APPENDIX E:

BST RUNWAY 15-33 CORRIDOR ANALYSIS

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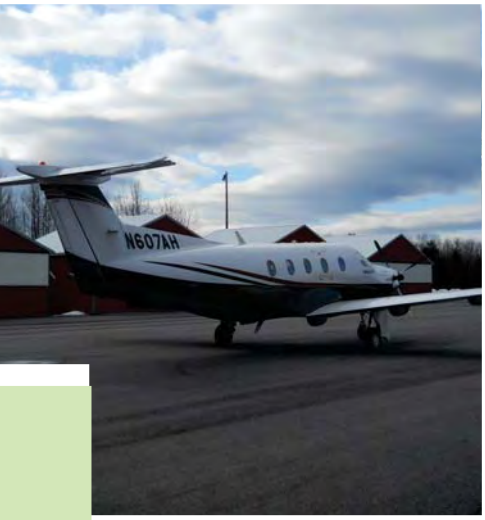
Belfast Municipal Airport

Airport Master Plan Update

Phase 1



City of Belfast, Maine

Runway 15-33 Corridor Analysis

ASG Innovative Airport Development Specialists

August 20, 2014

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Belfast Municipal Airport

Airport Master Plan Update – Phase 1

Belfast, Maine

Runway Corridor Analysis

August 20, 2014

Purpose

The City of Belfast, Maine wants to identify the potential need for runway operational enhancements at Belfast Municipal Airport (BST) that could include extended runway length. The City and the Airport have indicated that there is an existing demand for BST to accommodate corporate jet aircraft operations by a prominent, local company. Additionally, it has been recognized that other local area businesses and industries that currently utilize corporate aviation (either through their direct use or their customers' use) would also benefit from runway operational enhancements. The current Airport Master Plan did not consider this type of utilization and/or interest by corporate jet aircraft operators. This may have been due to the fact that the Airport has substantial constraints within its runway corridor that could impact its potential ultimate length.

As a potential prelude to a complete Airport Master Plan Update (AMPU), this Technical Memorandum encapsulates a "runway corridor analysis" that focuses on identifying and evaluating the implications with meeting the long-term demand for corporate in support of local industry for the benefit of the regional economy. This planning effort has been requested by the Federal Aviation Administration (FAA) in order to assess the potential for securing federal funding for any future projects related to runway enhancements. Specifically, this memo considers if improvements need to be made to BST's existing 4,000-foot runway in order to satisfy the long-term operational demand of critical aircraft that may operate at the Airport in the future. It is important to note that both the City and the Airport have indicated that there is strong community support for BST and its potential for supporting local economic growth.

(Note that if the resulting analysis indicates a substantial number of aircraft activities that would require and/or benefit from runway enhancements, a complete update to the Airport Master Plan will be required. At that point, the results of this analysis will be considered to be a Phase 1 of the AMPU and would be directly included into the subsequent phase of the complete AMPU.)

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Introduction, Continued

Process

As a potential Phase 1 of an overall AMPU, this planning effort complies with the requirements of FAA AC 150/5070-6B, *Airport Master Plans*, in addition to the FAA's primary guidance for determining runway length requirements (including FAA AC 150/5300-13A, *Airport Design*, and FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*). In general, this Technical Memorandum has been designed to answer the following three questions:

1. *What are the current conditions at Belfast Municipal Airport?* In response, this assessment will:
   - Provide a data collection effort based on existing data sources
   - Identify the current Design Aircraft and Runway Design Code for the Airport.
   - Identify the relevant airport design considerations per FAA AC 150/5300-13, *Airport Design*, that result from that current RDC determination.
   - Conduct a high-level forecast of aircraft operations at the Airport to compare current conditions with potential future conditions.

2. *What is the projected runway length requirement for Runway 15-33 at Belfast Municipal Airport?* To this end, this assessment will:
   - Conduct a runway length requirement analysis for Runway 15-33 based on the methodology stipulated in FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*.

3. *What are the reasonable alternatives for meeting the projected runway length requirements for Runway 15-33 when considering the current Airport operational and FAA regulatory environments?* To answer this question, this assessment will:
   - Identify physical and regulatory thresholds within the runway corridor
   - Identify a reasonable set of alternatives that meet the projected requriements to varying degrees.
   - Conduct an assessment of the alternatives.
   - Provide conclusions and recommendations.

Existing Conditions

Introduction

This section describes the role, activity, and physical facilities of the Belfast Municipal Airport (herein referred to as the "Airport" or by its identifier "BST") in Belfast, Maine. This inventory was conducted using the following sources of information:

- Current Airport Master Plan Update (AMPU) and Airport Layout Plan (ALP) update;
- Site visit and local area knowledge;
- Interviews with city officials;
- Coordination with the Maine Department of Transportation (MaineDOT) and Federal Aviation Administration (FAA); and
- FAA and MaineDOT Websites.

Location and Role

BST is located along Coastal Maine, approximately 100 miles east of Portland, Maine and 36 miles south of Bangor, Maine, in Waldo County. The Airport is located off U.S. Route 1 and Congress Street, 1 mile south of the city center. Route 1 is a north-south connector between Canada (St. Stephen, New Brunswick) and points south. State Route 3 is located east of the Airport (bisects U.S. Route 1) providing access to Augusta and I-95.

Owner: .....City of Belfast
Use: ..... Public
NPIAS Role: ..... General aviation (current and 5-year plan)
Asset Study Role: ..... General Aviation - Local
Airport Reference Point: .....44° 24' 34" N / 069° 00' 43" W
Field Elevation: ..... 197.7 feet above mean seal level (MSL)
Area Owned in Fee Simple: ..... 221 acres
Area Owned in Easement:..... 80 acres

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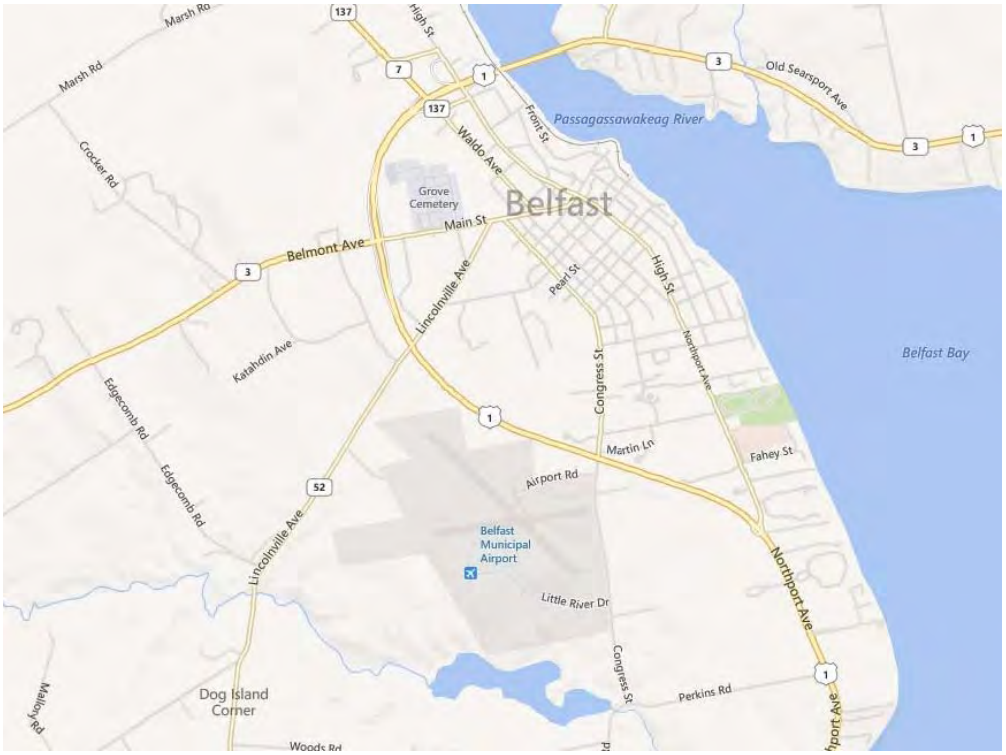
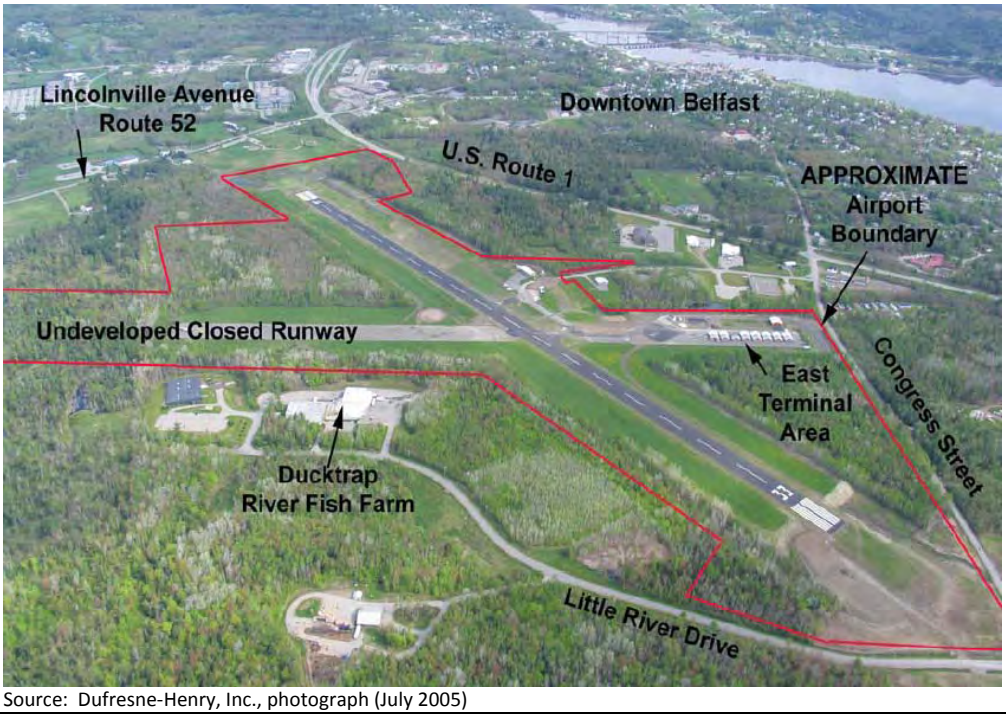
Airport Location Map



Source: Bing Maps 2014

Airport Aerial Image



Source: Dufresne-Henry, Inc., photograph (July 2005)

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Existing Conditions, Continued

Runway

BST has a single paved runway designated 15-33 (true bearing 133.42 – 313.43 degrees) that is 4,000 feet long by 100 feet wide. The surface is bituminous with a weight bearing capacity of 30,000 pounds for single-wheel aircraft. The Runway 15 approach end elevation is 197.7 feet above Mean Sea Level (MSL) and the Runway 33 approach end elevation is 158.7 feet (MSL), resulting in a gradient of 0.98% sloping toward the Runway 15 approach end. Runway 15-33 is in good condition, having been fully reconstructed in 2004.

BST had a crosswind runway (Runway 10-28) that has been decommissioned and since been the site of recent hangar development.

Taxiways

The Airport currently has a total of three taxiways – a short, partial parallel taxiway (located midfield) for the runway supported by two stub taxiways. The partial parallel taxiway is approximately 350 feet long by 35 feet wide. The two stub taxiways are each approximately 50 feet wide by 130 feet long. The current runway-to-taxiway centerline distance is 200 feet. Note that FAA airport design standards (based on FAA AC 150/5300-13A, *Airport Design*) for BST require a runway-taxiway separation of 225 feet and a minimum of 25 foot wide taxiways.

Aprons & Tiedowns

The Airport has one large aircraft parking apron that was originally the east end of the former Runway 10-28. The apron was expanded slightly in the summer of 2005 when the terminal building and fueling apron were moved to their current location, and again in 2006 to make room for an additional row of hangars. There are a total of 13 marked tiedowns on the apron.

Hangars

BST has a total of 23 hangars, 22 of which are located on the closed runway. Twenty of these are individual wood frame hangars of approximately 1,120 square feet (28 x 40 feet), while one is 50 x 55 feet (2,750 square feet) and another is 60 x 65 feet (3,900 square feet). All of these hangars are privately owned.

