LPS AVIA CONSULTING

Porter Airlines
Runway 08-26 Extension Study
Billy Bishop Toronto City Centre Airport

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Runway 08-26 Extension Study
Billy Bishop Toronto City Centre Airport (BBTCA)

Prepared for:

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Executive Summary

Porter Airlines retained LPS AVIA Consulting to review airport standards and recommended practices to determine how Runway 08-26 may be extended to support operation of the Bombardier CS100 aircraft. Porter Airlines provided LPS AVIA with the required runway distances for safe operations based on its mission requirements, which are supported by manufacturer calculations and take into account governing regulations.

Airport standards and practices are based in part on the most demanding type of aircraft using the airport on a regular basis, and known as the design aircraft. Each runway is classified by a code number related to its length, which in turn is based on the take-off distance of the design aircraft. The runway code number is used to establish protected areas on and in the vicinity of the airport. These areas are more restrictive as the runway code number increases to accommodate larger design aircraft, or operations in poor weather.

Certain areas near airports are overlain by Obstacle Limitation Surfaces and these have been defined for BBTCA by the Minister of Transport in Federal Airport Zoning Regulations enacted in 1985. The regulations are based on a Code 3 classification, which is a runway having a length between 1,200 m. and 1,799 m. The existing runway length is 1,216 m. The proposed new runway length of 1,569 m. falls within this classification.

A key sub-set of the Obstacle Limitation Surfaces protect the approach and takeoff paths used by aircraft. These Transport Canada-approved inclined surfaces extend outwards and upwards from the end of the runway strip/inner edge, along the extended runway centre line. In some circumstances, the runway threshold used for landing may be displaced further up the runway so that the inclined approach surface can safely clear an obstacle under the approach path.

As long as the current approach surfaces remain in the locations stated in the Airport Zoning Regulations, and the landing thresholds are partially displaced to these locations, Porter can achieve a landing distance which is sufficient for the operations projected. As a result there will be no need to make changes to the existing Marine Exclusion Zone.

Transport Canada requires specific runway design characteristics for safe take-off operations. These include, among other requirements, a 60 m. strip beyond the end of the take-off runway. Transport Canada is preparing a new rule mandating runway end safety areas (RESAs) be established at certain airports, and having a minimum length of 90 m. beyond the 60 m. strip, for a total length of 150 m. The existing runway length at BBTCA cannot be maintained when this new safety measure comes into force, and a runway extension of some 45 m. will be required at each end into the lake and harbor just to maintain current operations.

To accommodate CS100 operations it will be necessary to construct the new 90 m. RESA and relocated 60 m. runway strip, for a total of 150 m on reclaimed land at each end of the runway, as well as an 18 m. runway extension. Since the RESA and runway strip are not required at the departure end of the runway, they may be used for the initial take-off roll. The Greater Toronto Airports Authority has advised that use of a RESA for the initial take-off roll has been accepted by Transport Canada at Toronto Pearson International Airport.

The Runway 08-26 Extension Study concludes that an extension of 168 m. into the water at each end should be achievable within existing airport standards, recommended practices, established approvals and precedents. The existing Marine Exclusion Zone should not need to be expanded beyond current limits.

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1 Background

1.1 Porter Airlines' Expansion

Porter Airlines has recently announced their intentions to expand operations at the Billy Bishop Toronto City Centre Airport (BBTCA) by operating the new Canadian-built Bombardier CS100, expected to be the world's quietest commercial jet in production. The introduction of the CS100 will allow Porter Airlines to increase the number of domestic and trans-border destinations from BBTCA to include Vancouver, Edmonton, Calgary, Winnipeg, California, Florida and the Caribbean.

In order to safely and efficiently operate the CS100 at the BBTCA, airport infrastructure upgrades will be required. Porter Airlines has identified operational requirements for the CS100 at BBTCA, especially runway length requirements to support scheduled air services to the destinations identified above. Porter Airlines provided LPS AVIA with the required runway distances for safe operations based on its mission requirements, which are supported by manufacturer calculations and take into account governing regulations.

This study describes and illustrates how additional runway length can be provided to support the CS100 aircraft at BBTCA by extending Runway 08-26, while complying with a recent Notice of Proposed Amendment (NPA) issued by Transport Canada that proposes requiring Runway End Safety Areas (RESAs) at certified airports in Canada.

This study examines the extension of Runway 08-26 only, as the other operational runways at BBTCA are not operationally suitable to support Porter's scheduled air services with their current fleet of DHC8-400 aircraft, or the new CS100 aircraft expected to become part of Porter's fleet.

1.2 Study Objectives

The objective is to identify an expansion concept for Runway 08-26 that provides adequate runway length to support CS100 operations in compliance with Transport Canada's Aerodrome Standards and Recommended Practices, existing approvals and precedents, and the need for new Runway End Safety Areas (RESAs) when mandated for certified airports by Transport Canada.

