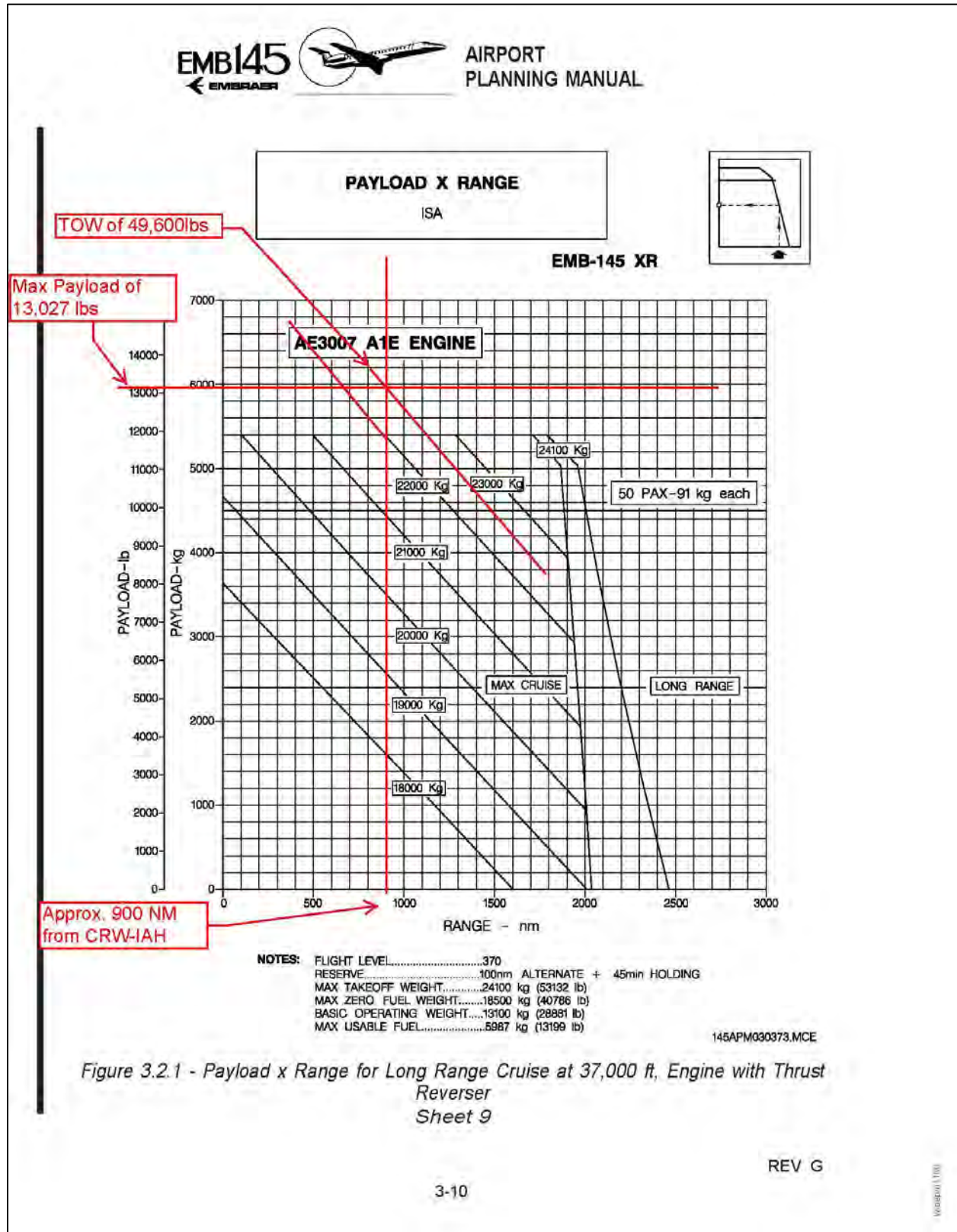
3.2.12 PAYLOAD/RANGE FOR LONG-RANGE CRUISE  
 MODEL 737-800

96 JULY 2010 D6-58325-6

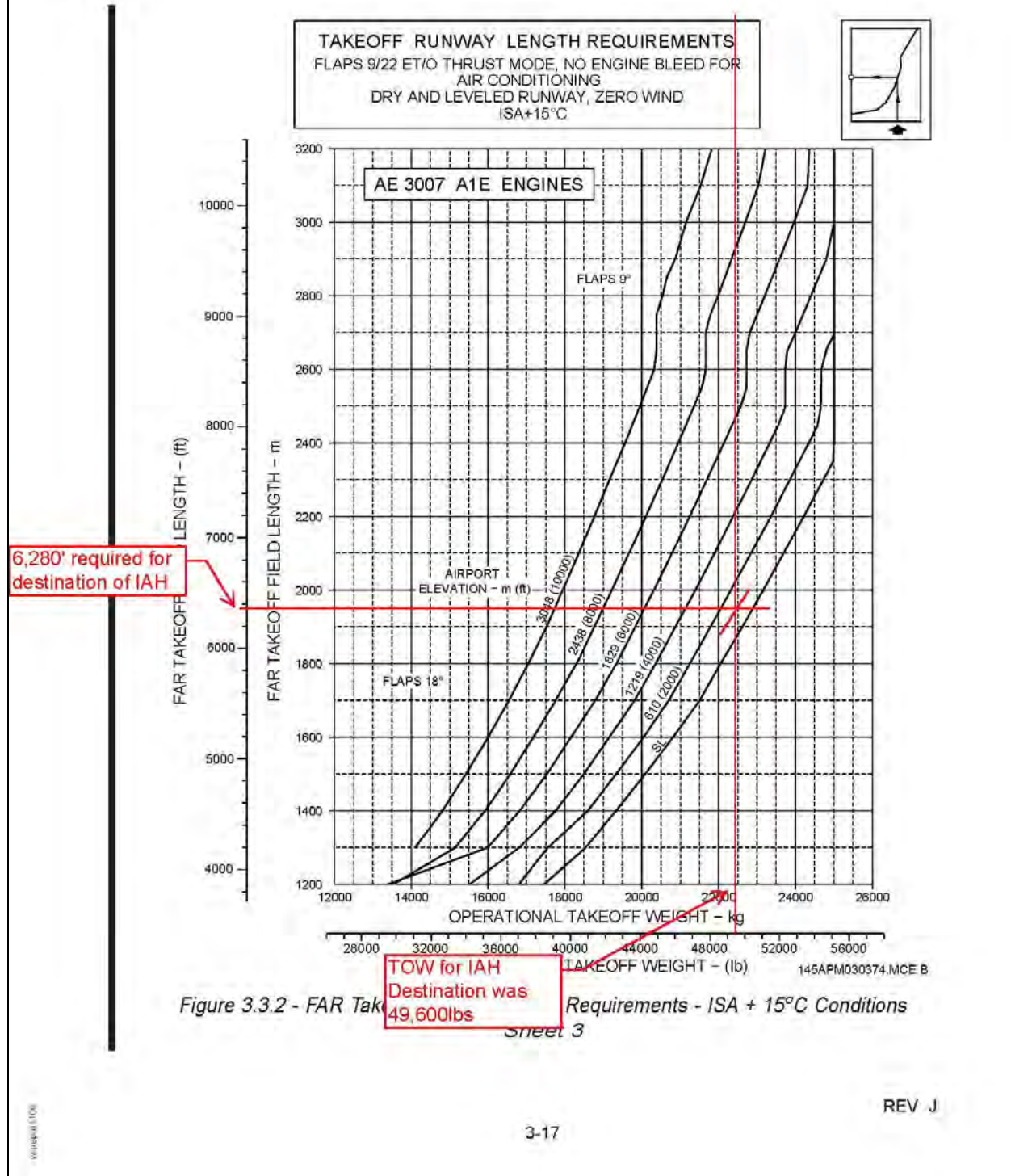
B737-800 TAKEOFF RUNWAY LENGTH REQUIREMENT