There is also an older hangar that is approximately 40 x 90 feet (3,600 square feet) located to the west of the primary hangar area. This facility is operated by the Airport's Fixed Base Operator (FBO) who leases it from the City of Belfast.

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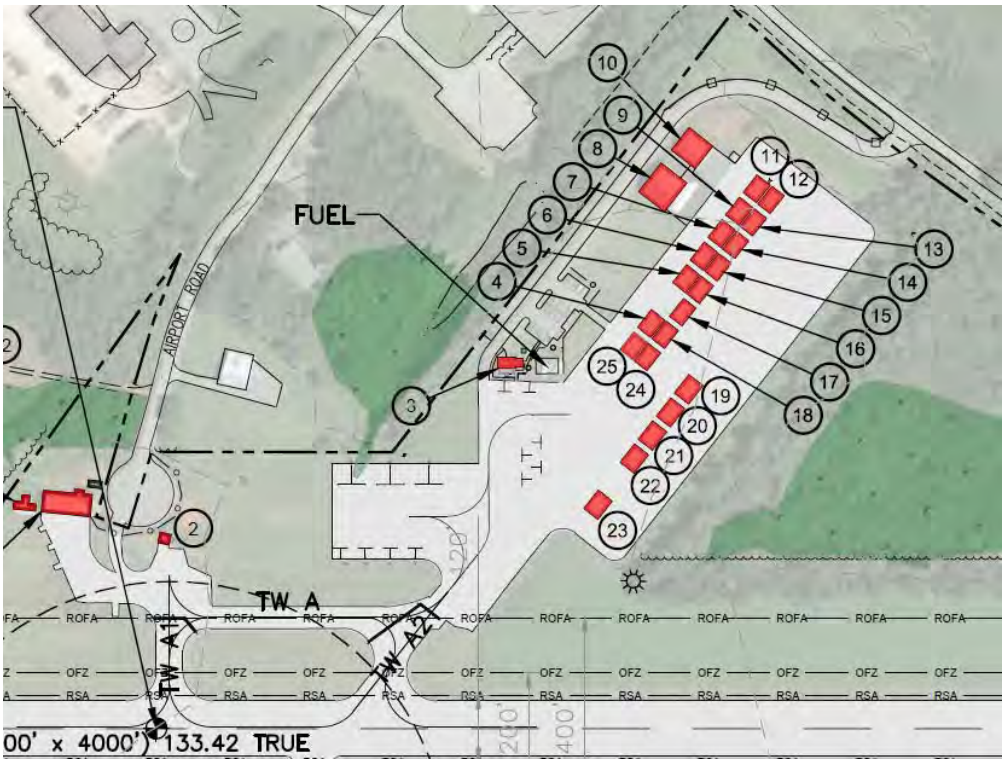
Existing Conditions, Continued

Airport Terminal Area



Source: Airport Solutions Group

Airport Lighting, Visual Navigation Aids, Markings

Following is a listing of BST's lights and systems:

Airport Rotating Beacon: .....On-Airport
Runway Lights: ..... Medium Intensity Runway Lights (MIRL)
Runway End Identifier Lights (REIL): ..... Runways 15 & 33
Vertical Guidance Slope Indicators (VGSI): ..... None
Runway Markings: ..... Non-Precision Instrument (NPI)
Navigational Aids: ..... NDB, GPS, LPV (pending)
Weather Reporting: ..... AWOS
Other Aids: ..... Lighted Wind Sock and Segmented Circle
Instrument Approach Procedures: .....
..... NDB (RW 15); RNAV (RW 15); RNAV (RW 33)
Lowest Approach Visibility Minimums: ..... 1 mile

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Existing Conditions, Continued

Support Facilities

Administration / FBO Building

The administration building was moved to its present location in 2004. It is a single-story, 28 x 40 foot wood structure that accommodates the Airport's only FBO (Maine Scenic Airways), as well as a flight training school. The FBO also operates the hangar mentioned previously.

Fueling Facilities

The Airport offers aviation gasoline (100LL), provided through a double-walled above ground 5,000 gallon tank. The fueling area is located on the main ramp adjacent to the FBO.

Ground Access

Airport access changed in 2004 when the FBO building was moved to its current location. The access, recently named Wright Brothers Drive, connects to Congress Street.

Automobile Parking

Automobile parking changed in 2004 when the FBO building was relocated. The paved lot measures 50 x 128 feet with room for approximately 19 automobiles.

Design Aircraft

FAA's airport design standards (FAA AC 150/5300-13A, *Airport Design*) are based on several design reference codes, which are established by the airport's design aircraft. The "design aircraft" is defined as the largest and fastest aircraft (in terms of wingspan and approach speed) that conducts at least 500 annual operations (takeoffs or landings), whether locally based or itinerant.

Based aircraft at Belfast Municipal include traditional Cessna, Beechcraft, Grumman, and Piper single-engine airplanes. The largest itinerant aircraft currently operating at the Airport is the Pilatus PC-12, a single-engine, nine-passenger turboprop aircraft utilized for typical general aviation activities. The Pilatus PC-12 represents BST's current design aircraft having the largest wingspan and fastest landing approach speed. Based on discussions with the aircraft's operator, the PC-12 has over 500 annual operations at BST. Its performance and specifications are listed below:

Design Aircraft: ..... Pilatus PC-12
Wingspan: ..... 53 feet, 3 inches
Airplane Design Group (ADG): II
Approach Speed: ..... 91 knots
Aircraft Approach Category (AAC): ..... B
Maximum Gross Takeoff Weight: ..... 10,450 pounds
Takeoff Field Length (over 50 ft obstacle): ..... 2,300 feet
Landing Distance (over 50 ft obstacle): ..... 1,830 feet

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Design Aircraft
(continued)

Source: Pilatus Aircraft Ltd

Runway Design Code (RDC)

The RDC is a coding system used to relate the airport design criteria to the operational and physical characteristics of the airplanes intended to operate at the airport. The code has three components relating to the airport design aircraft (discussed in the previous section). The first component, depicted by a letter, is the Aircraft Approach Category and relates to the aircraft approach speed (operational characteristic). The second component, depicted by a Roman numeral, is the Airplane Design Group and relates to the airplane wingspan (physical characteristic). The third component relates to the runway's visibility minimums.

The existing RDC at BST is B-II, based on designation of the Pilatus PC-12 as the design aircraft. Note that this classification does not mean larger and faster aircraft do not and cannot use the Airport. It simply means that the limited frequency of use by larger and faster aircraft does not rise to the level to which the Airport would need to be specifically designed to meet their needs.

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Airport Design Standards

Section 103 of the Federal Aviation Act of 1958 requires the development and maintenance of a national system of safe, delay-free, and cost-effective airports. As such, a system of standards and recommendations for the design of airports has been developed by the FAA so as to support this public charge. These standards and recommendations are detailed in FAA AC 150/5300-13A, *Airport Design*. For the purposes of this study, four of the airport design standards included in FAA AC 150/5300-13A have been identified for review. These standards were selected based on their potential directly impact the results of this *Runway Corridor Analysis* and are discussed below.

Runway Safety Area (RSA)

RSA dimensional requirements are determined by a combination of the RDC and the lowest instrument approach minimums for that runway. The RSA is designed to promote and increase airport safety, and is defined as a two-dimensional ground area centered on, and surrounding a runway which is prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway. The RSA, in accordance with FAA standards, should be free and clear of any obstructions, and should also be graded, but not necessarily paved. The existing RSA for BST is described in the following table.

RDC	Minimum Approach Visibility	RSA Length (beyond runway end)	RSA Width
B-II	> ¾ mile	300 feet	150 feet

Source: FAA AC 150/5300-13A, *Airport Design.*

Runway Object Free Area (ROFA)

ROFA dimensional requirements are also determined by a combination of the individual RDC of each airport runway and the lowest instrument approach minimums to that runway. A ROFA is a two-dimensional ground area centered on the runway centerline that requires the clearing of above ground objects protruding above the Runway Safety Area edge elevation. The FAA's standard for ROFAs asserts that no above ground objects be located within the OFA (including aircraft parking), unless the object is for the purpose of air navigation or aircraft ground maneuvering. The existing ROFA for BST is described in the following table.

RDC	Minimum Approach Visibility	RSA Length (beyond runway end)	RSA Width
B-II	> ¾ mile	300 feet	150 feet

Source: FAA AC 150/5300-13A, *Airport Design.*

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Airport Design Standards (continued)

Obstacle Free Zone (OFZ)

The OFZ clearing standard precludes aircraft and other object penetrations, except for frangible NAVAIDs that need to be located in the OFZ because of their function. It is both a design surface, and an operational surface that must be kept clear during operations. Its shape is dependent on the approach minimums for the runway end and the aircraft on approach. The Runway Obstacle Free Zone (ROFZ) is a defined volume of airspace centered above the runway centerline, above a surface whose elevation at any point is the same as the elevation of the nearest point on the runway centerline. At BST, the ROFZ extends 200 feet beyond each end of the runway and is 250 feet wide, based on the need of the runway to accommodate operations by small aircraft with approach speeds of 50 knots or more. While there are other OFZs other than the ROFZ, none are applicable to BST.

Runway Protection Zone (RPZ)

The RPZ is trapezoidal in shape and is centered on the extended runway centerline. The function of the RPZ is to enhance the protection of people and property on the ground, which is ideally achieved through airport ownership of the RPZ. Having control of the RPZ is ideal for ensuring that inappropriate development does not take place in the runway approaches; however, it is not necessarily essential. Some RPZ-compatible land uses, like the cemeteries near EWB, are effectively limited by their nature to be maintained as a compatible use.

The RPZ begins 200 feet beyond the end of the runway pavement that is usable for takeoffs and landings. The actual width and length of the RPZ is contingent on the RDC and the type of approach available. Generally, as the aircraft size increases and the approach minimums become more precise, the dimensions of the RPZ increase.

The RPZs on the approach ends of BST's Runway 15-33 is described in the following table.

RDC	Minimum Approach Visibility	Length	Inner Width	Outer Width
B-II	Non-Precision	1,000 feet	500 feet	700 feet

Source: FAA AC 150/5300-13A, *Airport Design*.

Projection of Aviation Activities

Introduction

Projecting future aviation demand is a critical element in the airport planning process since many of the ultimate proposals and recommendations of a master plan are principally based on aviation activity demand forecasts. Since the overall purpose of this planning effort is to establish the potential operational requirements for general aviation jet/business aircraft at BST, it is necessary to investigate if there is a reasonable basis for future runway operational enhancements by examining that specific category of aircraft. Thus, the purpose of this section is to identify potential changes in BST's future activities based on any forecasted change in larger aircraft activity at the Airport.

It is important to recognize that the FAA generates and maintains the current operational forecast for BST within its Terminal Area Forecast (TAF) database. So, this effort will focus primarily on if there is a significant deviation from the TAF that would also result in a change to the future critical design aircraft. If such a change were to be projected, it could impact BST's *Airport Design* requirements, which in turn could result in potential increased impacts associated with any runway extension. Therefore, this forecast is focused exclusively on projecting future aircraft operations, defined as either a departure or a landing (so, a single aircraft that lands and then later departs is counted as two operations).

For the purposes of this effort, the following forecasting methodologies have been reviewed and developed for aircraft operations at BST:

- FAA Terminal Area Forecast (TAF)
- Regression Analysis
- Trendline Analysis
- Market Share Analysis

These methodologies are discussed in the following sections.

Historical and Existing Conditions

Based on FAA airport inspection data as reflected in the Airport Master Record (as of 8/15/2011), the following table presents BST's existing based aircraft.

Single Engine	Multi Engine	Jet	Helicopter	Glider	Military	Ultra-Light	Total
15	0	0	1	0	0	1	**17**

Source: FAA 5010 *Airport Master Record*, 8/15/2011.

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Projection of Aviation Activities, Continued

Historical and Existing Conditions (continued)

FAA records also estimate that BST experienced a total of 10,000 aircraft operations in 2013. This total is broken down into operational types in the following table

Aircraft Category	Number	Percent of Total
Air Carrier (Itinerant)	0	0%
Air Taxi & Commuter (Itinerant)	2,000	20%
General Aviation (Itinerant)	2,000	20%
General Aviation (Local)	6,000	60%
Military (Itinerant)	0	0%
Total:	*10,000*	*100%*

Source: FAA Terminal Area Forecast (TAF) for 2013 (Forecast issued February 2014)

The following table presents the FAA's current operational estimate by fleet-mix. This assumes the local/itinerant mix is 65/35 percent respectively.