This study identifies known considerations associated with the runway expansion, in addition to mitigation measures that may be explored to minimize any impacts on operational practices at the airport. Considerations addressed include, but are not limited to:

- Airport certification criteria as per Transport Canada's document TP312E – Aerodrome Standards and Recommended Practices, 4th Edition;
- Registered Zoning criteria as per the Toronto Island Airport Zoning Regulations (SOR 85/515);
- Instrument approach design criteria as per TP308E – Criteria for the Development of Instrument Procedures (Revised 11/2011);
- Navigational aid impacts as per TP1247 – Land Use in the Vicinity of Airports, 8th Edition; and
- Impacts on the Marine Exclusion Zone (MEZ) established beyond the ends of Runways 08 and 26 to prevent conflicts between aircraft and tall ships.

1.3 New RESA Regulations

The provision of Runway End Safety Areas (RESAs) has been an internationally recognized practice for many years and has been adopted by the International Civil Aviation Organization (ICAO) and other regulatory bodies such as the U.K. Civil Aviation Authority (CAA), and the U.S. Federal Aviation Administration (FAA).

The objective of a Runway End Safety Area is to have an area free of objects, other than frangible visual aids required to be there by function, so as to reduce the severity of damage to an aircraft overrunning or undershooting the runway. A RESA is also provided to facilitate the movement of rescue and fire fighting vehicles.

Transport Canada's Aerodrome Standards and Recommended Practices Document TP312E – 4th Edition includes RESA standards similar to those promulgated by ICAO with occasional modification for Canadian circumstances.

RESAs have not been a mandatory requirement for certified Canadian airports but have been recommended practices due to high costs of implementation and severe constraints at many Canadian Airports.

The Transportation Safety Board (TSB) has recommended that RESAs be implemented at certified Canadian airports in order to improve the overall level of aviation safety.

Transport Canada's Notice of Proposed Amendment (NPA 2010-012 - Revised) to the Canadian Aviation Regulation proposes new regulations requiring RESAs be established at certified airports, which would harmonize Canadian airport requirements with international standards, particularly ICAO Annex 14, Volume I – Aerodrome Standards and Recommended Practices.

1.4 Notice of Proposed Amendment

The Notice of Proposed Amendment (NPA 2012-012 - Revised) to the Canadian Aviation Regulations with respect to RESAs has many parts; however, there are specific sections that could affect infrastructure requirements to meet the proposed regulations at Billy Bishop Toronto City Airport. Porter Airlines has expressed a desire to comply with the NPA while extending Runway 08-26 to support the CS100 aircraft.

Key sections of the NPA, relevant to Porter's runway expansion plans are listed below. NPA 2010-012 (Revised) states, in part:

Application

302.551 Subject to section 302.552, and 302.553, the airport operator shall provide a runway end safety area where the runway length is:

- *(a) 1,200m or greater; or*
- *(b) Less than 1,200m and the runway type is non-precision or precision; **and***
- *(c) The runway is utilized by scheduled passenger-carrying operations of an air carrier operating aircraft designed for more than 9 passenger seats as determined by the aircraft type certificate.*

302.552 A runway end safety area may not be provided prior to the declared LDA where one of the following is operational on the runway in use:

- *(a) Precision Approach Path Indicator (PAPI)*
- *(b) Abbreviated Precision Approach Path Indicator (APAPI); or*
- *(c) Instrument Landing System glide slope.*

Characteristics

302.557 The runway end safety area shall:

- *(a) have a minimum width twice that of the associated runway;*
- *(b) extend away from the runway;*
- *(c) be centered on the extended runway centreline; and*
- *(d) subject to section 302.558, have a minimum length of 150 m to the end of the RESA.*

Information Note: The 150m length is inclusive of the 60 m graded portion of the runway strip end.

302.558 Where a recognized EMAS is installed within the RESA and complies with section 302.560, the overall RESA length may be reduced.

302.559 The terrain in the runway end safety area shall:

- *(a) have no abrupt slope changes or open ditches*
- *(b) have an adequate slope to prevent the accumulation of water;*
- *(c) beyond the runway strip end, have maximum transverse and longitudinal slopes of 5 percent downwards;*
- *(d) not protrude into an Obstacle Limitation Surface (OLS); and*
- *(e) under dry conditions, be of sufficient strength to reduce the severity of structural damage to the critical aircraft overrunning / undershooting the runway.*

302.560 Where an EMAS is installed, it shall be designed to:

- *(a) stop the critical aircraft at a runway exit speed of 70 knots without imposing loads that exceed the aircraft's design limits causing major structural damage to the aircraft; and*
- *(b) not protrude into an Obstacle Limitation Surface (OLS).*

The Notice of Proposed Amendment to the Canadian Civil Aviation Regulations was presented as part of the September 21, 2011 CARAC Technical Committee Meeting.

The NPA is still at the consultation stage.

2 RESA Options

2.1 Challenges

There are challenges to providing additional land for RESAs at runway ends at Canadian airports. Transport Canada has suggested three options for complying with NPA 2010-012 (Revised). Not all options are beneficial to Porter Airlines and the Toronto Port Authority in terms of providing increased runway length while minimizing operational impacts such as encroachment in to the Marine Exclusion Zone.

