North Eleuthera Airport Master Plan

Eleuthera, Family Islands, Bahamas

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The Honourable Hanna-Martin
Minister of Transport and Aviation
Government of the Commonwealth of the Bahamas
3rd floor, Manx Corporate Centre
PO Box N-672
Nassau, Bahamas

Attention: **Minister Glenys Hanna-Martin**

Reference: **North Eleuthera Airport Master Plan**

We are pleased to submit the draft Airport Master Plan for North Eleuthera Airport. The Government of The Bahamas has embarked on a program to modernize its airports throughout the Family Islands as well as to transform these airports into vital economic catalysts for regional growth. This aggressive program is shaped by the International Civil Aviation Organization (ICAO) compliance assessments completed by Stantec that included an optimization strategy for these government owned airports.

We look forward to discussing our draft Airport Master Plan with you and are excited to continue the collaborative efforts to recreate a dynamic aviation infrastructure for the Bahamas. If you have any questions about the enclosed material, please feel free to contact me. We look forward to hearing from you.

Per:

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The journey has begun…
The transformation is underway.

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1.0 Study Context

1.1 INTRODUCTION

A successful Airport Master Plan is one that translates a long-term vision for growth and development at an airport into a plan that can be easily comprehended, is acceptable to the many airport stakeholders, and can be implemented in a series of practical stages to meet realistic financial and schedule constraints.

The Senior Project Manager and the task leaders on the team met with the government and its project designates in Nassau for a debrief on the project and then visited each of the four sites to meet with site representatives as well as stakeholders in the catchment area for each site. This re-familiarized team members with the airport site (current facilities and operating conditions) and regional infrastructure.

The team carried out the following tasks at each site:

- Met with the Bahamas Civil Aviation Department (BCAD) management and operations personnel, and other stakeholders in Nassau. This provided an opportunity to request or be supplied with required aerodrome data/documents and initial questions for various project stakeholders.
- Detailed tour of existing airport facilities and operation.
- Conduct visual observations of the existing airside operations.
- Meetings/consultations with various local stakeholders (air carriers, handlers, service provider, etc.) and government island representatives.
- Participated in a visit debrief to the Minister and senior advisors and BCAD staff on the site visits.

Background Review - Documents used in the previous study were utilized to supplement the existing conditions, financial performance and infrastructure requirements.

1.2 MASTER PLAN OBJECTIVES

The project goal for the Airport Master Plan is ***to provide the long term planning details for North Eleuthera Airport and its sub sectors. It is the blueprint to identify the opportunities for improving the operating environment at the airport to become a sustainable and critical catalyst for economic growth in the local catchment area and region.***

The following elements have been completed and comprise the work associated with the North Eleuthera Airport Master Plan:

- Consultation and site visits for key team members (including more detailed consultation and local feedback);
- Complete topographic survey of the airport in AutoCAD 2010 or newer version (Separate Files and Report);
- Geotechnical Report (Separate Report);
- An environmental site overview (Separate Report);

- Complete Noise Exposure Forecast for the site to support the relationship with the local community as well as integrate planning into the basis for an Airport Vicinity Development Plan (Separate Report);
- Socio-economic Assessment of the island and airport role (Chapter 2);
- Aviation Activity and Traffic Forecast (Chapter 3);
- Detailed review of the airfield and airside that included reference to the geotechnical work (including coring of some areas of pavement to determine the best recommendation and accurate costing) and airfield electrical assessment and costing. This included a complete airside development plan for the airport including a detailed plan of all apron, runway and taxiway geometrics for the next 15 – 20 years with costing associated with the next 10 year priority items (Chapter 4);
- Airport Land Use Plan identifying the airport land use categories for the long term including identification of any lands that may be considered for acquisition or to protect or expand airport potential. This includes landside development for each airport including areas that could be considered for commercial opportunities without infringing on the airside or operational support areas and parking, road access and utility corridors. (Chapter 5);
- Energy and Water Efficiency and Airport Sustainability (Chapter 6);
- Terminal development and facility plans that address the traffic and growth requirements and passenger services over the next 15 – 20 years. This considered alternative concepts for expansion with the preferred option presented to blend standardization with a unique aesthetic schematic design for each site and an approach to phasing the terminal facility to catch the traffic growth. Concession management discussion as well as sustainable operations and revenue collection have also been included in the terminal development planning (Chapter 7);
- Each airport also has a brief air service development approach to target and identify airline opportunities to best approach select carriers for generating interest in the location (Chapter 8);
- A capital and implementation plan that provides a detailed assessment of all facilities and infrastructure costs (including pavements), with commentary on mobile equipment, addressing priority and timing (Chapter 9).