Aircraft Category	Local		Itinerant		Total	
	Count	Mix	Count	Mix	Count	Mix
Single-Engine Reciprocating	6,175	95.0%	2,730	78.0%	8,905	89.1%
Multi-Engine Reciprocating	0	0%	175	5.0%	175	1.8%
Turboprop	0	0%	525	15.0%	525	5.3%
Jet	0	0%	0	0%	0	0%
Ultralight	162	2.5%	0	0%	162	1.6%
Helicopter	163	2.5%	70	2.0%	233	2.3%
Military (Itinerant)	0	0%	0	0%	0	0%
Total:	*6,500*	*100%*	*3,500*	*100%*	*10,000*	*100%*

Source: Airport Solutions Group; BST ALP Update (2008).

FAA Terminal Area Forecast (TAF)

Belfast Municipal Airport's current FAA TAF for aircraft operations and based aircraft is reflected in the following table.

Year	Itinerant Operations				Local Operations		Total Operations	Total Based Aircraft
	Air Carrier	AT & Commuter	GA	Military	Civil	Military		
2014	0	2,000	2,000	0	6,000	0	10,000	17
2019	0	2,000	2,000	0	6,000	0	10,000	17
2024	0	2,000	2,000	0	6,000	0	10,000	17
2029	0	2,000	2,000	0	6,000	0	10,000	17
2034	0	2,000	2,000	0	6,000	0	10,000	17

Source: FAA Terminal Area Forecast (TAF) (Forecast issued February 2014).

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Regression Analysis

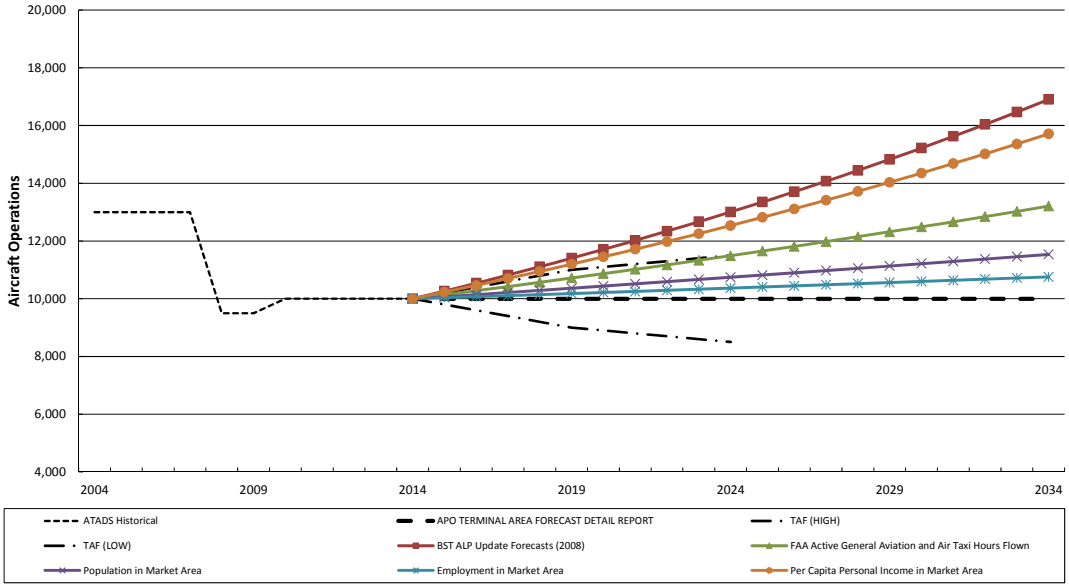
A regression analysis ties aviation demand (dependent variables), such as aircraft operations, to economic measures (independent variables), such as population, income or other reliable variables. Multiple combinations of these variables were tested as independent variable inputs against historic operations in a regression model, including the following:

- FAA Active General Aviation and Air Taxi Hours Flown
- Market Area Population
- Market Area Employment
- Market Area Per Capita Personal Income

Additionally, the aviation forecasts that had been generated and accepted by the FAA as part of the 2008 ALP Update were updated. All of the regression model variables, in addition to the updated 2008 forecast are reflected in the following table and chart. (Note that the FAA TAF estimate has also been included for comparative purposes.)

Year	FAA GA / Air Taxi Hours Flown	Market Area Population	Market Area Employment	Market Area Per Capita Personal Income	BST AMPU Forecasts (2008)	FAA TAF (2014)
2014	10,000	10,000	10,000	10,000	10,000	10,000
2019	10,717	10,364	10,180	11,197	11,404	10,000
2024	11,488	10,741	10,366	12,533	13,004	10,000
2029	12,316	11,134	10,561	14,033	14,827	10,000
2034	13,208	11,537	10,756	15,711	16,906	10,000

Source: Airport Solutions Group.



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Trendline Analysis

A trendline analysis typically uses the historical pattern of an activity and projects this trend into the future. For BST, aircraft operations in 2003 totaled approximately 13,000 in 2003, declining to an estimated 10,000 operations by 2008. Following this trend, BST would have no aircraft operations by 2030. This is inconsistent with what is being currently experienced at the Airport where operations have remained largely static. Additionally, it is not supported by the FAA's TAF which projects neither growth nor decline in operational totals. Therefore, the trendline analysis has been deemed to be inappropriate for application as part of this forecasting effort.

Market Share Analysis

A market share analysis assumes a top-down relationship between broader (i.e. national or regional) forecasts and local forecasts. Essentially, local forecasts are a market share (percentage) of a regional forecast, which in turn can itself be a market share (percentage) of national forecasts. For BST, the FAA TAF for the State of Maine was utilized as the basis for the market share analysis. The following table shows the total civil (i.e. non-military) aircraft operations as forecasted for Maine by the FAA. Annually, BST's civil aircraft operational total is on average 1.67 percent of the statewide total. By applying that percentage against the forecasted operational totals for Maine, a market share forecast can be established for BST (see following table).

Year	State of Maine Total Civil Operations	BST Total Civil Operations	BST % of Maine Total Civil Operations
Historic			
2009	621,723	10,000	1.61%
2010	606,766	10,000	1.65%
2011	593,538	10,000	1.68%
2012	594,534	10,000	1.68%
2013	586,192	10,000	1.71%
		Avg % of Total Civil Ops	*1.67%*
Forecasted			
2014	585,816	9,783	1.67%
2019	592,062	9,887	1.67%
2024	598,800	10,000	1.67%
2029	607,076	10,138	1.67%
2034	614,076	10,255	1.67%

Source: FAA TAF; Airport Solutions Group.

However, given that the basis of this *Runway Corridor Analysis* is to meet long term demand for aircraft that do not currently operate at BST (or do so very infrequently due to physical facility limitations), it is reasonable to include

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Market Share Analysis (continued)

their potential operations in this forecast. This can be accomplished by first identifying the existing level of jet operations within the market area. For BST, the closest airports that would reasonably accommodate existing jet demand for the Belfast area would be Bangor International Airport (BGR) and Knox County Regional Airport (RKD). The following table details the historical and forecasted jet operational levels for both of these airports.

Year	Bangor International (BGR)			Knox County Regional (RKD)		
	Jet Operations	Total Civil Operations	% Total Civil Operations	Jet Operations	Total Civil Operations	% Total Civil Operations
Historic						
2009	3,469	35,809	9.69%	1,450	55,000	2.64%
2010	3,538	33,555	10.54%	1,205	55,000	2.19%
2011	3,533	33,707	10.48%	1,038	55,000	1.89%
2012	3,421	35,604	9.61%	923	55,000	1.68%
2013	3,465	30,646	11.31%	797	55,098	1.45%
	Avg % of Total Civil Ops		*10.29%*	*Avg % of Total Civil Ops*		*1.97%*
Forecasted						
2014	3,127	30,382	10.29%	1,086	55,197	1.97%
2019	3,222	31,303	10.29%	1,096	55,707	1.97%
2024	3,319	32,246	10.29%	1,107	56,243	1.97%
2029	3,419	33,224	10.29%	1,118	56,814	1.97%
2034	3,523	34,236	10.29%	1,130	57,416	1.97%

Source: FAA Enhanced Traffic Management System Counts (ETMSC); FAA TAF; Airport Solutions Group.

Since it is the intent of this planning effort to explore the potential implications associated with providing facilities in the future, a specific percentage of forecasted jet operations for both BGR and RKD have been assumed to be accommodated by BST in the future. For the purposes of this planning effort, it has been assumed that up to 10 percent of the jet operations from both airports could be accommodated at BST if appropriate runway length and facilities were to be made available. It should be noted that this could be an aggressive assumption. Nevertheless, those totals have been added to the market share forecast presented above and are reflected in the following table.

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Projection of Aviation Activities, Continued

Market Share Analysis (continued)

Year	State of Maine Total Civil Operations	BST Total Civil Operations (non-jet)	BST % of Maine Total Civil Operations	BST Total Civil Operations (jet)*	BST Total Civil Operations
Historic					
2009	621,723	10,000	1.61%	0	10,000
2010	606,766	10,000	1.65%	0	10,000
2011	593,538	10,000	1.68%	0	10,000
2012	594,534	10,000	1.68%	0	10,000
2013	586,192	10,000	1.71%	0	10,000
	Avg % of Total Civil Ops		*1.67%*		
Forecasted					
2014	585,816	9,783	1.67%	421	10,204
2019	592,062	9,887	1.67%	432	10,319
2024	598,800	10,000	1.67%	443	10,443
2029	607,076	10,138	1.67%	454	10,592
2034	614,076	10,255	1.67%	465	10,720

Source: FAA Enhanced Traffic Management System Counts (ETMSC); FAA TAF; Airport Solutions Group.
* Forecasted totals based on assumption that 10% of BGR/RKD jet operations will migrate to BST.

Preferred Forecast

The Market Share methodology has been selected as the preferred projection of aircraft operations for BST. This methodology is based on the existing FAA TAF for the Airport and the State of Maine, since existing aircraft operational levels are not anticipated to change markedly given the existing conditions at the Airport. However, if appropriate runway and facility improvements are made at BST, the Airport would likely realize some operational growth in an aircraft class that does not currently regularly operate at BST (e.g. jet aircraft). Therefore, it is reasonable and appropriate for the Market Share methodology to reflect growth above the existing TAF in the jet aircraft classification. While such facility improvements could also result in growth in other aircraft classes as well, such growth would likely be limited and difficult to quantify.

The following table presents the local/itinerant operational split, as well as the overall operational type breakdown of the Preferred Forecast.

Year	Itinerant				Local		Total Operations
	Air Carrier	Air Taxi & Commuter	General Aviation	Military	General Aviation	Military	
2014	0	3,316	3,316	0	3,571	0	10,204
2019	0	3,354	3,354	0	3,612	0	10,319
2024	0	3,394	3,394	0	3,655	0	10,443
2029	0	3,442	3,442	0	3,707	0	10,592
2034	0	3,484	3,484	0	3,752	0	10,720

Source: Airport Solutions Group.

Continued on next page

Projection of Aviation Activities, Continued

Forecast Conclusion

The Preferred Forecast presents a generally positive view on long-term growth in aircraft operations at the Belfast Municipal Airport. It essentially assumes that the existing level of operations at the Airport will be maintained throughout the 20-year planning period, which largely follows general aviation's recent national historical trends of very limited growth. This is approach is consistent with the FAA's Terminal Area Forecast (TAF) for BST and the State of Maine.

Additionally, the Preferred Forecast assumes that BST's fleet mix will realize some increase to jet traffic as appropriate facilities are constructed at the Airport. Of the segments that comprise general aviation, corporate jet/turbine activity is projected to far outpace the growth in activities of other segments. This would appear to support the limited forecasted growth in jet activities at BST. Specifically, the Preferred Forecast provides for an increase in the operational totals above the TAF in the form of an increased number and frequency of jet operations at the Airport. This change would reasonably occur as a result of runway and facility improvements that would make jet operations more practicable at BST.