The intent is to identify an extension concept for Runway 08-26 that supports the operation of the CS100, while complying with the requirements of Transport Canada's the NPA 2010-012.

2.2 Construct RESAs per NPA

The Toronto Port Authority could construct RESAs extending a minimum of 90 m beyond each end of the runway strip, at a width of 90 m. In this case the total area for aircraft overrun beyond the end of each runway will measure 150 m in length. This will entail construction easterly into Toronto Harbor and a westerly extension into the lake.

This method of compliance may provide air carriers with increased operational flexibility in terms of declared distances for runway operations.

2.3 Reduce Declared Distances

In the absence of land and to reduce capital costs, Transport Canada has suggested shortening the operational lengths of runways (published as 'declared distances') to reclaim a portion of the runway for use as a RESA.

However, reducing runway lengths will result in:

- reduced aircraft payloads and potential proportionate increases in fares and tariffs;
- reduction in the overall number of destinations served by an air carrier (depending on the actual reduction in aircraft payloads and effects on range); and
- the potential elimination of certain aircraft types from using the runway now and in the future.

Reducing the declared distances for Runway 08-26 at BBTCA was not considered as part of this study, as Porter Airlines has indicated the requirement for additional runway length to support the CS100. In addition, a reduction in the current length of Runway 08-26 would limit the operational capability of Porter's current DHC8-400 fleet.

2.4 Engineered Materials Arresting System

Where land availability prevents the installation of a RESA, Engineered Materials Arresting Systems (EMAS) can be installed which decelerate an aircraft in a short distance in the event it over-runs the end of the runway. EMAS systems have a high capital cost, and significant maintenance and upkeep requirements. They contain special light weight concrete that must be kept clear of snow, which must be undertaken by specialized equipment that must be purchased, and stored at the airport and operated by specially trained staff. It is understood that several U.S. airports are experiencing significant maintenance and upkeep requirements for their EMAS installations, even under temperate climate conditions where snow is not a factor.

3 Regulatory Issues

3.1 Required Compliance

3.1.1 Airport Zoning Regulations

Many airports in Canada have Airport Zoning Regulations (AZRs) in place to protect the facility from incompatible development near the airport that may have a negative impact on airport operations and aviation safety.

The Toronto Island Airport Regulations (SOR/85-515) were enacted by the Minister of Transport pursuant to Section 6 of the Aeronautics Act in May 1985.

The Obstacle Limitation Surfaces (OLS) defined in TP312E form the basis for Airport Zoning Regulations at BBTCA. The AZRs include provisions to protect the outer surface, approach surface, transitional surface, and runway strip, among other criteria. The AZRs for BBTCA reflect Code 3 runway zoning requirements in most cases. However, the current Airport Operations Manual (AOM) classifies Runway 08-26 as a Code 2 facility, with some exemptions listed in Appendix R (e.g. Runway 26 approach slope is 6.38%).

The airport is currently certified with a Code 2 runway but protected for a future Code 3 runway.

3.1.2 TP312E

Transport Canada's document TP312E - Aerodrome Standards and Recommended Practices prescribes the physical characteristics and Obstacle Limitation Surfaces (OLS) to be provided at certified airports in Canada. In order to maintain an airport certificate, the airport operator is required to adhere to the standards contained within TP312E – 4th Edition, unless an exemption has been granted by Transport Canada, authorizing the deviation from the standard.

The physical characteristics and surfaces defined within TP312E are based on the aerodrome reference code, which is determined by the runway length and the aeroplane reference field length associated with the aircraft for which the airport facility is intended to serve.

Key sections of TP312E which apply to runway expansion include, but are not limited to:

- *Section 1.3* – Reference Code;
- *Section 2.3.2* – Declared Distances;
- *Section 3.1* – Runways;
- *Section 3.4* – Taxiways;
- *Section 3.5* – Holding Bays, Taxi-Holding Positions, and Road-Holding Positions;
- *Section 4.1* – Obstacle Limitation Surfaces;
- *Section 4.2* – Obstacle Limitation Requirements; and
- *Section 5.0* – Visual Aids for Navigation.

3.1.3 TP1247

Transport Canada's document TP1247E Land Use in the Vicinity of Airports, 8th Edition – Part II – Protection of Telecommunications and Electronic Systems provides standards and recommended practices for the protection of navigational aids and other telecommunication infrastructure.

Instrument Landing Systems

Electronic navigational aids which may be affected by runway extensions, RESA construction, and / or threshold relocations include:

- ILS Localizer Antenna (Runways 08 and 26); and
- Glide Path Antenna (Runways 08 and 26).

Section 2.5 of TP1247E describes the criteria for siting a localizer and glide path antenna to support an Instrument Landing System (ILS). Although several other aspects of TP1247E apply to land use at the BBTCA, Section 2.5 is the most relevant in terms of an extension to Runway 08-26, subsequent RESA development, and this study.