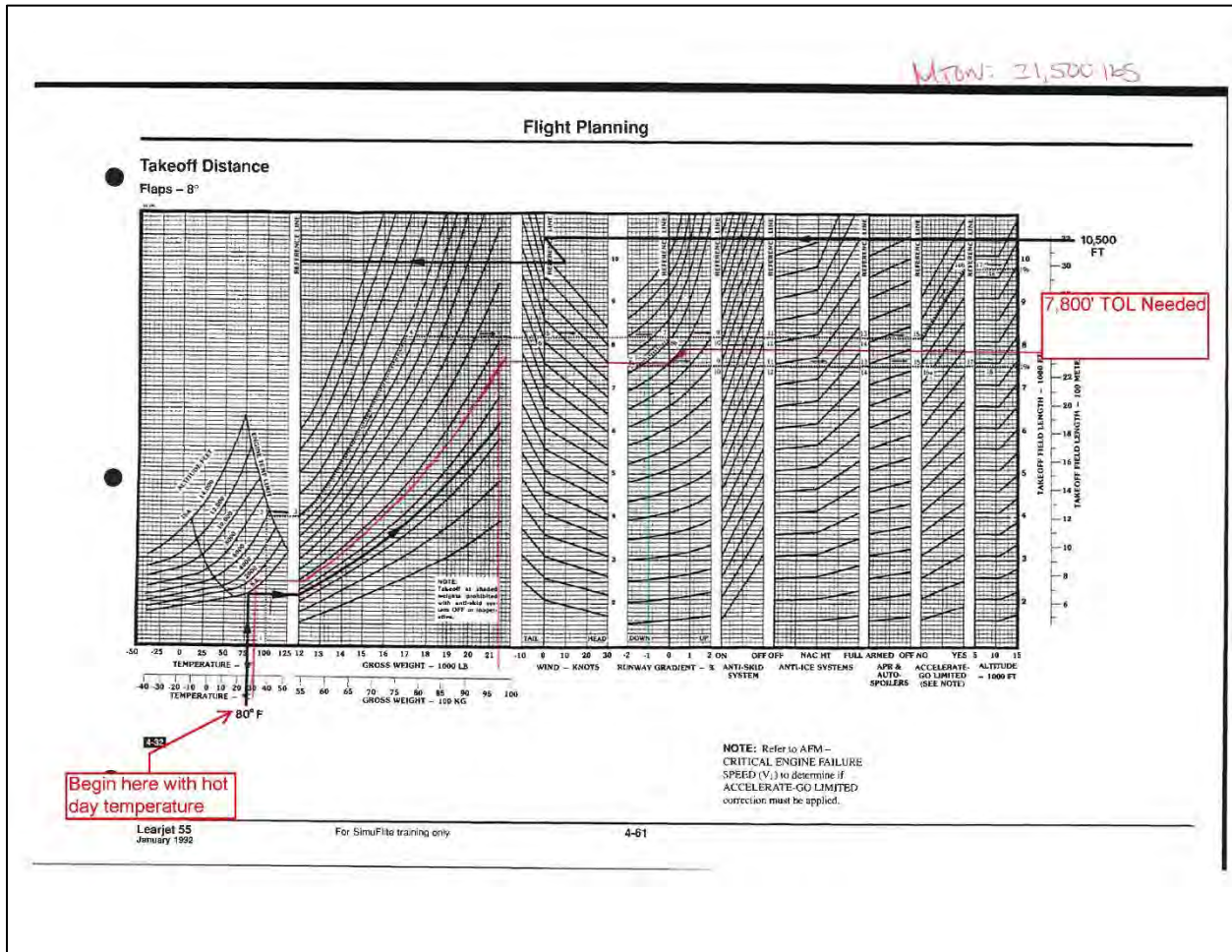
EMB145 PAYLOAD/RANGE CHART



EMB145 TAKEOFF RUNWAY LENGTH REQUIREMENT



LEARJET TAKEOFF RUNWAY LENGTH REQUIREMENT



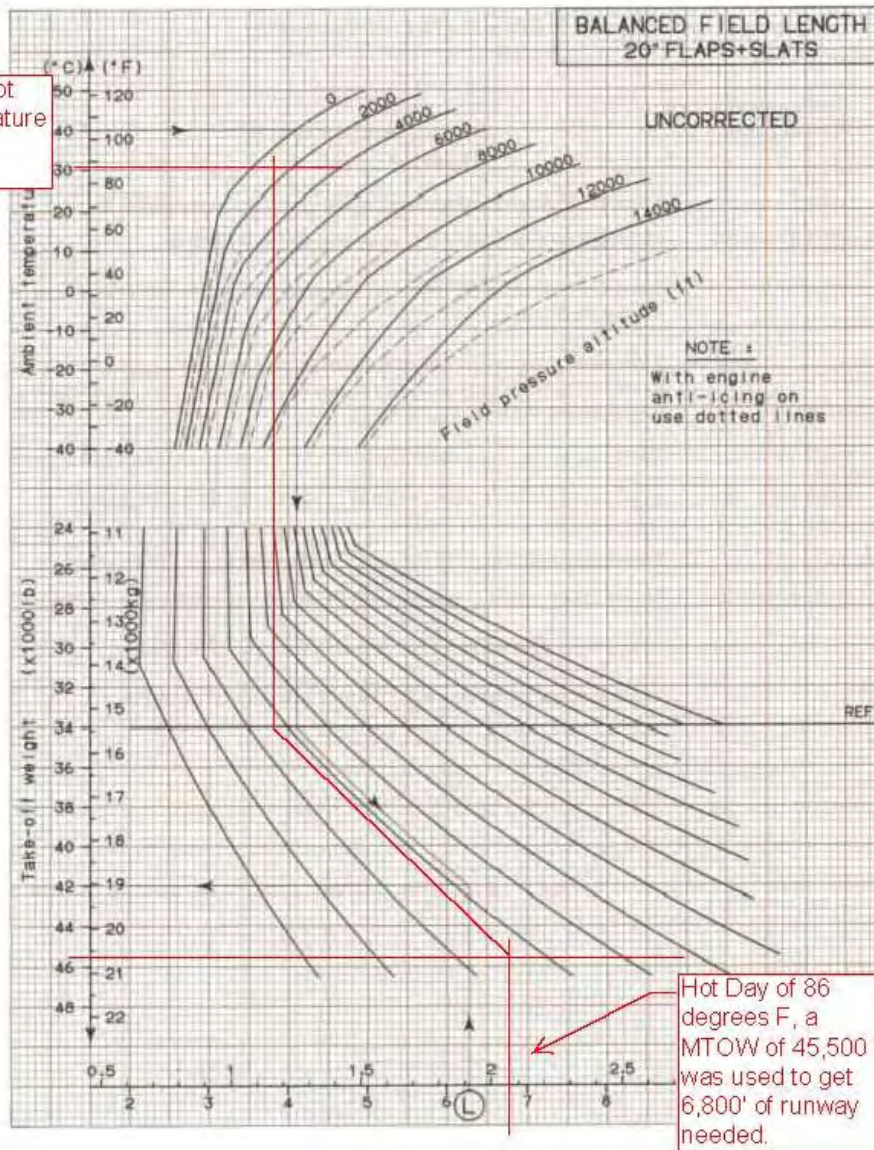


FALCON TAKEOFF RUNWAY LENGTH REQUIREMENT



4.3 Takeoff - FALCON 900A

Begin with Hot Day Temperature



Ref 5 - Dec 2010

Pub 926

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GULFSTREAM TAKEOFF RUNWAY LENGTH REQUIREMENT  
 (SEA LEVEL CHART)

91,000 LB MTOGW		OAT (°C)	55	50	45	40	35	30	25	20	15	5	-5
		OAT (°F)	131	122	113	104	95	86	77	68	59	41	23
		RATED EPR	1.42	1.46	1.48	1.52	1.54	1.58	1.58	1.58	1.58	1.58	1.58
<b>- 91,000 LB -</b>		FLD LNTH	*****	8,530	7,500	7,020	6,500	6,200	6,110	6,020	5,930	5,750	5,560
$V_{SE} = 191$ KCAS	$V_1$ KCAS	*****	141	141	140	139	137	137	137	137	137	138	138
$V_{REF} = 155$ KCAS	$V_R$ KCAS	*****	141	141	141	141	141	141	141	141	141	141	141
MAX TEMP = 51°C	$V_2$ KCAS	*****	147	147	147	147	147	147	147	147	147	147	147
<b>- 90,000 LB -</b>		FLD LNTH	*****	8,250	7,360	6,850	6,430	6,050	5,970	5,880	5,790	5,610	5,430
$V_{SE} = 189$ KCAS	$V_1$ KCAS	*****	140	140	139	137	136	136	136	136	136	136	136
$V_{REF} = 153$ KCAS	$V_R$ KCAS	*****	140	140	140	140	140	140	140	140	140	140	140
MAX TEMP = 52°C	$V_2$ KCAS	*****	146	146	146	146	146	146	146	146	146	146	146
<b>- 85,000 LB -</b>		FLD LNTH	7,940	7,040	6,460	6,050	5,690	5,370	5,290	5,210	5,130	4,970	4,810
$V_{SE} = 183$ KCAS	$V_1$ KCAS	135	135	134	132	131	130	130	130	130	130	130	130
$V_{REF} = 149$ KCAS	$V_R$ KCAS	135	135	135	135	135	135	135	135	135	135	135	135
MAX TEMP = 55°C	$V_2$ KCAS	141	141	141	141	141	141	141	141	141	141	141	141
<b>- 80,000 LB -</b>		FLD LNTH	6,710	6,110	5,670	5,320	5,010	4,730	4,670	4,600	4,530	4,390	4,250
$V_{SE} = 176$ KCAS	$V_1$ KCAS	131	129	127	126	124	123	123	123	123	123	123	123
$V_{REF} = 142$ KCAS	$V_R$ KCAS	131	131	131	131	131	131	131	131	131	131	131	131
MAX TEMP = 55°C	$V_2$ KCAS	136	136	136	136	136	136	136	136	136	136	136	136