Nevertheless, it is important to note that this increase is less than five percent of the TAF's projected annual operational forecast for BST, and is less than the FAA's threshold of 500 annual operations that could require a review and potential adjustment to the Airport's design aircraft. The latter point is critical in that the change of an airport's design aircraft is most often the trigger in starting the process for establishing justification for a federal funding investment to extend a runway. In this case, even with a relatively optimistic projection the forecast never results in the requirement to reevaluate BST's design aircraft, even in the out years. Note that from an airport planning perspective, this limited increase in jet operations would have no discernable impact on the Airport and its compliance with FAA *Airport Design* standards.

Finally, it should also be noted that if this *Runway Corridor Analysis* planning effort were to result in full Airport Master Plan Update for the Belfast Municipal Airport, forecast assumptions, methodologies, and rationales would be reviewed and updated during that process.

Runway Length Assessment

Runway Length Assessment Process

This runway length assessment follows the procedures as set forth in FAA AC 150/5325-4B – *Runway Length Requirements for Airport Design*. This advisory circular employs a five-step process to establish recommended runway lengths, and is generally described below:

Step #1: Identify the critical design airplanes or airplane group.
Step #2: Identify the airplanes or family group that will require the longest runway lengths at maximum certificated takeoff weight (MTOW).
Step #3: Determine the method that will be used for establishing the recommended runway length.
Step #4: Select the recommended runway length through application of the appropriate determination methodology.
Step #5: Apply any necessary adjustment to the obtained runway length.

Step #1

Identify the critical design airplanes or airplane group.

Based on the BST Operational data and because it is the intent of the design AC to establish runway lengths based on operationally demanding aircraft, the overall family groupings of aircraft was examined in this assessment in lieu of an individual aircraft. The family groupings of aircraft that were advanced in this analysis include the following:

- BST Aircraft Operations - 12,500 pounds or less,
- BST Aircraft Operations - More than 12,500 pounds up to and including 60,000 pounds, and

Note that since the existing level of operations at BST did not support carrying the "more than 60,000 pounds or Regional Jets" family grouping of airplanes category forward into the next steps of this assessment.

Step #2

Identify the airplanes or family group of airplanes that will require the longest runway lengths at maximum certificated takeoff weight (MTOW)

For BST, between the two applicable family groupings, it is intuitive that those aircraft that would require the greatest amount of runway length would be the larger aircraft that operate at the heaviest takeoff weights. In this case, those larger aircraft belong to the "More than 12,500 pounds up to and including 60,000 pounds" family group. Therefore, this will be the family grouping of airplanes that will be advanced into Step 3.

Continued on next page

Runway Length Assessment, Continued

Step #3

Determine the method that will be used for establishing the recommended runway length.

Based on Table 1-1 of the AC, the methodology described within Chapter 3 of the AC will be employed for this assessment. The specifics of this approach will be discussed in detail in Step #4.

Step #4

Select the recommended runway length through application of the appropriate determination methodology.

The methodology described in Chapter 3 of FAA AC 150/5325-4B, as selected in Step #3, is applicable for airplanes within a maximum certificated takeoff weight of more than 12,500 pounds up to and including 60,000 pounds.

Generally described, the runway length determination process employed within this chapter utilizes the following approach:

1) Compile database of required information (i.e. fleet mix, airport temperature, etc.);
2) Determine percentage of fleet categories and aircraft useful load factors, based on guidance within the AC; and
3) Calculate the runway length requirement through application of the AC-supplied performance tables.

Database of required information

Airport elevation above Mean Sea Level (MSL):	198 feet (MSL)
Mean daily maximum temperature (hottest month):	81°F (August)
Critical design airplanes:	Fleet mix described previously

Percentage of fleet categories and aircraft useful load factors

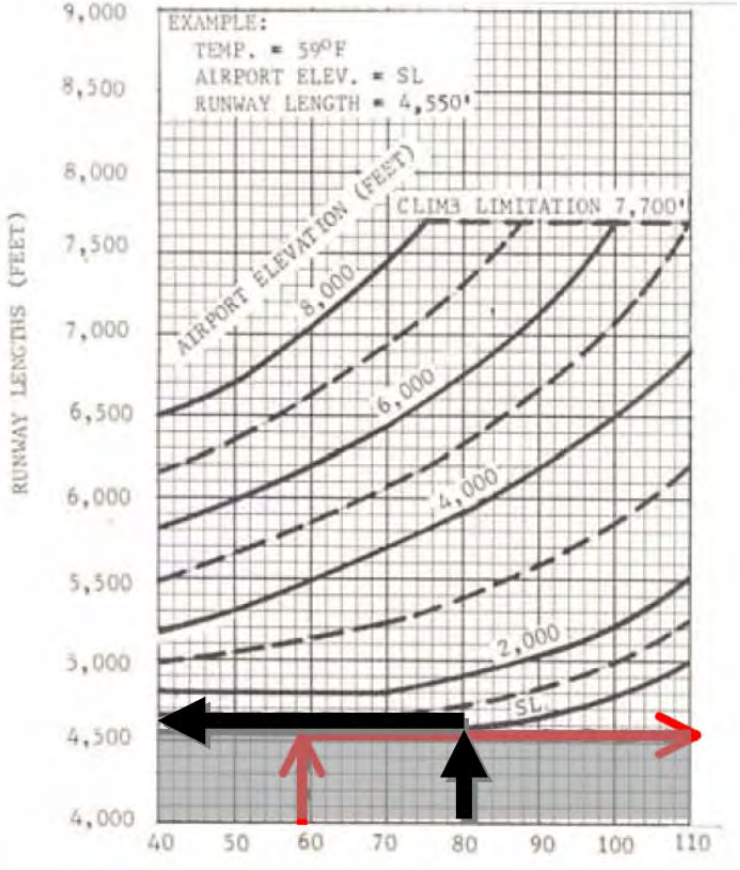
Airplanes that Make Up 75 Percent of the Fleet
60% useful load

Continued on next page

Runway Length Assessment, Continued

Step #4 (continued)

Calculate the runway length requirement



Initial Runway Length Determination: 4,600 ft
Length with Runway Gradient Correction: 4,990 ft

Step #5

Apply any necessary adjustment to the obtained runway length.

While the standard FAA runway length analysis process resulted in a recommended runway length of 4,990 feet, the Airport and the City wanted to ensure that this total was in fact "right sized" (i.e. neither excessive nor deficient) for BST and its future users. Therefore, an additional analysis was undertaken that utilized independent sources to either confirm or modify the FAA's recommended runway length.

The first additional step was to conduct individual discussions with several corporate aircraft operators to establish their specific operational needs. These discussions resulted in the determination that a length of 4,700 ft would generally be an adequate for fulfilling their defined goals.

Continued on next page

Runway Length Assessment, Continued

Step #5
(continued)

The second step was to take the information provided by the operators and apply industry/manufacturer data resources to confirm their conclusion. However, in order to do that, several assumptions had to be made to create a baseline for comparison. These assumptions (reflected in the following table) essentially encompass what might be typical conditions for a jet operating at BST in the future.

Corporate Aircraft Operational Considerations

Aircraft:	Bombardier CL-300
Departing:	Belfast, ME (BST)
Destination:	Midwest Region (at a minimum)
BST Temp:	ISA + 15C (86F);
BST Elevation:	198' MSL
BST Runway Condition:	Dry
PAX load	Four passengers
Other Factors:	– Manufacturers Specifications/Data – **NO WIND** – **NO OPERATOR REQUIREMENTS**

Two key points regarding these assumptions is that manufacturer performance data cannot consider winds aloft conditions due to their inherent variability; therefore, manufacturer-provided aircraft ranges are overestimated. Additionally, aircraft operators typically have individual operating requirements and limitations due to company policies, safety standards, insurance requirements, etc. These do not permit an operator to fly an aircraft to its full capabilities. Thus, while manufacturer's data may indicate what an aircraft can physically do, operators are typically not permitted to reach those physical limits.

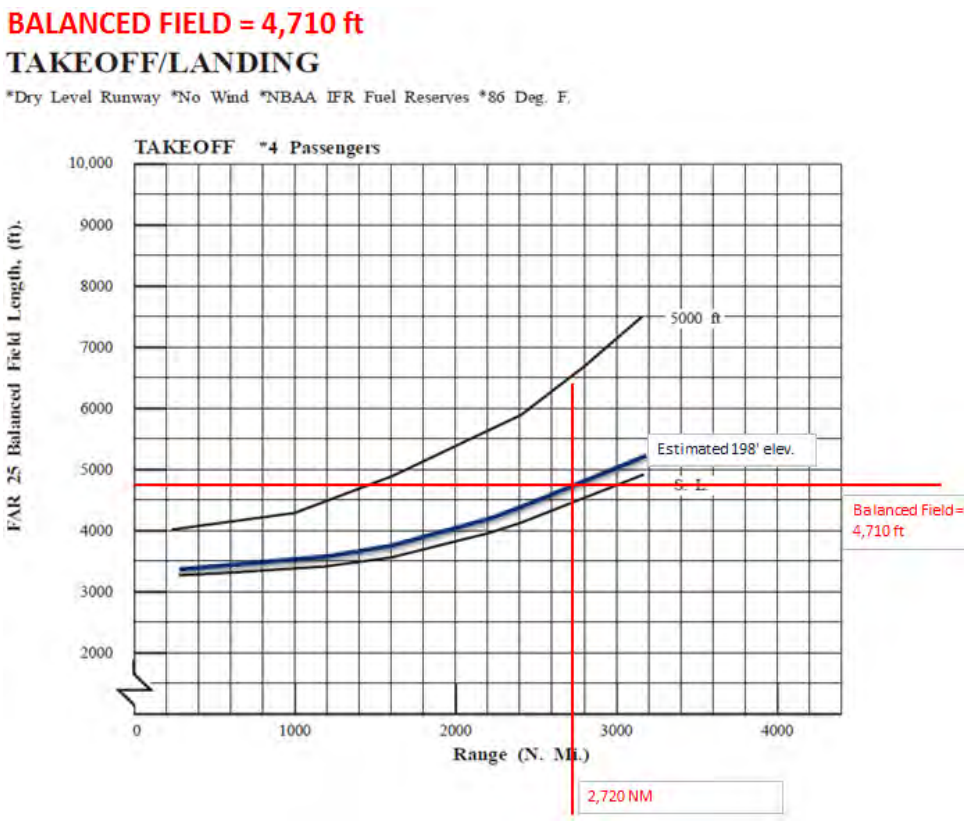
The graphic below shows an industry performance table for the CL-300 based on the aforementioned assumptions. It shows that based on an assumed runway length of 4,710 feet, the CL-300 is physically capable of realizing a range of 2,720 nautical miles. That range is then reflected in the following graphic. (Again, these results do not consider winds aloft or operator limitations.)

Continued on next page

Runway Length Assessment, Continued

Step #5
(continued)

Aircraft Performance Table for the CL-300



Projection of 2,720 NM Range Based at BST

Through this analysis and based on discussions with corporate aircraft operators, a length of 4,710 ft was deemed to be an appropriate for fulfilling their defined goals of the operators and for BST. Therefore, it is recommended that the optimum

Continued on next page

Step #5 (continued)

runway length for Belfast Municipal Airport be reduced from 4,990 ft (Step #4) to 4,710 ft (Step #5).

For additional information regarding the coordination with aircraft operators, please see the following meeting notes reproduced below:

We had phone conversations with several corporate aircraft operations staffers … to provide them with a general overview of our work to date and to get their feedback on the preferred alternative. Following are some of the key notes:

- *J. Miklas provided a general review of the planning process undertaken, the key physical considerations/barriers around BST.*
- *Mr. Miklas summarized the feedback that we had originally been provided by corporate operators in terms of operational goals for any extension (i.e. 5,000 ft of runway; CL-300 Challenger aircraft; West Coast = longest destination).*
- *Mr. Miklas noted that through various discussions with corporate aircraft operators that there was consensus that Walsh Field should not be directly impacted by any potential runway extension.*
- *Mr. Miklas acknowledged that corporate aircraft operators' provision of manufacturer data tables provided valuable insights/validation with respect to the more generalized data tables that ASG had.*
- *One corporate aircraft representative completed several analyses based on their operational standards. (See following table.)*

Here it is very important to note that manufacturers' data is based on the actual operational capabilities of a standard aircraft – it is what the aircraft can physically do, often at its design limits. However, this is typically different than how an operator will actually use the aircraft in that an operator will often have customized alterations (i.e. interior, seating, payload capacities, engines, etc.) that will change the aircraft weights and performance. Additionally, an operator has liability limitations imposed upon it by their insurance carriers, corporate counsel, etc. In essence, operators typically are significantly more conservative in how they fly their aircraft. For example, an operator may utilize an IFR fuel reserve requirement that significantly exceeds that of what a manufacturer may indicate. (That is why we use manufacturer data for airport planning – the conditions of operations are simply too variable.)