ILS Localizer and Glide Path Antennas, supporting instrument approaches to Runways 08 and 26 may be impacted as a result of runway extension and subsequent RESA development.

Relocation of a runway threshold will require relocation of the corresponding glide path antenna. The localizer antenna may require realignment/recalibration so it corresponds with the new threshold location.

Visual Approach Aids

Visual landing aids are provided at BBTCA. Many lighting systems will be extended and adjusted to support runway expansion. These visual aids include, but are not limited to:

- Threshold/End Lighting 08/26;
- Runway 08-26 Edge Lighting;
- Lead-in Lighting System;
- Runway Identification Lights (RILs) 08;
- Visual Alignment Guidance System (VAGS) 26;
- Touchdown Zone Lights;
- Runway Guard Lights;
- PAPI 08 – Runway 08;
- APAPI – Runway 26; and other issues.

Precision Approach Path Indicator (PAPI) and an Abbreviated Precision Approach Path Indicator (APAPI) support Runways 08 and 26 respectively. These provide visual guidance to aircraft on approach and are located at a specified distance from each runway threshold.

Associated with these aids are Obstacle Protection Surfaces (OPS) to protect for full visibility of the systems during the approach phase of flight. The characteristics of the OPS (i.e. origin, divergence, length, and slope) are determined by the runway code and location of landing aid fixtures themselves.

Relocation of a runway threshold will result in a relocation of the PAPI/APAPI system. This relocation may introduce new obstructions penetrating the newly defined OPS.

3.1.4 TP308E

Transport Canada's document TP308 - Criteria for the Development of Instrument Procedures includes criteria for determining the Obstacle Clearance Surface (OCS) requirements for a runway and details how instrument approach procedures are developed, published, and monitored.

TP308 specifies the size and dimensions of the obstacle-free airspace required for an instrument approach, a missed approach, or a circling procedure.

Relocation of the thresholds associated with Runway 08 and 26 at BBTCA will require a shift in the location of the OCS and an investigation is required to determine if any obstacles penetrate the relocated OCS. An approach designer would usually conduct this assessment during the conceptual design phase of any runway extension or improvement project.

3.2 Key Issues

3.2.1 Runway Code Number

The primary consideration in the development of RESA's and/or runway extensions supporting Runway 08-26 is the reference code number assigned to the runway.

Airport standards and practices are based in part on the most demanding type of aircraft using the airport on a regular basis, and known as the design aircraft. Each runway is classified by a code number related to its length, which in turn is based on the take-off distance of the design aircraft. The runway code number is used to establish protected areas on and in the vicinity of the airport. These areas are more restrictive as the runway code number increases to accommodate larger design aircraft, or operations in poor weather.

The declared airport reference code for Runway 08-26, as outlined in the Airport Operations Manual (AOM) is Code 2 Non-Precision.

However, TP312E, 4th Edition states that runways greater than 1,200 m in length are to be classified as Code 3 facilities.

Although Runway 08-26 is currently classified as a Code 2 Non-Precision, this feature was likely certified prior to 1993 when the earlier TP312E, 3rd Edition was in effect.

It is likely that when TP312E 4th Edition came into effect the existing runway classification was allowed to remain based on Transport Canada's stated provision that:

When a runway in a given code is increased in length by an amount that places it within the next code number, other related aerodrome characteristics do not have to match the new reference code number unless the increase in length is more than 150 m (500').

This stipulation is likely the reason why the runway is classified as a Code 2 facility in the AOM, while it is over 1,200 m in length.

This situation should be confirmed with Transport Canada.

The most recent TP312E 4th edition standards state the following application within the 'Foreword' section of the document:

The specifications contained in this manual are applicable to land airports which are certified pursuant to the Air Regulations Part III.

Airports which were certified in accordance with Standards and Recommended Practices contained in previous editions of this manual may, except where otherwise specified, maintain the airport in accordance with the specifications applicable at the time of certification.

Where the airport, portions of the airport or its facilities are rehabilitated, replaced, refurbished or improved, the specifications contained in this edition of the manual apply.

Consequently improvements to the airport, including RESA provision and/or runway extension may require re-certification of Runway 08-26 as a Code 3, Non-Precision facility.

Upgrading from Code 2 to Code 3 may introduce new obstacles in the vicinity of the airport, and create operational constraints for airlines. The required runway code should be confirmed with Transport Canada.

3.2.2 Marine Exclusion Zone

The Airport Operations Manual for BBTCA contains specific sections related to tall ship operations near the airport. There are specific procedures to be followed by vessels in excess of 18.3 m (from waterline to topmost extremity), as well as other procedures to prevent interference between vessels and aircraft on approach to Runways 08 and 26.

Tall ship procedures have been established to protect the Obstacle Limitation Surfaces (OLS), Obstacle Clearance Surfaces (OCS) and instrument approach procedures during the pleasure boating season (approximately May 1st to October 31st).

As part of the tall ship operations stated within the AOM, a Marine Exclusion Zone (MEZ) was created at the end of Runways 08 and 26.