<b>- 75,000 LB -</b>		FLD LNTH	5,770	5,330	4,960	4,660	4,400	4,160	4,100	4,040	3,980	3,860	3,730
$V_{SE} = 169$ KCAS	$V_1$ KCAS	124	123	121	119	118	116	116	116	116	116	116	116
$V_{REF} = 136$ KCAS	$V_R$ KCAS	126	126	126	126	126	126	126	126	126	126	126	126
MAX TEMP = 55°C	$V_2$ KCAS	131	131	131	131	131	131	131	131	131	131	131	131
<b>- 70,000 LB -</b>		FLD LNTH	5,010	4,650	4,330	4,080	3,880	3,780	3,730	3,680	3,630	3,520	3,420
$V_{SE} = 163$ KCAS	$V_1$ KCAS	118	116	114	113	112	112	112	112	112	112	112	112
$V_{REF} = 130$ KCAS	$V_R$ KCAS	121	121	121	121	121	121	121	121	121	121	121	121
MAX TEMP = 55°C	$V_2$ KCAS	126	126	126	126	126	126	126	126	126	126	126	126
<b>- 65,000 LB -</b>		FLD LNTH	4,400	4,130	4,000	3,890	3,790	3,690	3,640	3,590	3,540	3,440	3,340
$V_{SE} = 157$ KCAS	$V_1$ KCAS	112	111	111	112	112	112	112	112	112	113	113	113
$V_{REF} = 125$ KCAS	$V_R$ KCAS	117	117	117	117	117	117	117	117	117	117	117	117
MAX TEMP = 55°C	$V_2$ KCAS	123	123	123	123	123	123	123	123	123	123	123	123
<b>- 60,000 LB -</b>		FLD LNTH	4,140	4,000	3,880	3,780	3,690	3,610	3,560	3,510	3,460	3,360	3,270
$V_{SE} = 151$ KCAS	$V_1$ KCAS	111	111	112	112	112	113	113	113	113	113	113	113
$V_{REF} = 119$ KCAS	$V_R$ KCAS	117	117	117	117	117	117	117	117	117	117	117	117
MAX TEMP = 55°C	$V_2$ KCAS	122	122	122	122	122	122	122	122	122	122	122	122
<b>- 55,000 LB -</b>		FLD LNTH	4,000	3,880	3,770	3,680	3,600	3,530	3,480	3,430	3,390	3,290	3,200
$V_{SE} = 144$ KCAS	$V_1$ KCAS	111	112	112	113	113	114	114	114	114	114	114	114
$V_{REF} = 113$ KCAS	$V_R$ KCAS	117	117	117	117	117	117	117	117	117	117	117	117
MAX TEMP = 55°C	$V_2$ KCAS	122	122	122	122	122	122	122	122	122	122	122	122
<b>- 50,000 LB -</b>		FLD LNTH	3,670	3,760	3,660	3,590	3,520	3,450	3,410	3,360	3,310	3,220	3,130
$V_{SE} = 138$ KCAS	$V_1$ KCAS	112	112	113	113	114	114	114	114	114	114	115	115
$V_{REF} = 110$ KCAS	$V_R$ KCAS	117	117	117	117	117	117	117	117	117	117	117	117
MAX TEMP = 55°C	$V_2$ KCAS	122	122	122	122	122	122	122	122	122	122	122	122