Aircraft	*Runway Departure Length*	*Temp*	*Runway Conditions*	*Flight Time Available*
CL-300	*4000 (existing)*	*90*	*Dry*	*1.8 hrs*
CL-300	*4700 (existing)*	*90*	*Dry*	*3.5 hrs*
CL-300	*4700 (existing)*	*60*	*Dry*	*4.5 hrs*
CL-300	*4700 (existing)*	*90*	*Wet*	*2.5 hrs*
CL-300	*4700 (existing)*	*60*	*Wet*	*3.2 hrs*
CL-300	*5000 (existing)*	*90*	*Dry*	*4.3 hrs*
CL-300	*4700 (existing)*	*60*	*Wet*	*4.8 hrs*

Conclusions: *Based on corporate operators' operational requirements, 4,700 will not get a CL-300 to the West Coast (note: neither would 5,000 ft). However, 4,700 ft is adequate for the manner in which the operators generally operate their aircraft. This means that the need for direct flights to the West Coast is limited and they most often target areas in the range of Kansas City, St. Louis, Dallas and Atlanta. Additionally, if aircraft operators do need to go to the West Coast, they will simply stop over at one of those airports for fuel. It will not be a detriment. Corporate aircraft operators also acknowledged that the operational benefits gained from extending from 4,700 ft to 5,000 ft were minimal and likely unnecessary when considering the potential physical impact on the surrounding area.*

- *Corporate aircraft operators stressed the importance of the parallel taxiway to them for safety purposes.*
- *Finally, Mr. Miklas specifically asked them if a runway at BST with a departure length of 4,700 feet and a landing length of 4,400 feet would meet the long term operational needs of the corporate aircraft operators. They stated that it would meet their needs and that they would endorse this alternative when asked.*

We took all of this as very positive in that it validates our efforts in terms of providing the runway length <u>needed</u> and not just runway length <u>wanted</u>. We believe that is the right position to be in for future discussions with the City of Belfast, FAA and MaineDOT.

Runway Length Alternatives

Introduction

The process employed for this alternatives analysis included the following steps:

1) Identify the "runway corridor" for BST's Runway 15-33
2) Identify the critical triggers or thresholds within that corridor related to physical, financial, environmental, and/or some other regualtory consideration.
3) Establish an appropriate range of alternatives based on those thresholds
4) Conduct an evaluation of those alternatives based on a variety of relevant metrics.

BST Runway 15-33 Corridor

The graphic on the following page shows BST including the runway "corridor." Also reflected in this graphic are three other associated physical improvements that have been included in the Airport's current Capital Improvement Plan (CIP). These include the following:

- Runway 15-33 rehabilitation
- Property acquisition/transfer for Taxiway A
- Taxiway A construction (note that this project is also of particular interest to corporate aircraft operators)

Continued on next page

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Proposed Acquisition Area for Taxiway (5.8 acres)

Potential Property Transfer Options (5.8 acres)

Taxiway A Construction (Group II)

Runway 15-33 Rehabilitation

Airport Road

Lower Congress St.

Reeds Lane

Little River Drive

Lincolnville Avenue

Walsh Field

15

33

Order-of-Magnitude Cost Projections
(Planning Level)

Runway 15-33 Rehabilitation	$1.77M
Taxiway 'A' Property Acquisition	$0*
Taxiway 'A' Construction	$3.25M
Total:	**$5.02M**

* assumes property transfer with Maine National Guard

Proposed Property Acquisition Area

- Area accounts for new Taxiway Safety Area (TSA) and Taxiway Object Free Area (TOFA)

- Due to significant grade changes, assumption made that a 4:1 positive slope could be established beyond the extent of the TOFA. (Results in 72' beyond the end of the TOFA.)

- To account for lack of grading data and full engineering design effort, an minumum 50' buffer was added.

- Potential Part 77 clearances was added as an additional consideration.

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NO.	DATE	DESCRIPTION	BY

PROJECT
RUNWAY 15-33 CORRIDOR STUDY

OWNER
BELFAST MUNICIPAL AIRPORT
BELFAST, MAINE

PROJECT NO.	XXX-XXX
CADD FILE	
DESIGNED BY	TAL
DRAWN BY	TAL
CHECKED BY	DWR
DATE	MAR 2013
DRAWING SCALE	1"=200'

SHEET TITLE
OTHER CIP PROJECTS / CONSIDERATIONS

GRAPHIC SCALE
0 150 300 600

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X OF X

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Runway Length Alternatives, Continued

Runway Extension Critical Thresholds

For the purposes of this analysis, seven critical thresholds have been identified within the runway corridor. These "thresholds" are simply physical features that would have to be addressed if they were to be impacted by a runway extension. These are listed below and are presented in the graphic on the following page (it should also be noted that each subsequent threshold assumes a sequential and cumulative impact for an overall runway extension):

A. Existing Building Envelope – This area includes the existing runway footprint (i.e. runway pavement and Runway Safety Area).
B. Expansion Area 1on RW 33 End – This area includes the existing RSA and areas beyond up to, but not impacting, Lower Congress Street and Little River Drive. Expansion of existing runway footprint into this area is on-airport and includes significant fill to meet grades (no retaining wall).
C. Expansion Area 1 on RW 15 End – This area includes the existing RSA and areas beyond up to the existing airport property line. Expansion of existing runway footprint into this area is on-airport and includes significant fill to meet grades and wetlands impacts.
D. Airport Property Line - Expansion of runway footprint beyond A, B, and C above would require the acquisition of off-airport properties.
E. Expansion Area 2 on RW 15 End – This area includes City of Belfast properties currently utilized as recreational baseball fields and a dog park (Walsh Field). Any expansion of runway footprint beyond A, B, C, and D above would result in impacts to and possible required relocation of an existing 4(f) property (community park), as well as wetlands impacts. It should be anticipated that use of this area would result in significant costs and could foster considerable community resistance.
F. Expansion Area 2 on RW 33 End – This is an estimation based on what might be required in association with the relocation of Lower Congress Street to account for a runway extension. Any expansion of runway footprint beyond A, B, C, and D would require a relocation of Lower Congress Street, which would result in the need to acquire off-airport properties (including residences) and wetlands impacts. Also would require the relocation of a portion of Little River Drive. It should be anticipated that use of this area would result in significant costs and could foster community resistance.
G. Expansion Area 3 on RW 15 End - Expansion of runway footprint beyond A, B, C, D and E would require a relocation of Lincolnville Avenue, which will necessitate the acquisition of off-airport properties (including residences) and impacting existing businesses. It should be anticipated that use of this area would result in significant costs and could foster community resistance.

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DEVELOPMENT THRESHOLDS
(PLANNING ASSUMPTIONS)

A Includes the existing runway footprint (i.e. runway pavement and Runway Safety Area (RSA).

B Expansion of existing runway footprint into this area is on-airport and includes fill to meet grades (possible retaining wall).

C Expansion of existing runway footprint into this area is on-airport and includes fill to meet grades (possible retaining wall) and wetlands impacts.

D Expansion of runway footprint beyond A, B, and C, requires acquisition of off-airport properties.

E Expansion of runway footprint beyond A, B, C, and D will require impacts to and possible required acquisition of an existing 4(f) property (community park), as well as wetlands impacts.

F Expansion of runway footprint beyond A, B, C, and D will require a relocation of Lower Congress Street, which will result in the acquisition of off-airport properties (possibly including homes) and wetlands impacts. Also would require the relocation of a portion of Little River Drive.

G Expansion of runway footprint beyond A, B, C, D and E will require a relocation of Lincolnville Avenue, which will result in the acquisition of off-airport properties (possibly including homes) and impacting existing businesses.

Airport Road
Walsh Field
Lower Congress St.
Reeds Lane
Little River Drive
Lincolnville Avenue

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PROJECT
RUNWAY 15-33 CORRIDOR STUDY

OWNER
BELFAST MUNICIPAL AIRPORT
BELFAST, MAINE

PROJECT NO.	XXX-XXX
CADD FILE	
DESIGNED BY	TAL
DRAWN BY	TAL
CHECKED BY	DWR
DATE	JAN 2013
DRAWING SCALE	1"=200'

SHEET TITLE
DEVELOPMENT THRESHOLDS
(PLANNING ASSUMPTIONS)

GRAPHIC SCALE
0 150 300 600

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X OF X

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Runway Length Alternatives, Continued

Range of Runway Extension Alternatives

Following is a listing of the range of runway extension alternatives that have been developed as part of this analysis. These are also reflected graphically in the following pages.

- Alternative 1 – No Build (4,000')
- Alternative 2 – Extend Southeast (4,170')
- Alternative 3 – Extend Southeast & Northwest (4,410')
- Alternative 4 – Extend Southeast & Northwest (4,700')
- Alternative 5 – Extend Southeast & Northwest (5,000')
- Alternative 6 – Maximum Extension to Southeast & Northwest (5,178')

- Alternative 1A – Alt 1 with Declared Distance Application (4,300' ASDA)
- Alternative 2A – Alt 2 with Declared Distance Application (4,470' ASDA)
- Alternative 3A – Alt 3 with Declared Distance Application (4,710' ASDA)

It should also be noted that no alternatives were generated for options that required the relocation of Lower Congress Street or Lincolnville Road. These were deemed to be unnecessary based on the runway length analysis.

For planning and comparative purposes, order-of-magnitude costs ranges have also been generated for each alternative as well. These are located on the individual graphics as well as in a summary table following the alternatives. It should be noted that the cost estimates did not include costs associated with avigation easements and obstruction removal, nor did they include estimates for the potential relocation of Walsh Field (if required by alternative).

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Order-of-Magnitude Cost Projections
(Planning Level)

Runway 15-33 Extension	***NA***
Runway 15-33 Rehabilitation	**$2.0M**
Taxiway 'A' Construction	**$2.2M**
Total:	**$4.2M***

* does not include obstruction removal requirements

Alternative 1
(Key Features)

- "No-Build" Alternative
- 4,000 feet available for both takeoff and landing for both runways
- Complies with FAA Airport Design Standards
- No additional impacts outside of existing runway corridor footprint.

4,000' (Land & Depart)

15

33

RUNWAY SAFETY AREA (RSA)

RUNWAY OBJECT FREE AREA (ROFA)

RUNWAY PROTECTION ZONE (RPZ)

RUNWAY PROTECTION ZONE (RPZ)

Airport Road

Lower Congress St.

Reeds Lane

Little River Drive

Lincolnville Avenue

Walsh Field

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PROJECT
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OWNER
BELFAST MUNICIPAL AIRPORT
BELFAST, MAINE

PROJECT NO.	XXX-XXX
CADD FILE	
DESIGNED BY	TAL
DRAWN BY	TAL
CHECKED BY	DWR
DATE	OCT 2013
DRAWING SCALE	1"=200'

SHEET TITLE
ALTERNATIVE 1
(NO BUILD)

GRAPHIC SCALE
0 150 300 600

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Order-of-Magnitude Cost Projections
(Planning Level)

Runway 15-33 Extension: $1.45M - $1.95M

Runway 15-33 Rehabilitation	$2.0M
Taxiway 'A' Construction	$2.2M
Total:	**$5.65M - $6.15M***

* does not include obstruction removal requirements

Alternative 1A
(Key Features)

- "No-Build" Alternative with application of Declared Distances.
- Pave Runway Safety Areas (RSAs) on both ends (300 feet on each end).
- Results in additional 300 feet of takeoff distance for both runways (total of 4,300 feet).
- Landing distances remain at 4,000 feet.
- Compliance alternative for meeting FAA Airport Design Standards
- No additional impacts outside of existing runway corridor footprint.