All vessels are required to remain clear of the MEZ, whose outer perimeter is defined by lighted buoys located beyond the ends of the primary runway.

An additional "protected area"; has been created beyond the MEZ that marks a 35.4m height limitation, also based on the criteria of the obstacle limitation surfaces associated with Runways 08 and 26.

Tall ships must remain outside of the protective areas at all times, and special procedures are in place to ensure that tall ships are not navigating Toronto Harbour's 'Western Gap' (under the approach surface associated with Runway 08) while the runway is operational.

An extension to Runway 08-26 and/or RESA construction will require land reclamation beyond the existing ends of Runways 08 and 26, within the MEZ. Since the dimensions of the MEZ are based on the current approach surface characteristics defined by the AOM, any change in the location and/or dimensions of the approach surfaces and the inner edge (the point of origin of the approach surface) could have a negative impact on the MEZ.

If the current approach surfaces continue as defined in the Airport Operations Manual, then the existing MEZ perimeter should not change.

3.3 Other Considerations

Sections 3.1 and 3.2 identify regulatory requirements and operating agreements having the greatest impact on the extension of Runway 08-26 and coincident RESA development.

Addressing these and other considerations require further consultations and confirmation with the Toronto Port Authority, Transport Canada, and the approach designer.

There are issues of lesser importance as they can be resolved during the design stage. They should not impact the feasibility or viability of extending Runway 08-26 and development of RESAs. All considerations should be identified and addressed in detail during the conceptual design stage.

4 Runway Expansion Concept

4.1 Operational Requirements

Porter Airlines provided LPS AVIA with the required runway distances for safe operations of the Bombardier CS100 based on defined mission requirements, and supported by manufacturer calculations and governing regulations. A runway extension concept has been prepared based on the operational requirements provided by Porter. Key assumptions include the following:

- The runway extension will trigger an upgrade from a Code 2 runway to a Code 3 runway by Transport Canada.
- The runway extension will include provision of 90 m x 90 m RESAs at the end of each runway strip, complying with NPA 2010-012. The total extension into water will be 168 m on each runway end.
- The NPA does not require a RESA prior to the landing surface as vertical guidance (PAPI/APAPI) is provided for the approaches to the runway.
- A portion of the RESA will be used for the initial portion of the take-off roll for each runway. The GTAA has reported that Transport Canada has accepted this procedure for Runway 05-23 at Toronto Pearson International Airport.
- TP312E 3.1.1.5 Recommendation stipulates that a minimum graded area 60 m in length is required before a threshold of a runway.
- TP312E 3.1.6.10 Standard stipulates that for a Code 3 Non-Precision runway, a 45 m. graded area, capable of supporting an aircraft, is required on each side of the extended runway centreline within the runway strip. It is assumed that the 45 m. graded area extends for 45 m. before the commencement of the declared distances (subject to Transport Canada confirmation).

4.2 Runway 08-26 Expansion

The Runway 08-26 expansion concept presented herein requires fill to be placed beyond the existing shoreline to accommodate a runway extension, and the supporting RESAs as per the NPA. Effort has been made to minimize the amount of fill to be placed beyond the existing shoreline.

The primary infrastructure and operational elements associated with the expansion concept include:

- A 124 m (408') runway extension to both Runways 08 and 26, resulting in an overall extension of 248 m (816')
- RESAs at each runway end;
- A change in reference code from a Code 2 Non-Precision runway to a Code 3 Non-Precision facility; and
- Displacement of runway thresholds to the existing inner edge locations associated with Runway 08 and 26 approach surfaces to minimize impacts on TP312E OLS, the AZRs, and the MEZ.

The current dimensions of the MEZ are not anticipated to be impacted based on this runway expansion and RESA development concept. The MEZ boundaries are defined based on the characteristics and location of the approach surfaces to Runways 08 and 26, which are not relocated to accommodate the expansion concept presented herein.

Figure 4-1 illustrates how the MEZ is currently defined, and how a runway extension will not result in the adjustment of the MEZ boundaries, as per the expansion concept identified herein. The resulting declared distances for the Runway 08-26 expansion and RESA development concept are shown in Table 4-1. The Expansion Concept is illustrated in Figure 4-2.