- Notes:
1. Increase available field length 2% for each 5 knots of headwind (up to 40 knots).
  2. Decrease available field length 18% for each 1% of uphill slope (up to 2%).
  3. Decrease field length 1,100 feet if ground spoilers are inoperative.
  4. Data is valid for engine bleeds off
  5. Cowl and wing anti-ice off

An average of the sea level and the 2,000' elevation takeoff charts was used since the Airport elevation is between the two. Average = 6,765'

GULFSTREAM TAKEOFF RUNWAY LENGTH REQUIREMENT  
 (2,000' CHART)

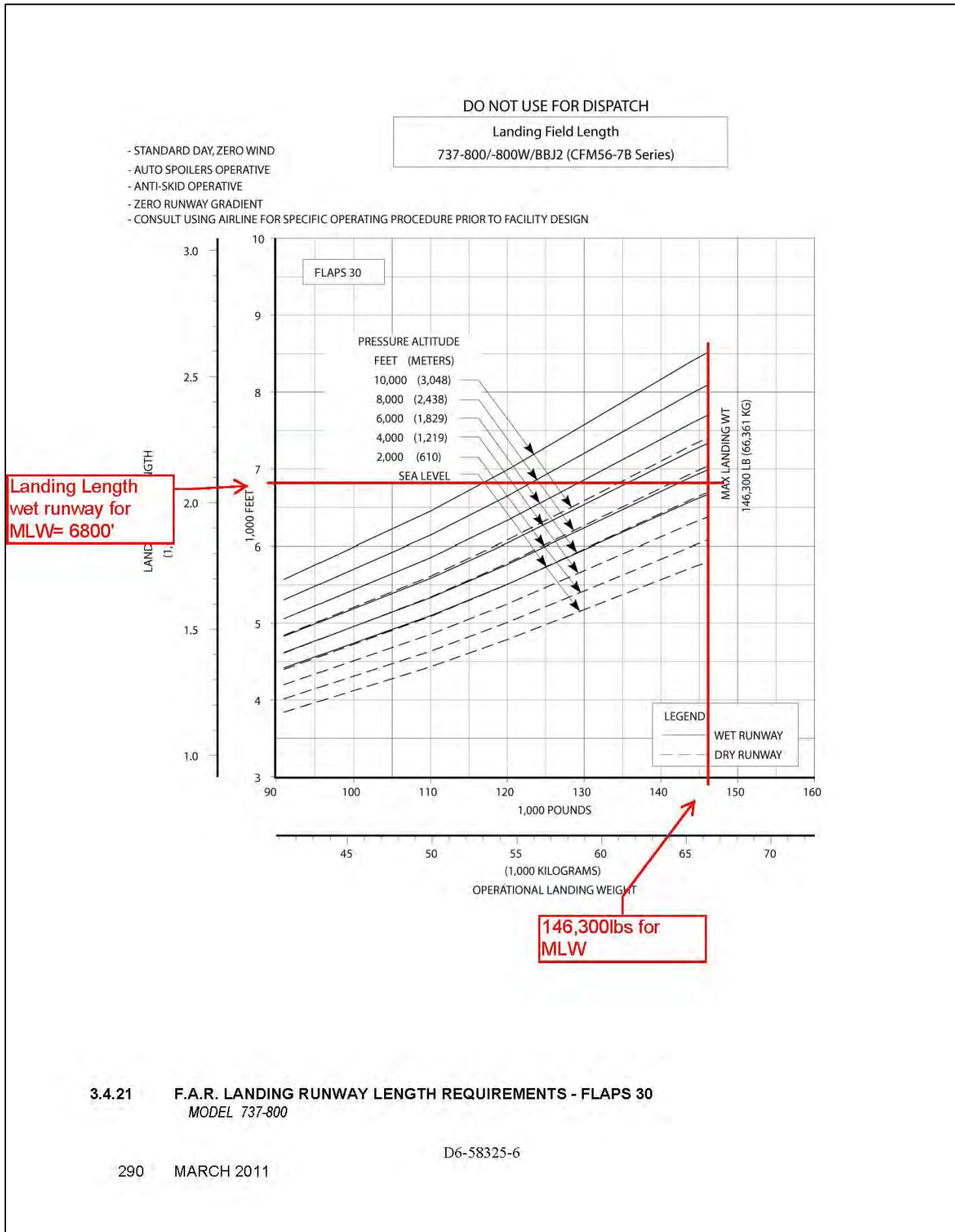
		Takeoff – Dry Runway – Flaps 20°											
		Airport Pressure Altitude = 2,000 feet											
91,000 LB MTOGW		OAT (°C)	50	45	40	35	30	25	20	15	10	0	-10
		OAT (°F)	122	113	104	95	86	77	68	59	50	32	14
		RATED EPR	1.45	1.48	1.51	1.54	1.58	1.60	1.60	1.60	1.60	1.60	1.60
<b>-- 91,000 LB --</b>													
	FLD LNTH	*****	*****	8,580	7,840	7,330	6,960	6,650	6,750	6,640	6,430	6,220	
V <sub>rot</sub> = 193 KCAS	V <sub>1</sub> KCAS	*****	*****	143	142	141	140	140	140	140	140	140	140
V <sub>rot</sub> = 155 KCAS	V <sub>R</sub> KCAS	*****	*****	143	143	143	143	143	143	143	143	143	143
MAX TEMP = 44°C	V <sub>2</sub> KCAS	*****	*****	149	149	149	149	149	149	149	149	149	149
<b>-- 90,000 LB --</b>													
	FLD LNTH	*****	9,270	8,310	7,630	7,150	6,790	6,680	6,580	6,480	6,270	6,070	
V <sub>rot</sub> = 192 KCAS	V <sub>1</sub> KCAS	*****	142	142	141	140	139	139	139	139	139	139	139
V <sub>rot</sub> = 155 KCAS	V <sub>R</sub> KCAS	*****	142	142	142	142	142	142	142	142	142	142	142
MAX TEMP = 45°C	V <sub>2</sub> KCAS	*****	148	148	148	148	148	148	148	148	148	148	148
<b>-- 85,000 LB --</b>													
	FLD LNTH	8,810	7,860	7,160	6,700	6,300	5,990	5,900	5,810	5,720	5,540	5,360	
V <sub>rot</sub> = 185 KCAS	V <sub>1</sub> KCAS	137	137	136	135	133	132	132	132	132	132	132	132
V <sub>rot</sub> = 149 KCAS	V <sub>R</sub> KCAS	137	137	137	137	137	137	137	137	137	137	137	137
MAX TEMP = 50°C	V <sub>2</sub> KCAS	142	142	142	142	142	142	142	142	142	142	142	142
<b>-- 80,000 LB --</b>													
	FLD LNTH	7,410	6,710	6,250	5,870	5,530	5,260	5,180	5,100	5,020	4,870	4,710	
V <sub>rot</sub> = 178 KCAS	V <sub>1</sub> KCAS	131	131	129	128	126	125	125	125	125	125	125	125
V <sub>rot</sub> = 143 KCAS	V <sub>R</sub> KCAS	132	132	132	132	132	132	132	132	132	132	132	132
MAX TEMP = 51°C	V <sub>2</sub> KCAS	137	137	137	137	137	137	137	137	137	137	137	137
<b>-- 75,000 LB --</b>													
	FLD LNTH	6,290	5,840	5,450	5,130	4,840	4,610	4,540	4,470	4,400	4,260	4,130	
V <sub>rot</sub> = 171 KCAS	V <sub>1</sub> KCAS	126	124	123	121	120	119	119	119	119	119	119	119
V <sub>rot</sub> = 137 KCAS	V <sub>R</sub> KCAS	127	127	127	127	127	127	127	127	127	127	127	127
MAX TEMP = 51°C	V <sub>2</sub> KCAS	132	132	132	132	132	132	132	132	132	132	132	132
<b>-- 70,000 LB --</b>													
	FLD LNTH	5,430	5,050	4,720	4,450	4,210	4,010	3,950	3,890	3,840	3,720	3,600	
V <sub>rot</sub> = 164 KCAS	V <sub>1</sub> KCAS	119	117	116	114	113	111	111	111	111	111	111	111
V <sub>rot</sub> = 131 KCAS	V <sub>R</sub> KCAS	122	122	122	122	122	122	122	122	122	122	122	122
MAX TEMP = 51°C	V <sub>2</sub> KCAS	127	127	127	127	127	127	127	127	127	127	127	127
<b>-- 65,000 LB --</b>													
	FLD LNTH	4,720	4,400	4,130	3,980	3,870	3,780	3,730	3,680	3,620	3,520	3,410	
V <sub>rot</sub> = 158 KCAS	V <sub>1</sub> KCAS	113	111	109	109	109	110	110	110	110	110	110	110
V <sub>rot</sub> = 125 KCAS	V <sub>R</sub> KCAS	117	117	117	117	117	117	117	117	117	117	117	117
MAX TEMP = 51°C	V <sub>2</sub> KCAS	123	123	123	123	123	123	123	123	123	123	123	123
<b>-- 60,000 LB --</b>													
	FLD LNTH	4,370	4,110	3,970	3,870	3,770	3,690	3,640	3,590	3,540	3,440	3,330	
V <sub>rot</sub> = 151 KCAS	V <sub>1</sub> KCAS	111	109	109	110	110	110	110	110	110	110	110	111
V <sub>rot</sub> = 119 KCAS	V <sub>R</sub> KCAS	117	117	117	117	117	117	117	117	117	117	117	117
MAX TEMP = 51°C	V <sub>2</sub> KCAS	122	122	122	122	122	122	122	122	122	122	122	122
<b>-- 55,000 LB --</b>													
	FLD LNTH	4,090	3,960	3,860	3,760	3,680	3,600	3,550	3,500	3,460	3,360	3,260	
V <sub>rot</sub> = 145 KCAS	V <sub>1</sub> KCAS	109	109	110	110	111	111	111	111	111	111	111	111
V <sub>rot</sub> = 113 KCAS	V <sub>R</sub> KCAS	117	117	117	117	117	117	117	117	117	117	117	117
MAX TEMP = 51°C	V <sub>2</sub> KCAS	122	122	122	122	122	122	122	122	122	122	122	122
<b>-- 50,000 LB --</b>													
	FLD LNTH	3,950	3,840	3,740	3,660	3,580	3,520	3,470	3,420	3,380	3,280	3,180	
V <sub>rot</sub> = 138 KCAS	V <sub>1</sub> KCAS	109	110	110	111	111	111	112	112	112	112	112	112
V <sub>rot</sub> = 110 KCAS	V <sub>R</sub> KCAS	117	117	117	117	117	117	117	117	117	117	117	117
MAX TEMP = 51°C	V <sub>2</sub> KCAS	122	122	122	122	122	122	122	122	122	122	122	122