RW 33

TORA = 4,300'
TODA = 4,300'
ASDA = 4,300'
LDA = 4,000'

Airport Road
Walsh Field
Lower Congress St.
Reeds Lane
RUNWAY SAFETY AREA (RSA)
RUNWAY OBJECT FREE AREA (ROFA)
RUNWAY PROTECTION ZONE (RPZ)
RUNWAY PROTECTION ZONE (RPZ)
Little River Drive
Lincolnville Avenue

LDA = 4,000'
ASDA = 4,300'
TODA = 4,300'
TORA = 4,300'

RW 15

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OWNER
BELFAST MUNICIPAL AIRPORT
BELFAST, MAINE

PROJECT NO.	XXX-XXX
CADD FILE	
DESIGNED BY	JBM
DRAWN BY	JBM
CHECKED BY	JH
DATE	OCT 2013
DRAWING SCALE	1"=300'

SHEET TITLE
ALTERNATIVE 1A
(DECLARED DISTANCE APPLICATION)

GRAPHIC SCALE
0 150 300 600

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X OF X

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Order-of-Magnitude Cost Projections
(Planning Level)

Runway 15-33 Extension:	**$1.35M - $1.85M**
Runway 15-33 Rehabilitation	$2.0M
Taxiway 'A' Construction	$2.2M
Total:	**$5.55M - $6.05M***

* does not include obstruction removal requirements

Alternative 2
(Key Features)

- "Extend Southeast" Alternative

- Requires relocation of the RW 33 approach end Runway Safety Area (RSA) to as close to Lower Congress Street as possible without impacting the street. May require retaining walls. Assumes some flexibility in application of Runway Object Free Area (ROFA).

- 4,170 feet available for both takeoff and landing for both runways

- Complies with FAA Airport Design Standards

- Impacts realized by extending existing runway corridor footprint.

4,170' (Land & Depart)

Airport Road

Lower Congress St.

Reeds Lane

Walsh Field

15

33

RUNWAY SAFETY AREA (RSA)

RUNWAY OBJECT FREE AREA (ROFA)

RUNWAY PROTECTION ZONE (RPZ)

RUNWAY PROTECTION ZONE (RPZ)

Little River Drive

Lincolnville Avenue

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PROJECT
RUNWAY 15-33 CORRIDOR STUDY

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BELFAST, MAINE

PROJECT NO.	XXX-XXX
CADD FILE	
DESIGNED BY	TAL
DRAWN BY	TAL
CHECKED BY	DWR
DATE	OCT 2013
DRAWING SCALE	1"=200'

SHEET TITLE
ALTERNATIVE 2
(EXTEND SOUTHEAST)

GRAPHIC SCALE
0 150 300 600

DRAWING NO.

X OF X

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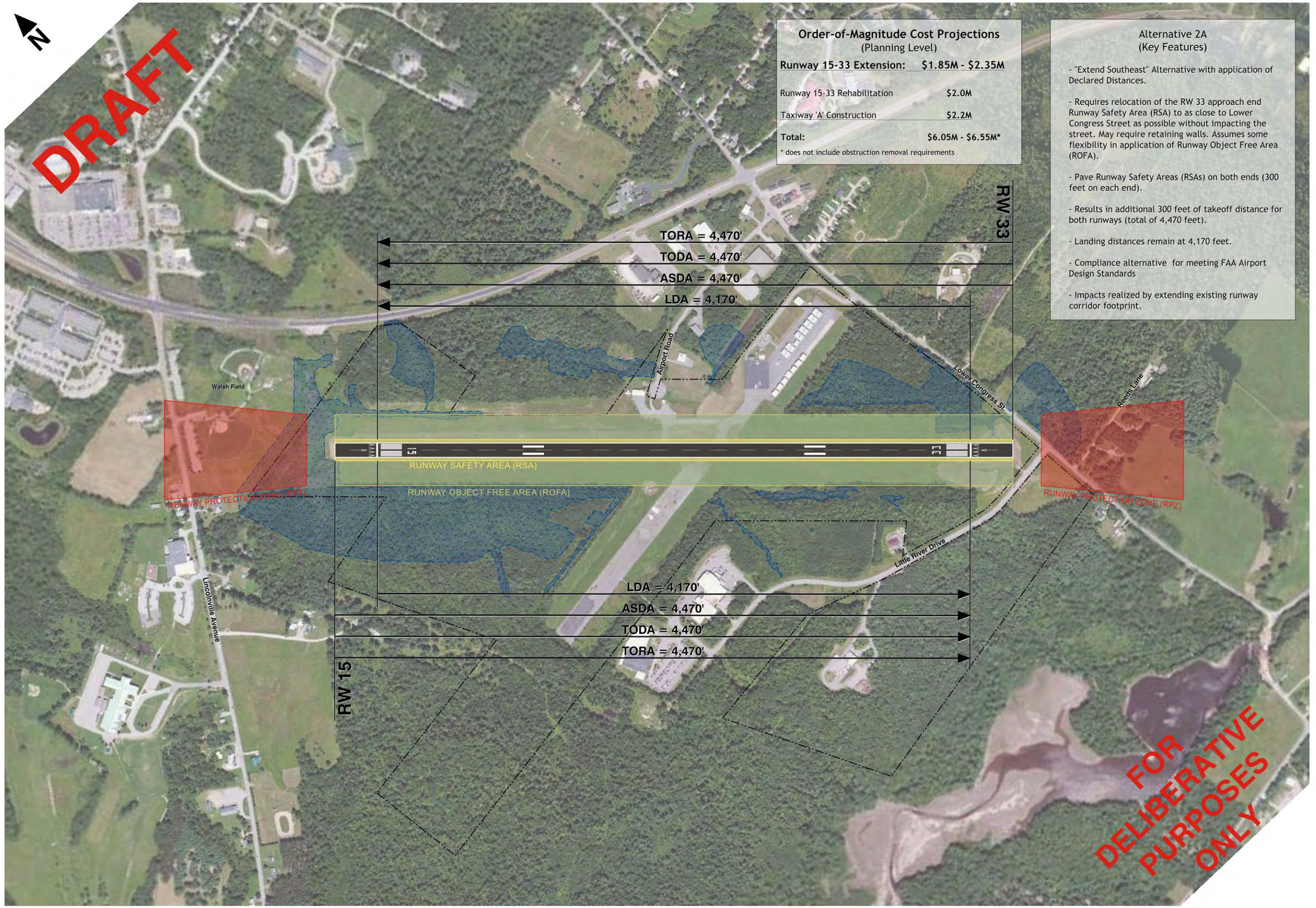

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PROJECT
RUNWAY 15-33 CORRIDOR STUDY

OWNER
BELFAST MUNICIPAL AIRPORT
BELFAST, MAINE

PROJECT NO.	XXX-XXX
CADD FILE	
DESIGNED BY	JBM
DRAWN BY	JBM
CHECKED BY	JH
DATE	OCT 2013
DRAWING SCALE	1"=300'

SHEET TITLE
ALTERNATIVE 2A
(DECLARED DISTANCE APPLICATION)

GRAPHIC SCALE
0 150 300 600

DRAWING NO.

X OF X

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Order-of-Magnitude Cost Projections
(Planning Level)

Runway 15-33 Extension:	**$2.55M - $3.05M**
Runway 15-33 Rehabilitation	$2.0M
Taxiway 'A' Construction	$2.2M
Total:	**$6.75M - $7.25M***

* does not include obstruction removal requirements

Alternative 3
(Key Features)

- "Extend Northwest & Southeast" Alternative
- Includes all features associated with Alternative 2.
- Requires relocation of the RW 15 approach end Runway Safety Area (RSA) to as close to the existing airport property line without impacting it. May require retaining walls. Impacts existing wetlands.
- 4,410 feet available for both takeoff and landing for both runways
- Complies with FAA Airport Design Standards
- Impacts realized by extending existing runway corridor footprint.

4,410' (Land & Depart)

Airport Road

Lower Congress St.

Reeds Lane

Walsh Field

15

33

RUNWAY SAFETY AREA (RSA)

RUNWAY OBJECT FREE AREA (ROFA)

RUNWAY PROTECTION ZONE (RPZ)

RUNWAY PROTECTION ZONE (RPZ)

Little River Drive

Lincolnville Avenue

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NO.	DATE	DESCRIPTION	BY

PROJECT
RUNWAY 15-33 CORRIDOR STUDY

OWNER
BELFAST MUNICIPAL AIRPORT
BELFAST, MAINE

PROJECT NO.	XXX-XXX
CADD FILE	
DESIGNED BY	JBM
DRAWN BY	JBM
CHECKED BY	JH
DATE	OCT 2013
DRAWING SCALE	1"=300'

SHEET TITLE
ALTERNATIVE 3
(EXTEND NORTHWEST & SOUTHEAST)

GRAPHIC SCALE
0 150 300 600

DRAWING NO.

X OF X

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DRAFT

N

Order-of-Magnitude Cost Projections
(Planning Level)

Runway 15-33 Extension: $3.75M - $4.25M

Runway 15-33 Rehabilitation	$1.77M
Taxiway 'A' Construction	$3.25M
Total:	**$8.77M - $9.27M***

* does not include obstruction removal requirements

Recommended Alternative
(Alternative 3A)
Key Features

- "Extend Northwest & Southeast" Alternative with application of Declared Distances - pave Runway Safety Areas (RSAs) on both ends (300 feet on each end).

- **RW 15:** requires relocation of the Runway Safety Area (RSA) to as close to the existing airport property line without impacting it (including toe of slope). Impacts existing wetlands.
Total Additional Pavement = 540'

- **RW 33:** requires relocation of the Runway Safety Area (RSA) to as close to the existing airport property line and roads without impacting (including toe of slope).
Total Additional Pavement = 470'

- Landing distances remain at 4,410 feet.

- Compliance alternative for meeting FAA Airport Design Standards

RW 33

TORA = 4,710'
TODA = 4,710'
ASDA = 4,710'
LDA = 4,410'

RW 15

LDA = 4,410'
ASDA = 4,710'
TODA = 4,710'
TORA = 4,710'

RUNWAY SAFETY AREA (RSA)

RUNWAY OBJECT FREE AREA (ROFA)

RUNWAY PROTECTION ZONE (RPZ)

RUNWAY PROTECTION ZONE (RPZ)

Airport Road

Lower Congress St.

Reeds Lane

Little River Drive

Lincolnville Avenue

Walsh Field

FOR DELIBERATIVE PURPOSES ONLY

AIRPORT SOLUTIONS GROUP
INNOVATIVE AIRPORT DEVELOPMENT SPECIALISTS

NO.	DATE	DESCRIPTION	BY

PROJECT
RUNWAY 15-33 CORRIDOR STUDY

OWNER
BELFAST MUNICIPAL AIRPORT
BELFAST, MAINE

PROJECT NO.	XXX-XXX
CADD FILE	
DESIGNED BY	JBM
DRAWN BY	JBM
CHECKED BY	JH
DATE	MAR 2014
DRAWING SCALE	1"=300'

SHEET TITLE
ALTERNATIVE 3A
(DECLARED DISTANCE APPLICATION)

GRAPHIC SCALE
0 150 300 600

DRAWING NO.

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N

Order-of-Magnitude Cost Projections
(Planning Level)

Runway 15-33 Extension:	**$3.55M - $4.05M**
Runway 15-33 Rehabilitation	$2.0M
Taxiway 'A' Construction	$2.2M
Total:	**$7.75M - $8.25M***

* does not include obstruction removal requirements

Alternative 4
(Key Features)

- "Extend Northwest & Southeast" Alternative
- Includes all features associated with Alternative 3.
- Requires relocation of the RW 15 approach end Runway Safety Area (RSA) beyond the existing property line. Likely would require relocation of Walsh Field. May require retaining walls. Impacts existing wetlands.
- 4,700 feet available for both takeoff and landing for both runways
- Complies with FAA Airport Design Standards
- Impacts realized by extending existing runway corridor footprint.