Figure 4-1 – Cross Section of Runway 26 Threshold

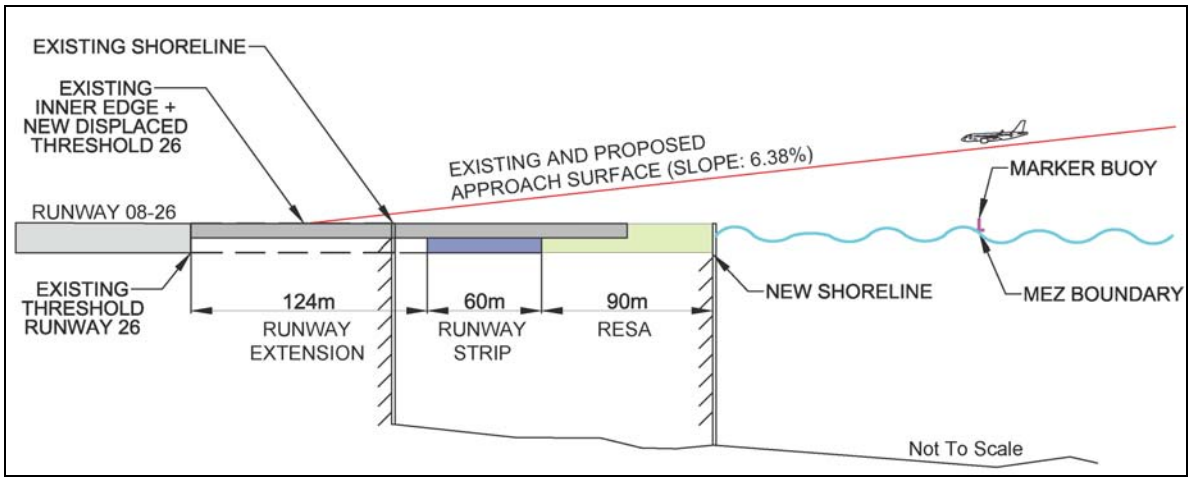

Table 4-1 – New Declared Distances

Declared Distance	Existing		Modified	
	08	26	26	08
TORA	3,988'	3,988'	5,149'	5,149'
TODA	4,338'	4,338'	5,641'	5,641'
ASDA	3,988'	3,988'	5,149'	5,149'
LDA	3,988'	3,988'	4,593'	4,593'

4.3 Expansion Impact on Airport

The concept presented in Figure 4-2 will have the following key impacts on the airport.

The reference code associated with Runway 08-26 may change from Code 2 Non-Precision to Code 3 Non-Precision, depending on interpretation by Transport Canada. The reference code may have a direct impact on the characteristics of the runway strip, approach surface length, divergence and slope, and transitional zoning specifications listed within the AOM and the AZRs. The slope of the approach surface associated with Runways 08 and 26 is not expected to change based on an extension of the runway and subsequent RESA development, as an exemption to TP312E currently exists within the Airport Operations Manual permitting slopes of 4.8% and 6.38% for Runways 08 and 26 respectively.

Discussions with Transport Canada must be undertaken to determine if the existing Code 2 Non-Precision classification and the approach slopes can be maintained if Runway 08-26 is expanded and RESAs are developed as per Figure 4-2.

If Transport Canada rules that a Code 3 Non-Precision classification is required for Runway 08-26, the increase in runway strip dimensions, and subsequent move of the lower edge of the transitional surfaces could restrict the parking of certain aircraft types on the southern-facing gates of the air terminal.

Analysis suggests that the DHC8-400 aircraft positioned at these gates will comply with the transitional zoning; however, aircraft tail heights in excess of approximately 9 m (29') will penetrate the transitional zoning. In addition, the transition from a Code 2 to a Code 3 runway facility will cause the position of Taxiway 'D' to be within the runway strip, potentially restricting it's use and affecting overall runway capacity during peak periods.

Other impacts occasioned by this runway expansion concept include, but are not necessarily limited to the following:

- Obstacle Protection Surfaces (OPS) associated with PAPI/APAPI installations for Runways 08 and 26 will change as these visual aids will require relocation to correspond with the new threshold locations.
- As a result of threshold relocations, instrument approach designs and associated Obstacle Clearance Surfaces (OCS) will require modification. A detailed study by an approach designer will assist in identifying any obstacles that may limit minimum descent altitudes and/or minimum visibility requirements.
- Threshold/end lighting and runway edge lighting will require modification to support the runway extension and development of RESAs.
- Runway Identification Lights (RILs) supporting Runway 08 will require relocation to correspond with the new threshold.
- Touchdown zone and lead-in lighting will require relocation to correspond with the new threshold locations for Runways 08 and 26.
- The Visual Alignment Guidance System (VAGS), system associated with Runway 26 will require relocation to correspond to the new threshold location.
- The APAPI installation supporting Runway 26 will require upgrade to a PAPI system as per TP312E standards. Both the existing and new PAPI systems will require relocation to correspond with the new threshold locations of Runways 08 and 26.
- The ILS glide path antennas associated with Runways 08 and 26 may require relocation to correspond with the new threshold locations. The ILS localizer antennas may require realignment and/or recalibration. Further study is required to determine actual feasibility.