- Notes:
1. Increase available field length 2% for each 5 knots of headwind (up to 40 knots).
  2. Decrease available field length 18% for each 1% of uphill slope (up to 2%).
  3. Decrease field length 1,100 feet if ground spoilers are inoperative.
  4. Data is valid for engine bleeds off
  5. Cowl and wing anti-ice off

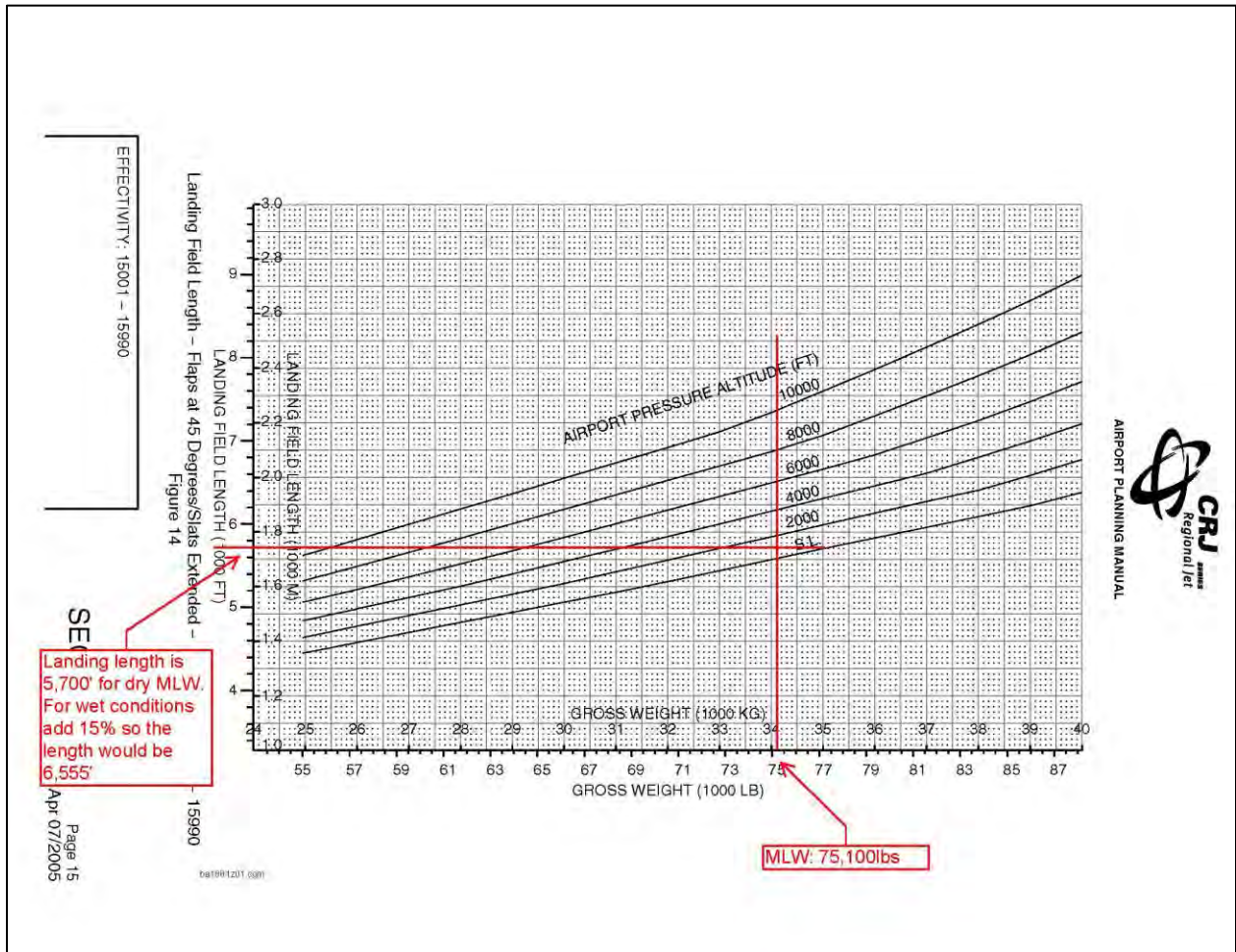
An average of the sea level and the 2,000' elevation takeoff charts was used since the Airport elevation is between the two. Average = 6,765'