4,700' (Land & Depart)

15

33

RUNWAY SAFETY AREA (RSA)

RUNWAY OBJECT FREE AREA (ROFA)

RUNWAY PROTECTION ZONE (RPZ)

RUNWAY PROTECTION ZONE (RPZ)

Walsh Field

Reeds Lane

Little River Drive

Lincolnville Avenue

FOR DELIBERATIVE PURPOSES ONLY

AIRPORT SOLUTIONS GROUP
INNOVATIVE AIRPORT DEVELOPMENT SPECIALISTS

NO.	DATE	DESCRIPTION	BY

PROJECT
RUNWAY 15-33 CORRIDOR STUDY

OWNER
BELFAST MUNICIPAL AIRPORT
BELFAST, MAINE

PROJECT NO.	XXX-XXX
CADD FILE	
DESIGNED BY	JBM
DRAWN BY	JBM
CHECKED BY	JH
DATE	OCT 2013
DRAWING SCALE	1"=300'

SHEET TITLE
ALTERNATIVE 4
(4,700 foot RUNWAY
EXTEND NORTHWEST & SOUTHEAST)

GRAPHIC SCALE
0 150 300 600

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Order-of-Magnitude Cost Projections
(Planning Level)

Runway 15-33 Extension:	**$4.15M** - $4.65M****
Runway 15-33 Rehabilitation	$2.0M
Taxiway 'A' Construction	$2.2M
Total:	**$8.35M - $8.85M***

* does not include obstruction removal requirements
** does not include ballfield complex relocation

Alternative 5
(Key Features)

- "Extend Northwest & Southeast" Alternative
- Includes all features associated with Alternative 3.
- Requires relocation of the RW 15 approach end Runway Safety Area (RSA) beyond the existing property line. Would require relocation of Walsh Field. May require retaining walls. Impacts existing wetlands.
- 5,000 feet available for both takeoff and landing for both runways
- Complies with FAA Airport Design Standards
- Impacts realized by extending existing runway corridor footprint.

5,000' (Land & Depart)

15

33

Walsh Field

Reeds Lane

Little River Drive

Lincolnville Avenue

RUNWAY SAFETY AREA (RSA)

RUNWAY OBJECT FREE AREA (ROFA)

RUNWAY PROTECTION ZONE (RPZ)

RUNWAY PROTECTION ZONE (RPZ)

FOR DELIBERATIVE PURPOSES ONLY

AIRPORT SOLUTIONS GROUP
INNOVATIVE AIRPORT DEVELOPMENT SPECIALISTS

NO.	DATE	DESCRIPTION	BY

PROJECT
RUNWAY 15-33 CORRIDOR STUDY

OWNER
BELFAST MUNICIPAL AIRPORT
BELFAST, MAINE

PROJECT NO.	XXX-XXX
CADD FILE	
DESIGNED BY	JBM
DRAWN BY	JBM
CHECKED BY	JH
DATE	OCT 2013
DRAWING SCALE	1"=300'

SHEET TITLE
ALTERNATIVE 5
(5,000 foot RUNWAY
EXTEND NORTHWEST & SOUTHEAST)

GRAPHIC SCALE
0 150 300 600

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Order-of-Magnitude Cost Projections
(Planning Level)

Runway 15-33 Extension:	**$4.65M** - $5.15M****
Runway 15-33 Rehabilitation	$2.0M
Taxiway 'A' Construction	$2.2M
Total:	**$8.85M - $9.35M***

* does not include obstruction removal requirements
** does not include ballfield complex relocation

Alternative 6
(Key Features)

- "Extend Northwest & Southeast" Alternative
- Includes all features associated with Alternative 3.
- Requires relocation of the RW 15 approach end Runway Safety Area (RSA) beyond the existing property line to maximum extent without impacting Lincolnville Ave. Would require relocation of Walsh Field. May require retaining walls. Impacts existing wetlands.
- 5,000 feet available for both takeoff and landing for both runways
- Complies with FAA Airport Design Standards
- Impacts realized by extending existing runway corridor footprint.

AIRPORT SOLUTIONS GROUP
INNOVATIVE AIRPORT DEVELOPMENT SPECIALISTS
ASG OFFICE
PHONE (781) 491-0083 / FAX (781) 491-0382

NO.	DATE	DESCRIPTION	BY

PROJECT
RUNWAY 15-33 CORRIDOR STUDY

OWNER
BELFAST MUNICIPAL AIRPORT
BELFAST, MAINE

PROJECT NO.	XXX-XXX
CADD FILE	
DESIGNED BY	JBM
DRAWN BY	JBM
CHECKED BY	JH
DATE	OCT 2013
DRAWING SCALE	1"=300'

SHEET TITLE
ALTERNATIVE 6
(MAXIMUM EXTENSION to NORTHWEST & SOUTHEAST)

GRAPHIC SCALE
0 150 300 600

DRAWING NO.

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Runway Length Alternatives, Continued

Alternatives Evaluation

	Alternative 1	Alternative 2	Alternative 1A	Alternative 3	Alternative 2A	Alternative 4[1]	Alternative 3A	Alternative 5[1]	Alternative 6[1]
Takeoff distance (ft)	4,000	4,170	4,300	4,410	4,470	4,700	4,710	5,000	5,178
Landing distance (ft)	4,000	4,170	4,000	4,410	4,170	4,700	4,410	5,000	5,178
Estimated Range (CL300) (nm)[2]	1,900	2,150	2,275	2,420	2,450	2,710	2,720	2,950	3,100
Meets Athenahealth Goals	No	No	No	No	No	Yes	Yes	Yes	Yes
Est. Extension Cost (low)	$0	$1,180,000	$1,230,000	$3,030,000	$1,800,000	$3,980,000	$3,750,000	$4,520,000	$4,980,000
Est. Extension Cost (high)	$0	$1,680,000	$1,730,000	$3,530,000	$2,300,000	$4,480,000	$4,250,000	$5,020,000	$5,480,000
Avg. Cost per Linear RW Foot	*NA*	$8,412	$4,933	$8,000	$4,362	$6,043	$5,634	$4,770	$4,440
Avg. Cost per NM (range)	*NA*	$5,720	$3,947	$6,308	$3,727	$5,222	$4,878	$4,543	$4,358

[1] *Does not include any costs associated with relocation of existing ballfield complex or further extension of TW A.*

[2] *Based on manufacturers data (no winds aloft, does not consider operator restrictions. Does not include costs associated with airspace clearance and obstruction removal.*

Runway Length Alternatives, Continued

Recommended Alternative

Based on this technical memorandum, as well as on discussions with representatives from FAA, MaineDOT, and the City of Belfast, the recommended alternative was identified as **Alternative 3A**.

It was determined that this alternative achieved the following:

- met the City of Belfast's desire to minimize surrounding community and environmental impacts while still accommodating the long-term needs of BST and its operators;
- met current and projected operational requirements for its current corporate aircraft operators;
- met all FAA planning and engineering standards and requirements; and
- is consistent with MaineDOT's airport system plan and was consistent with their desire to promote economic development and airport sustainability.

Note that this recommendation was presented to the Belfast City Council on March 18, 2014. The briefing paper for that presentation is provided in the Appendix A.

Additionally, another briefing was provided to neighbors that abut the Airport on March 31, 2014.

Conclusion

Next Steps

This technical memorandum concludes the Runway Corridor Analysis for Belfast Municipal Airport. Through the process described above, an appropriate recommended development alternative was identified, in addition to several other required airport improvements. If the City and the Airport believe that this development is practicable and a worthy consideration for the Airport's long-term viability, the next step would be to conduct an update to the Airport Master Plan and its associated Airport Layout Plan (ALP). This would be required for the FAA to provide approval and potential funding for these projects.

If the City and the Airport do not believe this development plan to have merit, this Technical Memorandum should become an appendix to BST's 2008 Airport Layout Plan Update.

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Appendix

Contents Briefing paper provided to the Belfast City Council on March 18, 2014.

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Belfast Municipal Airport

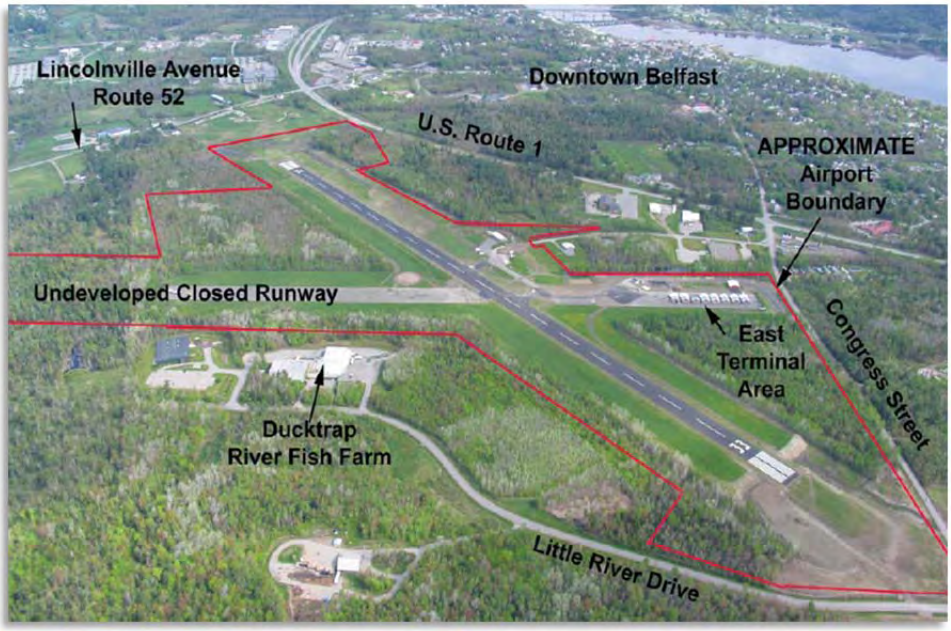
Airport Master Plan Update (AMPU) – *Phase 1*

City Council Briefing

March 18, 2014

Key Facts about Belfast Municipal Airport (BST)

- Publicly-owned, public-use General Aviation airport
- Identified within the FAA NPIAS, making it eligible for federal funding
- Generated $3.9M in economic activity *(2006 MaineDOT study)*
- Runway 15-33 *(100' x 4,000')* / crosswind runway decommissioned
- Three taxiways and three nonprecision instrument approaches
- One Fixed Base Operator (FBO), 24 hangars, 11 tiedowns
- Current based aircraft = 17 *(primarily single-engine piston)*
- Current annual operations *(takeoffs & landings)* = 10,000 *(27 avg/day)*
- Current design aircraft = Beechcraft King Air 350
- Largest aircraft currently operating = Pilatus PC-12



King Air 350

Pilatus PC-12

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What is the Purpose of the Master Plan Update?

- The Belfast Municipal Airport (BST) has been approached about the need to accommodate corporate jet aircraft by local industries.
- An Airport Master Plan Update (AMPU) is the proper FAA tool to identify the potential need for specific runway operational enhancements. Neither the 1999 BST AMPU, nor the 2008 BST Airport Layout Plan (ALP) Update projected recent utilization and/or interest by corporate jet aircraft operators. The *BST AMPU – Phase I* is funded through an FAA grant with a local match.
- The *BST AMPU – Phase I* includes a "runway corridor analysis" that focuses on potential future critical aircraft and their runway requirements. Specifically, the analysis must determine if improvements need to be made to the existing 4,000-foot runway to satisfy future operational requirements.
- Analysis results must ultimately be integrated into an updated ALP (*BST AMPU – Phase II*).

What questions are answered by the *BST AMPU – Phase I*?

The *BST AMPU – Phase I* effort complies with the FAA's primary guidance for determining runway length requirements, including FAA AC 150/5300-13, *Airport Design* and FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*. The general approach taken in this study is to answer the following two questions:

1. *What is the projected runway length requirement for Runway 15/33 at Belfast Municipal Airport?*
2. *What are the reasonable alternatives for meeting the projected runway length requirements when considering the current Airport operational and FAA/State/Local regulatory environments?*

What is the projected runway length requirement for Runway 15/33?