1.3 ICAO STANDARDS AND A SHIFT IN APPROACH

Currently, public, government operated aerodromes within the Commonwealth of the Bahamas are required to comply with the Bahamas Civil Aviation Regulations (2001). With respect to design standards to be followed by aerodromes, these regulations essentially follow the current edition of ICAO's Annex 14 – Volume 1 - Aerodrome Design and Operations. The Regulations for the Bahamas are in the process of being updated in December, 2015.

ICAO Annex 14 is considered to be a "Design Based Approach" since an airport operator selects a type and classification of aerodrome, while standards, such as employed by the U.S. FAA, are considered to be an "Operational Based Approach" since they are based on the types of aircraft operating into the aerodrome. The "Design Based Approach" employed by ICAO stems from the early days in airport design following World War II when design standards were based on different airport classes. These standards were based on best engineering judgment of the era and not on empirical operational data and risk-based assessment.

ICAO and the industry as a whole is moving toward an "Operational Based Approach". In fact, Transport Canada has enacted new aerodrome design standards (Document TP312, 5th Edition) as of September 15, 2015, which were 10 years in the making. Their standards follow the U.S. FAA operational based approach and principals while retaining some aspects of ICAO's Annex 14. In addition, the new standards are more closely harmonized with current Instrument Approach Procedures and new lighting technologies. The Transport Canada design standards now require that an aerodrome level of service be chosen based on:

- an aircraft size group (predicated on an aircraft's wingspan, main gear span, tail height and approach speed);
- runway operational approach capabilities (e.g. precision, non-precision and non-instrument); and
- an aerodrome's visibility.

Most importantly, key Transport Canada design standards were developed taking into account a risk-assessment using the latest in empirical data regarding runway operational performance, aircraft approach and take-off profiles and historical incident and accident data.

It is understood that the ***Bahamas Civil Aviation Department will adopt aerodrome design standards that will align with the 'operational based approach'*** similar to the FAA and those recently enacted by Transport Canada. In so doing, many ***of the Family Islands aerodromes will benefit from the new standards which in some cases will result in lesser infrastructure requirements without compromising on aviation safety.*** As a result, the analyses, findings and recommendations made in this Master Plan have been based on the 'operational based approach' in its design recommendations.

2.0 Socio-Economic Analysis of Airport Development

2.1 INTRODUCTION

Air transport services in the Family Islands can be characterized that they provide a vital social and economic link between residents and businesses. The Family Islands airport at North Eleuthera impacts the local economy in terms of its direct, indirect and induced contribution to employment, but also serves as a strategic catalyst, enhancing business efficiency and productivity by providing access to suppliers and customers. It is a gateway for activity and access to the popular Harbour Island and Spanish Wells areas as well. By opening up new markets for international travel, expansion of the North Eleuthera Airport may also be considered to be a major driver of the local tourism industry.

2.2 AIRPORT LOCATION

Eleuthera Island is approximately two miles wide and 110 miles long. It is divided between North Eleuthera and South Eleuthera. There are more natural wrecks here than off any other island in the Bahamas. This is especially true along The Devil's Backbone, a shallow and jagged reef extending across the northern edge of Eleuthera.

Eleuthera: Facts & Figures	
Population (2010)	11,515
Seasonal residents (2011)	2,954
Timeshare visitors (2011)	55
Hotel visitors (2011)	23,943
Number of hotel rooms (2012)	568
Tourism-related investments (approved/in progress - past 5 years)	$2.2 bn

Key points of distinction - Harbour Island:

- Harbour Island is located just off the tip of Eleuthera, separated by a narrow channel. Regular ferry service shuttles resort and hotels guests as well as daily visitors from North Eleuthera for a day of exploring and shopping in Dunmore Town.
- This tiny island is a vacation magnet for the rich and famous, savvy travellers and beach vacationers.
- Famous for the pink beach that runs the entire length of its eastern shore.
- Harbour Island, Bahamas, was ranked "The Best Island in the Caribbean" by Travel Leisure magazine.

2.3 AIRPORT ROLE

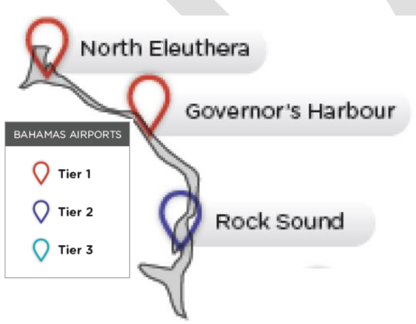

Figure 2.1: Regional Map of North Eleuthera

The North Eleuthera Airport is located in the northern area of the long and narrow island of Eleuthera as part of the extensive islands and cays in the Bahamas (see Figure 2.1). It is a uniquely situated airport with an adjacently to the Commonage lands and the access to Harbour Island, the original capital of the Bahamas.