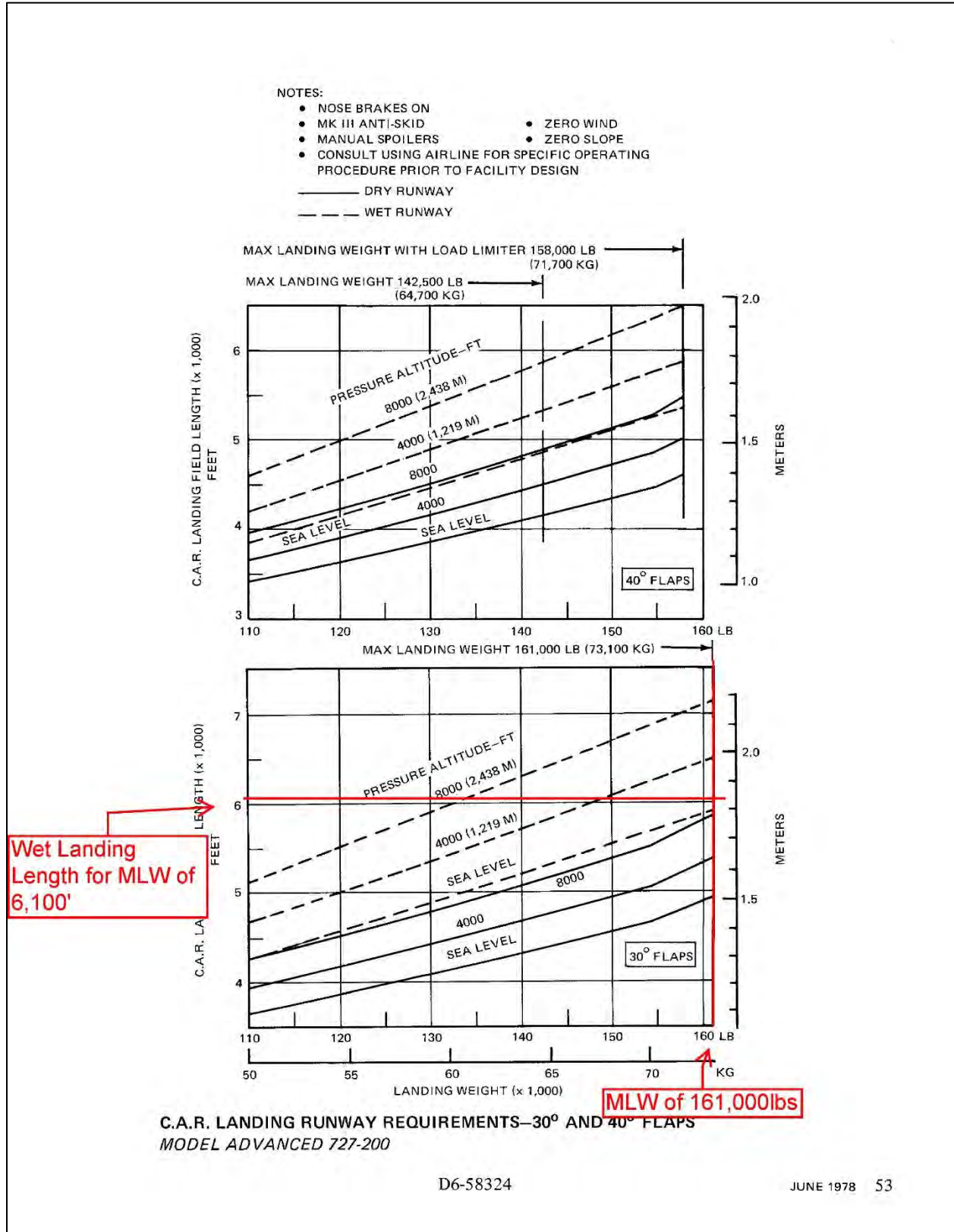
B737-800 LANDING LENGTH REQUIREMENT



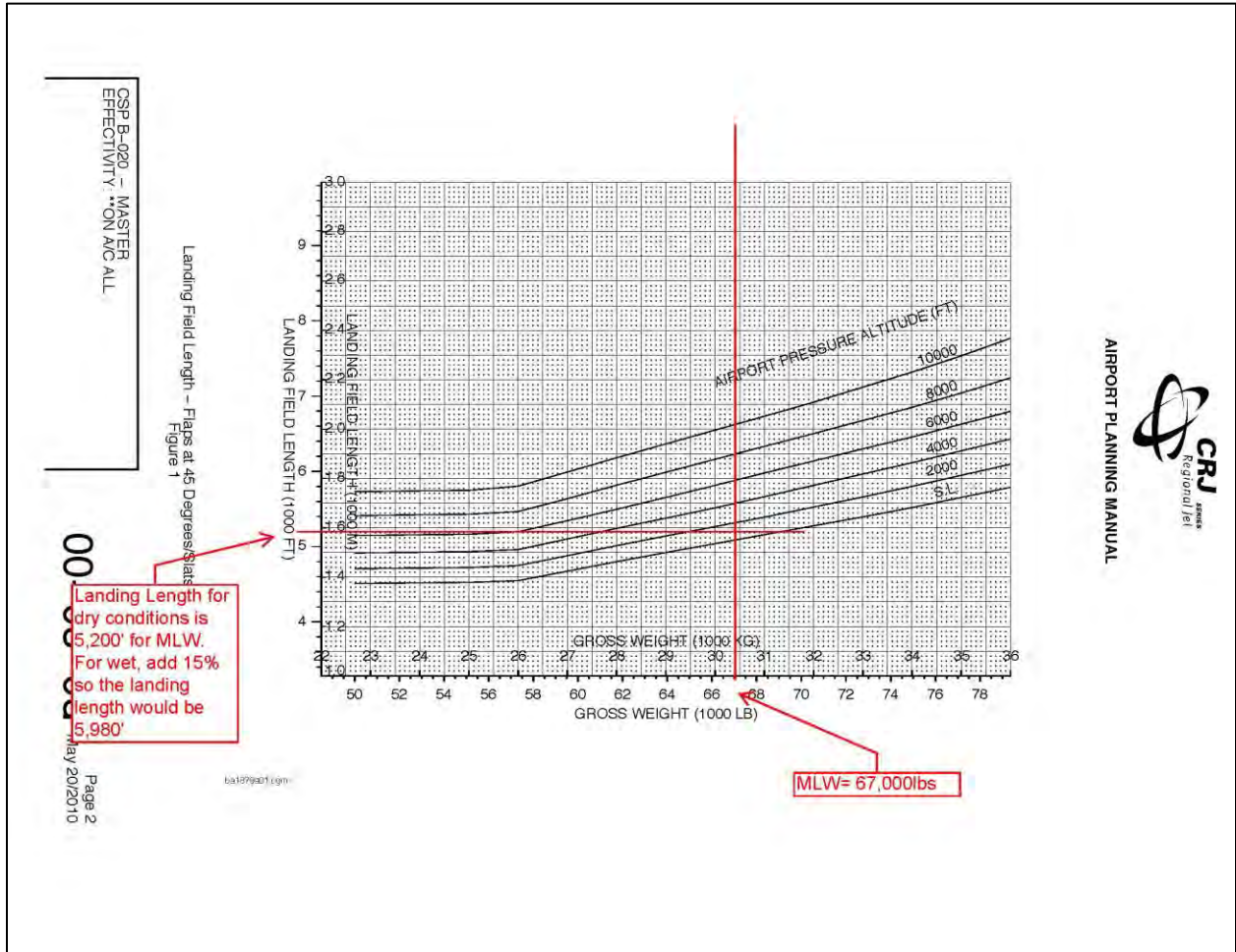
CRJ 900 LANDING LENGTH REQUIREMENT



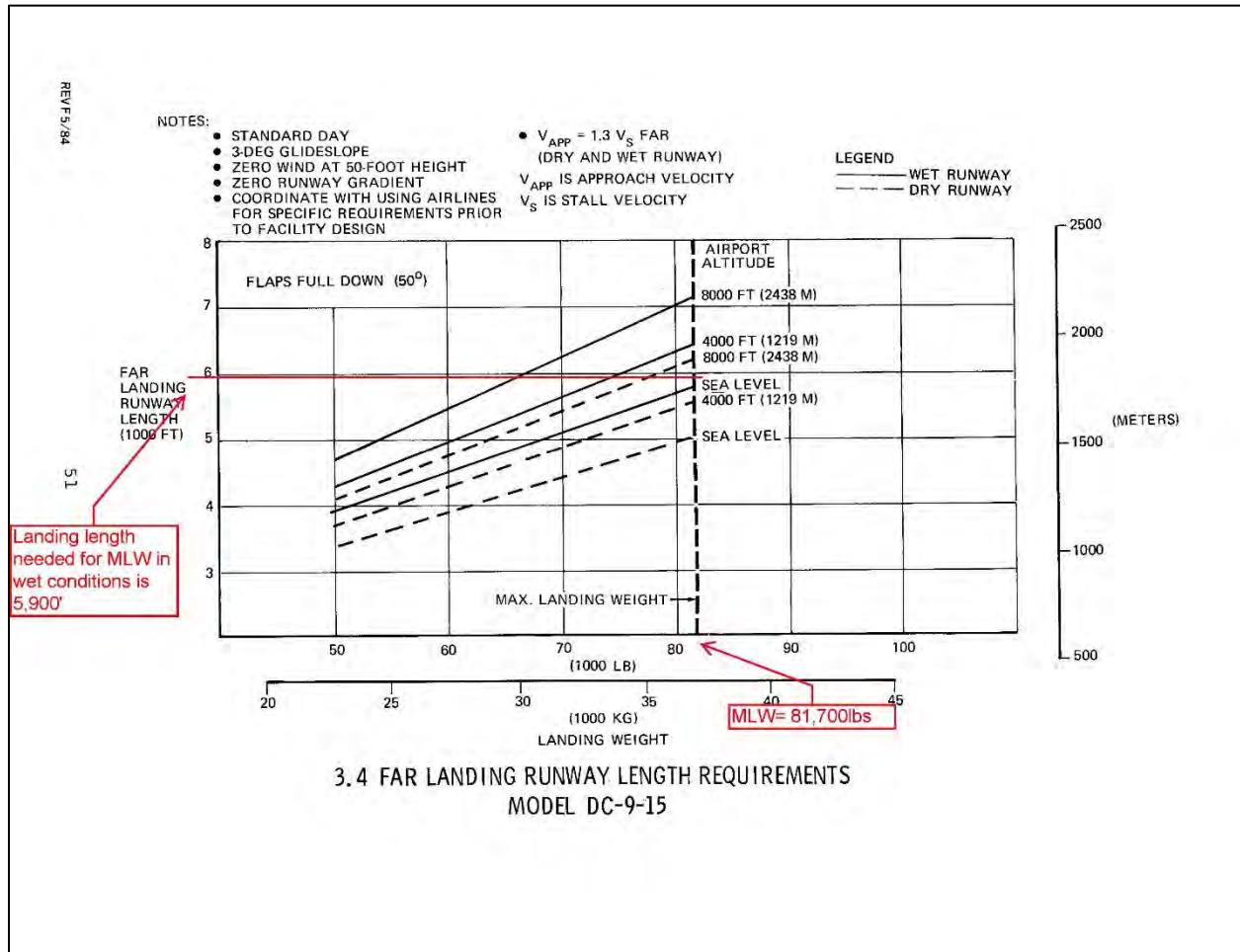
B727 LANDING LENGTH REQUIREMENT



CRJ 700 LANDING LENGTH REQUIREMENT

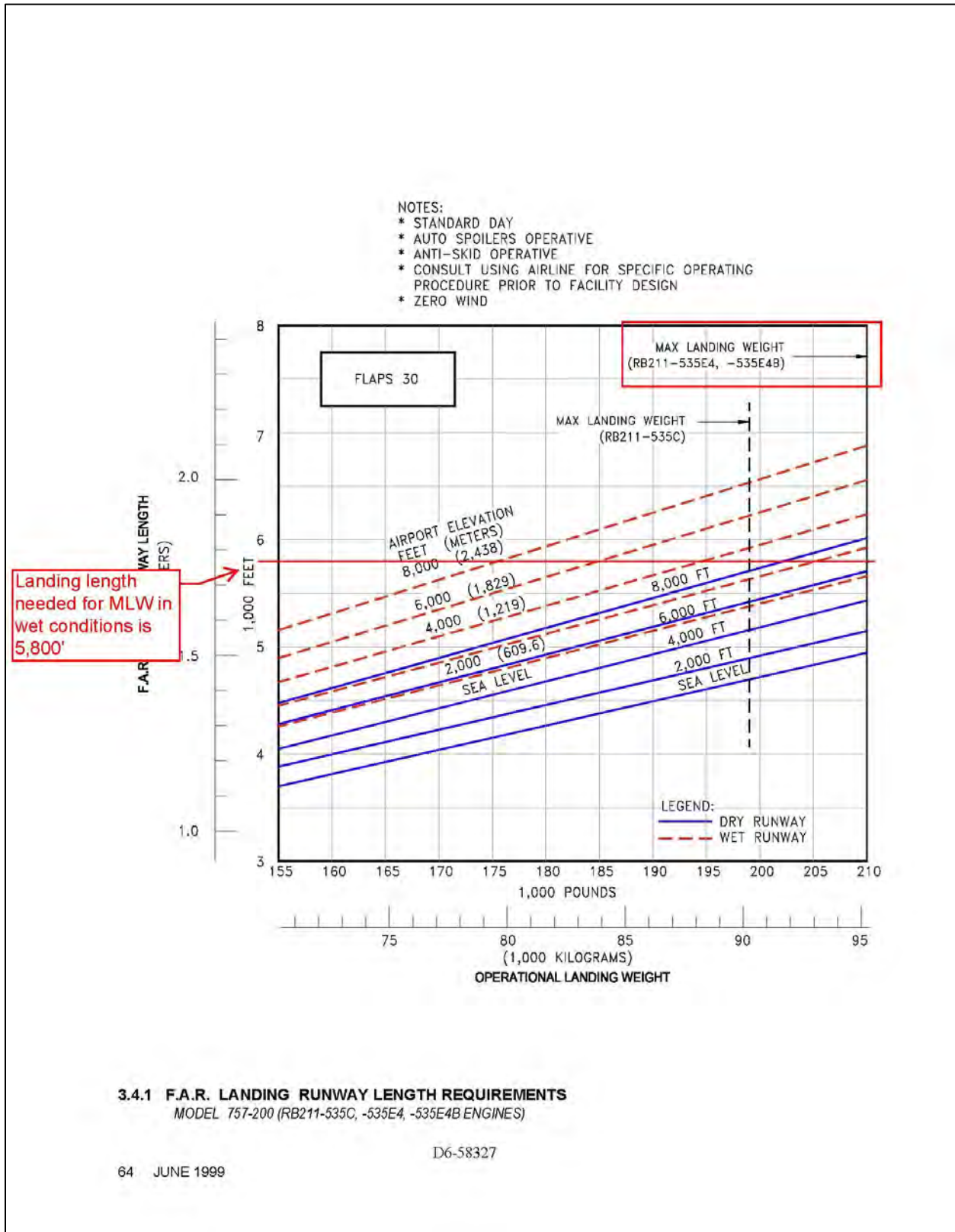


DC-9 LANDING LENGTH REQUIREMENT





B757 LANDING LENGTH REQUIREMENT



GULFSTREAM LANDING LENGTH REQUIREMENT

# Landing Distance

Using Twin-Engine R MTOW of 75,300lbs No Braking)

Landing Distance (Feet)						
ALT (Ft)	Gross Weight (lb)					
	90,500	90,000	85,000	80,000	75,300	75,000
15,000	14,160	14,060	13,070	12,100	11,220	11,160
14,000	13,560	13,460	12,510	11,590	10,740	10,690