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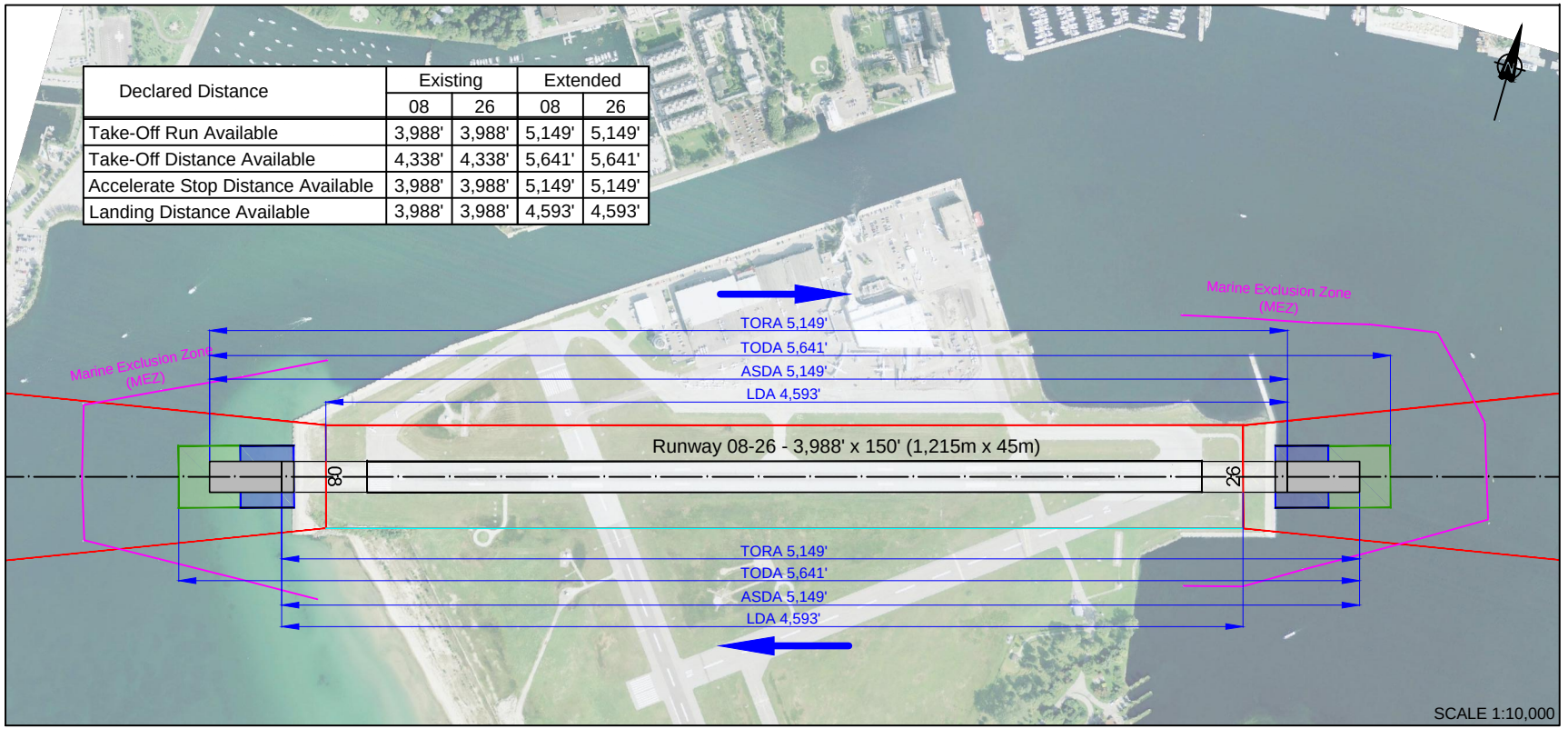
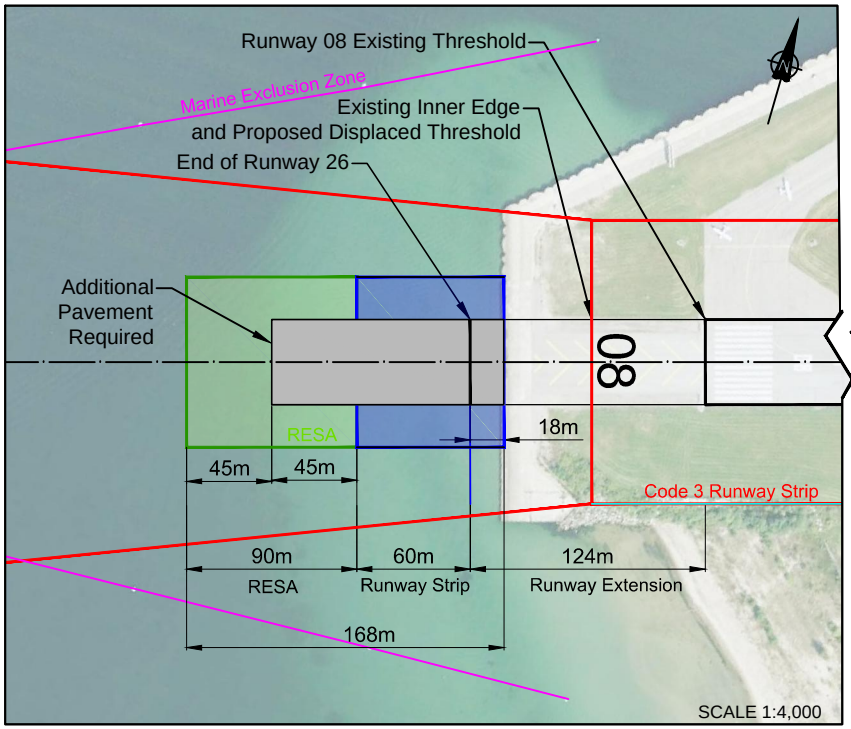
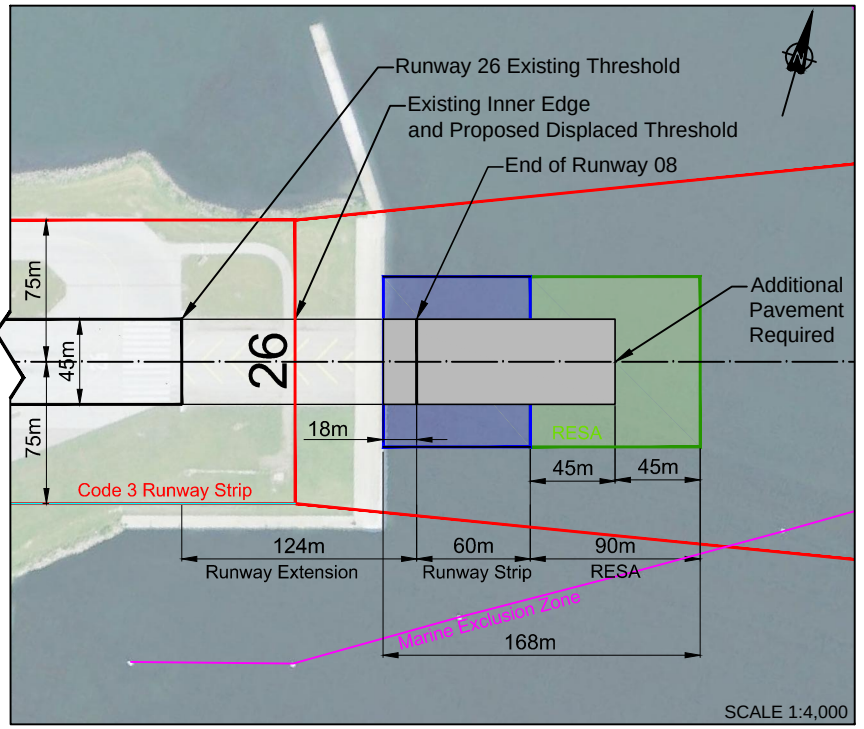
Declared Distance	Existing		Extended	
	08	26	08	26
Take-Off Run Available	3,988'	3,988'	5,149'	5,149'
Take-Off Distance Available	4,338'	4,338'	5,641'	5,641'
Accelerate Stop Distance Available	3,988'	3,988'	5,149'	5,149'
Landing Distance Available	3,988'	3,988'	4,593'	4,593'