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2.4 PUBLIC CONSULTATION PROCESS

An integral part of the Airport Master Plan process included a public involvement program. The primary purpose of involving the island community in the planning process is to ensure that the objectives and values of local businesses and residents are incorporated into the Airport Master Plan, thus ensuring that the final plan has broad public support. The specific objectives are:

- To provide opportunities for island residents to be kept up-to-date and involved in the planning process;
- To incorporate residents' values and goals into the planning process; and.
- To understand the outlook of local businesses and incorporate these into forecasting of airport requirements.

The Family Islands present a unique situation in terms of airport master planning, since the majority of airline passengers are tourists rather than residents. This requires a tailored approach to public engagement activities since businesses reflect the interest of tourism while residents reflect the interests and values of the communities. While a number of the businesses are small, local and family owned, hotel chains, airlines and similar business segments are international and the values expressed may not reflect interests or priorities of the island communities.

The consulting team made itself available to elected officials, businesses and residents on the Family Islands. Communication was structured to be open and participatory which helped to build agreement within the island community on the general approach and conclusions obtained regarding airport planning and future requirements (see Appendix 1).

A significant resource at each location was the island administrators and airport and tourism managers who all provided a wealth of local information (Table 2.1). Their contribution to this work is gratefully acknowledged.

Table 2.1: Primary Contacts for Consultation Activities for North Eleuthera Airport

Location	Airport Manager	Island Administrator	Tourism Manager
North Eleuthera Airport	Ms. Danielle Gibson	Mr. Jolton Johnson	Jacqueline Gibson

2.4.1 Approach to Consultation

We recognize that the North Eleuthera residents, businesses and community leaders have the best information and are directly impacted by airport plans. Meetings were convened with the island administrators, local businesses, community groups, including the Commonage Committee, as well as airport staff.

The role of airport staff was two-fold:

1. To be involved in the technical component of the planning process and to provide input on airport growth scenarios, criteria for evaluating demand side management and supply options, preferred options and implementation strategies, and

2. To advise the consultant team on process and planning issues such as providing ideas on ways to involve their constituents in the development of the master plans.

2.5 COMMUNITY AND AIRPORT STAKEHOLDER MEETINGS SUMMARY FEEDBACK

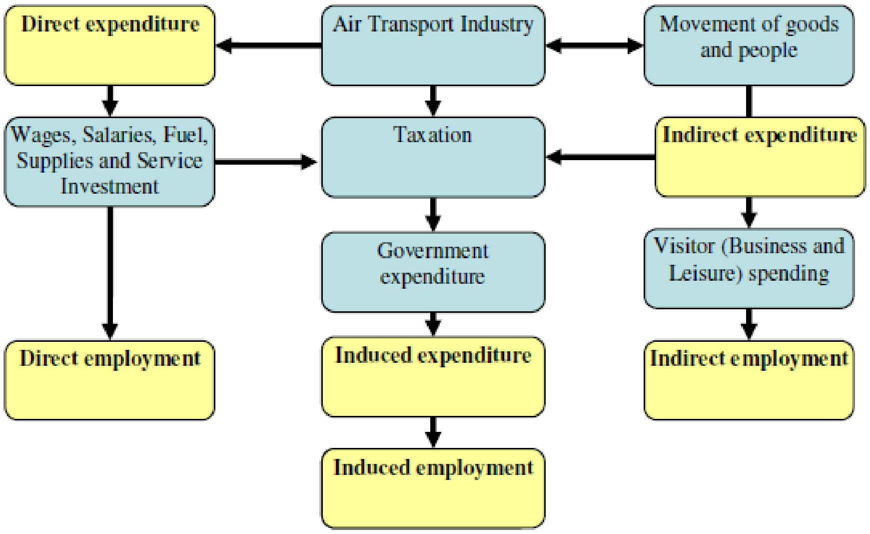
The feedback related to North Eleuthera Airport from businesses and local government towards expansion of airport facilities was positive and supportive. There was a consistent message from businesses and airport operations staff that the current facilities are inadequate and in some cases, embarrassing. Overcrowding of the terminals was consistently noted by airport staff. Buildings are in poor condition and present a poor first impression to the island communities was also noted. Local businesses, including the rental car and taxis, expressed the desire for new and updated airport facilities to increase business activities. The airport at North Eleuthera is on Commonage Land. While the spokespeople were strongly supportive of airport expansion, they expressed the need for recognition and possibly compensation or participation for continued use and future expanded use of the land.

The recent placement and efforts by the Ministry to have an airport manager at North Eleuthera supported by knowledgeable and energetic staff has had a significant impact on improving the operating conditions at the airport. Notwithstanding the exceptional efforts of airport staff, the functional obsolescence of the air terminal buildings, maintenance and storage buildings, combined with the serious compliance issues and congestion associated with runways, taxi-ways and aprons was manifest. The existing Fixed Base Operation has a solid business and fuelling operation although the apron is to small and not compliant. The potential to expand the concession and operational space for airlines and business in the terminal is required.