- Airport Reference Code (ARC) = B-II *(same as existing)*
- Design Aircraft = Challenger 300 *(ARC B-II)*
- Challenger 300 is a mid-sized corporate jet capable of transcontinental flights for up to nine passengers. *It is not a commercial service aircraft.*

Challenger 300

Continued on next page

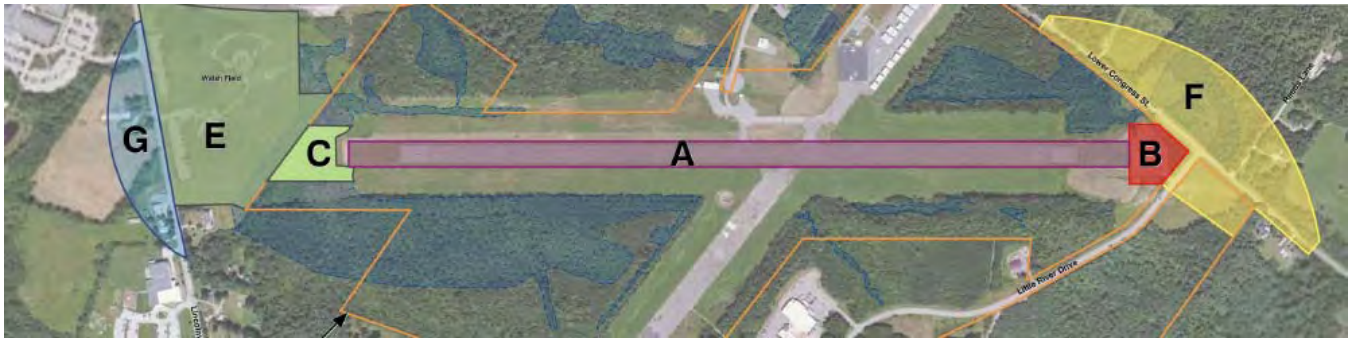
What is the projected runway length requirement for Runway 15/33? (continued)

- FAA AC 150/5300-13A, *Airport Design*, defines FAA-required safety and design standards for ARC B-II.
- FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design,* defines a five-step process to establish recommended runway length.
- Standardized FAA process resulted in a recommended runway length for Runway 15-33 of 4,990 feet.
- FAA runway length was modified based on direct communications with aircraft operators and an engineering/planning assessment of current airport facilities, constraints and challenges. The purpose of this was to ensure that the recommended runway length was "right-sized" for BST.
- The recommended runway length was established at 4,710 feet.

Note: Recommended runway length would not allow for the operation of other commercial service aircraft beyond that which could currently operate at BST.

What are the alternatives for meeting the projected runway length requirements for Runway 15/33?

- The process employed for this alternatives analysis included the following steps:
  1) Identify the "runway corridor" for BST's Runway 15/33.
  2) Identify the critical triggers or thresholds within that corridor related to physical, financial, environmental, and/or some other regualtory consideration.
  3) Establish an appropriate range of alternatives based on those thresholds
  4) Conduct an evaluation of those alternatives based on a variety of relevant metrics.
- Seven envelopes or triggers were identified with respect to the existing runway corridor. These included grades, wetlands, potential property acquisition, Walsh Field, and potential road relocations.
- Also considered potential runway realignment and reactivation of former crosswind runway.
- Nine alternatives developed based on various lengths and various triggers/thresholds



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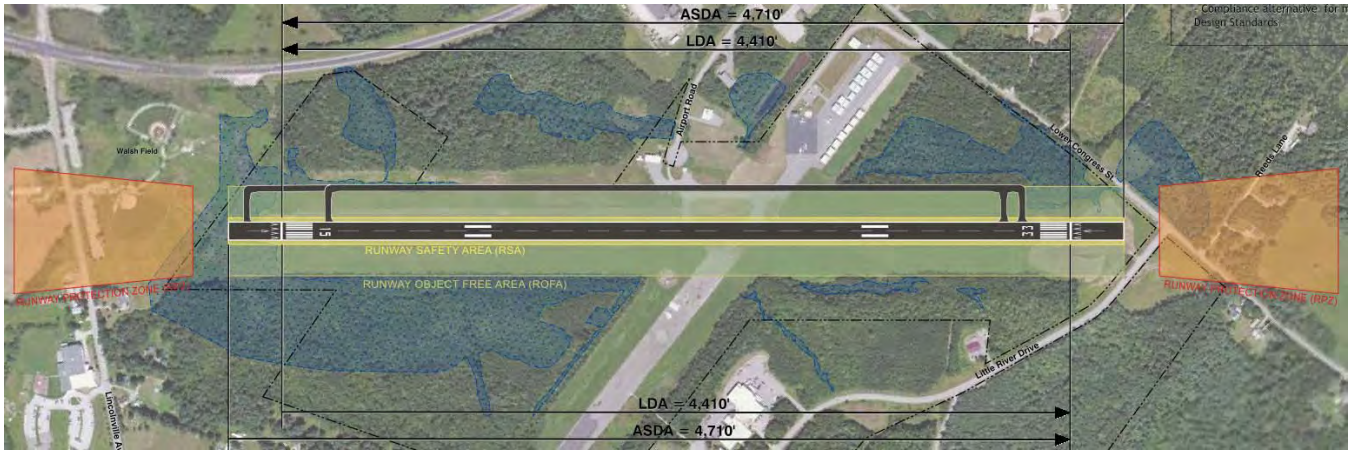
What is the recommended alternative for meeting the projected runway length requirements for Runway 15/33?

Based on the *BST AMPU – Phase I*, as well as on discussions with representatives from FAA, MaineDOT, and the City of Belfast at a January 30, 2014 meeting, a recommended alternative was identified. It was determined that the recommended alternative achieved the following:

- met the City of Belfast's desire to minimize surrounding community and environmental impacts while still meeting the long-term needs of BST and its operators;
- met current and projected aircraft operational requirements for key local industry and businesses;
- met all FAA planning and engineering safety standards and design requirements;
- was consistent with MaineDOT's airport system plan and was consistent with their desire to promote economic development and airport sustainability.



Next Steps

The next step in the process involves conducting Phase II of the *BST Airport Master Plan Update*. This would include the following elements:

1. Remaining Master Plan Elements - Facility Requirements, Recommended Plan, Environmental Overview, & Implementation Plan; ultimate plan will likely also include property transfer and new taxiway due to safety considerations.
2. Airport Layout Plan (ALP) update – planning document of record; required by FAA for future actions
3. Other Elements - Aerial survey; airport land use compatibility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Municipal Airport
ASG
Innovative Airport Development Specialists
City of Belfast - City Council Briefing
March 18, 2014


Belfast Municipal Airport
Airport Master Plan
Phase I
Agenda
1. Airport Master Plan – Phase I
– Inventory / Forecasts
– Runway Corridor Analysis
2. Airport Master Plan – Phase II
– Remaining master plan elements
– Airport Layout Plan (ALP)
– Aerial survey
3. Questions / Comments
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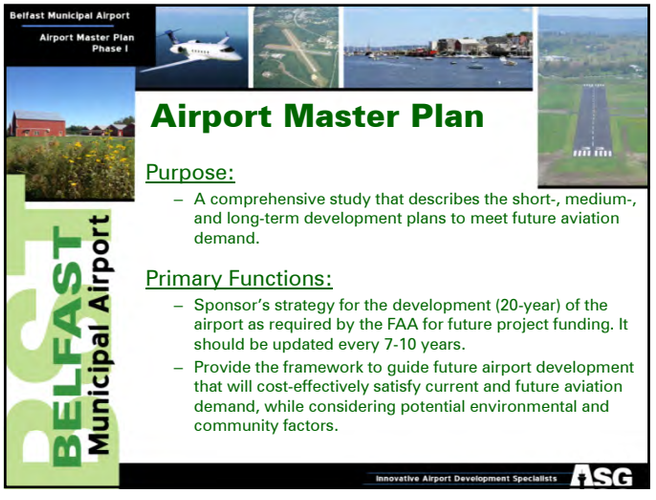
Belfast Municipal Airport
Airport Master Plan
Phase I
Airport Master Plan
Purpose:
– A comprehensive study that describes the short-, medium-, and long-term development plans to meet future aviation demand.
Primary Functions:
– Sponsor's strategy for the development (20-year) of the airport as required by the FAA for future project funding. It should be updated every 7-10 years.
– Provide the framework to guide future airport development that will cost-effectively satisfy current and future aviation demand, while considering potential environmental and community factors.
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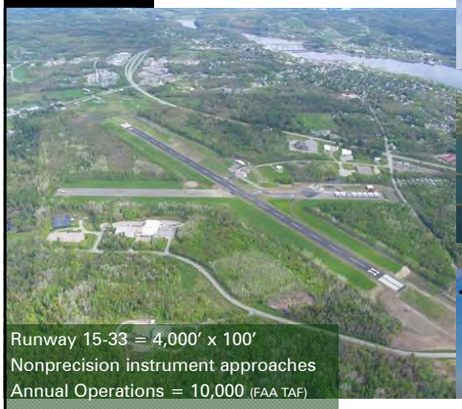
Belfast Municipal Airport
Airport Master Plan
Phase I



Cessna 182

Cessna 421

Pilatus PC-12

Runway 15-33 = 4,000' x 100'
Nonprecision instrument approaches
Annual Operations = 10,000 (FAA TAF)
Based Aircraft = 17 (FAA TAF)

Belfast Municipal Airport
Airport Master Plan
Phase I

Beech 1900

Runway Corridor Analysis

1. Forecasts / Critical Aircraft
   - Consistent with FAA TAF & 2007 BST ALP Update
   - Design Aircraft = ARC B-II *(500+ annual ops)*
     - Approach speed 91 knots or more but less than 121 knots
     - Tail height = 20' - < 30'; Wingspan = 49' - < 79'

Pilatus PC-12

Cessna Citation III

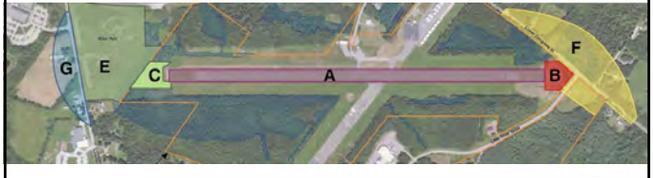
Challenger 300

Innovative Airport Development Specialists ASG

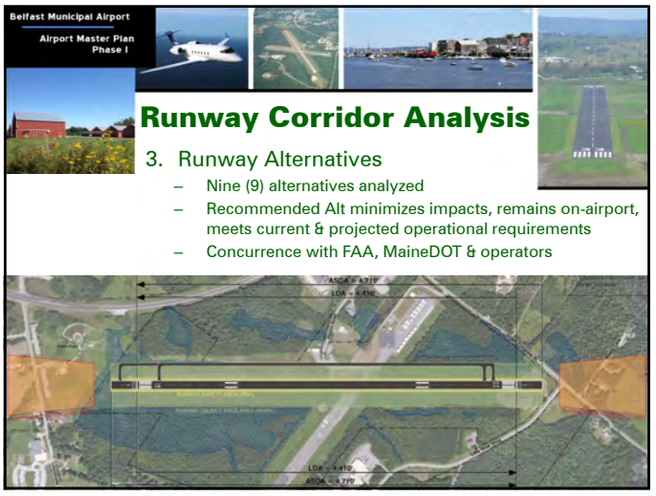
Belfast Municipal Airport
Airport Master Plan
Phase I

Runway Corridor Analysis

2. Runway Length Assessment
   - FAA methodology = 4,990 ft
   - Assessment Recommendation = 4,700 ft
     - Coordination with operators, users, & regulatory agencies
     - Planning/engineering analysis of existing conditions/facilities



Innovative Airport Development Specialists ASG


Belfast Municipal Airport
Airport Master Plan
Phase I
Runway Corridor Analysis
3. Runway Alternatives
– Nine (9) alternatives analyzed
– Recommended Alt minimizes impacts, remains on-airport, meets current & projected operational requirements
– Concurrence with FAA, MaineDOT & operators


Belfast Municipal Airport
Airport Master Plan
Phase I
Airport Master Plan
– Phase II
1. Remaining Master Plan Elements
– Facility Requirements, Recommended Plan, Environmental Overview, Implementation Plan
2. Airport Layout Plan (ALP)
– Legal document for FAA
– Update required for future actions
3. Other Elements
– Aerial Survey
– Airport Land Use Compatibility
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Belfast Municipal Airport
Airport Master Plan
Phase I
Thank You!
Questions / Comments
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