12,000	12,450	12,360	11,490	10,660	9,880	9,830
10,000	11,470	11,390	10,590	9,820	9,110	9,060
8,000	10,560	10,480	9,760	9,040	8,390	8,350
6,000	9,750	9,680	9,010	8,360	7,760	7,730
4,000	9,010	8,950	8,330	7,740	7,190	7,160
2,000	8,340	8,280	7,710	7,160	6,660	6,630
0	7,740	7,680	7,160	6,660	6,200	6,180

Landing Distance (Feet)						
ALT	Gross Weight (lb)					
	70,000	65,000	60,000	55,000	50,000	45,000
15,000	10,240	9,350	8,490	7,660	6,870	6,130
14,000	9,250	8,360	7,490	6,670	5,980	5,240
12,000	8,260	7,370	6,490	5,770	5,080	4,340
10,000	7,270	6,380	5,490	4,860	4,170	3,430
8,000	6,280	5,390	4,490	3,950	3,260	2,520
6,000	5,290	4,400	3,500	2,930	2,240	1,500
4,000	4,300	3,410	2,510	1,900	1,210	470
2,000	3,310	2,420	1,510	900	210	210
0	2,320	1,430	510	110	110	110

Average of the two elevations to get Airport LDA

An average of 6,660'+6,200' is 6,430' plus 15% for wet runways is 7,395'

**Notes:**

1. Reference Landing Field Length is a FAR 135 factored, ISA-Day, dry runway distance for a normal landing configuration (Flaps 39°, Anti-Skid operative and Automatic deployment of speed brakes / ground spoilers).
2. For intended destination wet, multiply landing field lengths above by 1.15.
3. For unfactored landing distances, multiply field lengths above by 0.60.
4. Field lengths seen above are based on no wind or runway slope, but may be conservatively used with headwinds or uphill runway slopes.