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Client

porter

Title

Billy Bishop Toronto City Centre Airport (BBTCA)

Runway 08-26 Extension Study

Notes

1. Preliminary
2. All dimensions approximate

Figure No. 4-2

Drawn By EDH

Approved By RAM

Date MAY 2013

Scale Varies

Filename YTZ RESAR1.dwg

5 Conclusions

5.1 Conclusions

The Runway 08-26 Extension Study concludes that an extension of 168 m. into the water at each end should be achievable within existing airport standards, recommended practices, established approvals and precedents. The approach surfaces associated with Runways 08 and 26 will increase in length and divergence based on a Code 3 designation. It is not expected that the approach surface slopes will change based on a current exemption to protect the integrity of the MEZ. Therefore, the existing Marine Exclusion Zone will not need to be expanded beyond current limits.

The following considerations should be discussed with Transport Canada and the Toronto Port Authority to confirm overall feasibility.

- Runway 08-26 may be classified as a Code 3 Non-Precision facility;
- Use of Runway End Safety Areas for initial take-off roll must be confirmed;
- The runway strip associated with Runway 08-26 will increase from 90m in width to 150m;
- DHC8-400 aircraft parked at the southern-facing gates of the air terminal should not penetrate the transitional zoning surface; however, larger aircraft types (such as the CS100) may be required to park on the eastern and western facing gates to respect the new transitional zoning surface.
- The impact on the transitional zoning surface as a result of moving to a Code 3 facility should be confirmed;
- Aircraft taxi hold positions on Taxiways 'A' and 'D' will be relocated further from the runway which reduces aircraft circulation space and possibly impacts runway capacity and circulation;
- Adjustments will be required to visual aids, including but not limited to runway edge lighting, lead in lighting, Runway Identification Lights (RILs), Visual Alignment Guidance System (VAGS) - Runway 26, and touchdown zone lighting;
- The APAPI system associated with Runway 26 will need to be upgraded to a PAPI system. Both PAPIs will need to be relocated, as well as the associated obstacle protection surfaces, potentially introducing new obstacles;
- Existing instrument approaches defined by TP308 will have to be re-designed; and
- The existing Instrument Landing Systems (ILS) supporting Runways 08 and 26 will have to be modified to correspond to the new threshold locations. Specialist studies will be required to determine the feasibility of modifying the existing systems.

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