2.6 SOCIO-ECONOMIC IMPACTS OF AIRPORT DEVELOPMENT

Airlines and airports make vital contributions to any nation's economy; *first as a key component of a country's transportation infrastructure which facilitates the domestic and international flow of commerce, and second as an industry that generates significant direct and indirect employment in leisure and business travel-related industries*. The Bahamas geography typified by a large number of islands and cays, particularly concentrated in the Family Islands, means that air travel provides the same essential services as highways provide in other countries. In the case of the Family Islands Airports, the most important economic contribution aviation makes is through its impact on the tourism industry and as a facilitator of growth. According to the International Civil Aviation Organization (2002), air transport facilitates growth elsewhere in an economy by, on average**, 3.5 times as much as its direct impact on output and by a staggering 6.1 times as much as its direct impact on jobs.**

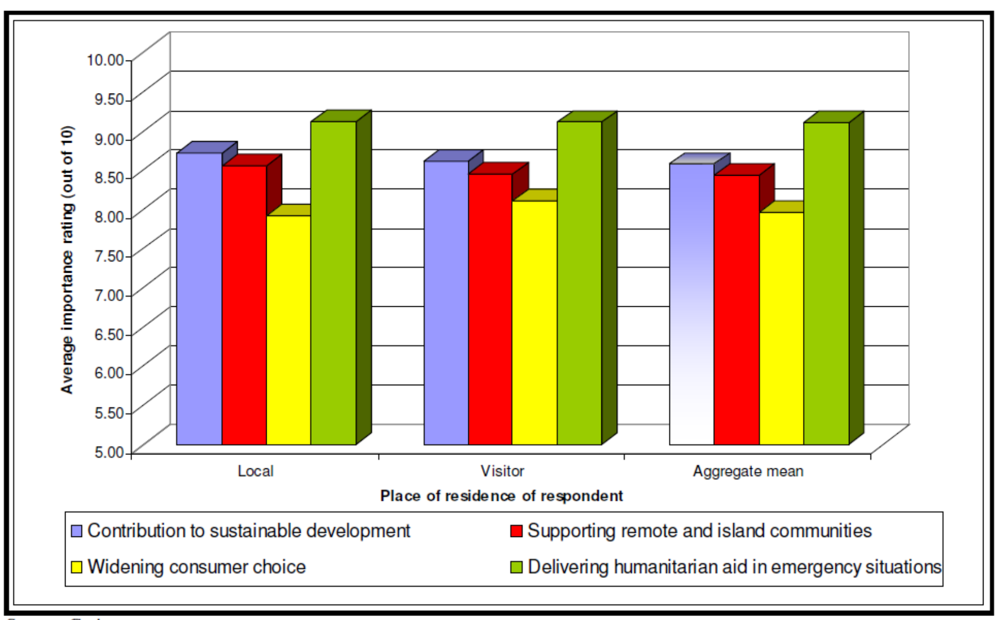
Figure 2.2: Air Transportation Impact on Bahamian Economy



2.6.1 Social value of air transport sector to region: Qualitative Research

A survey of air travel was completed by Caricom in 2012. On aggregate, survey respondents confirmed that they highly valued the air transport sector's role in facilitating social and economic prosperity in the region. Respondents were aware that the importance rating was supposed to be given relative to the role other sectors would have on the four revealed socioeconomic indicators. Although it was not possible for most respondents to consider all other socio-economic influences simultaneously, the survey results confirm the sector's wider impacts on the region's economy.

Figure 2.3: Passenger Survey on Importance of Air Travel in Caricom region



Source: Caricom passenger survey

2.6.2 Family Island Socio-economic Impact of Airport Development

The methodology for the socio economic assessment of airport development has been carried out in four stages as follows:

1. Identification of existing socioeconomic baseline conditions;
2. Assessment of the potential effects which could occur temporarily during construction and permanently during operation;
3. Identification of the mitigation measures which will and have been incorporated into the scheme to reduce any negative impacts; and
4. Description of the residual effects, i.e. prediction of the effects which are likely to occur assuming the mitigation measures are implemented.

The socioeconomic impacts of the airport scheme have the potential to have impacts on the national economic and social environment. Due to the small size of the island of Eleuthera and the availability of data, the assessment of impacts is qualitative. Where appropriate local impacts specific to the airport site or the site of its supporting infrastructure have been assessed. Impacts beyond the national boundaries have not been considered.

The potential effects of the proposed airport and its associated infrastructure have been considered under a number of key headings. These are based on potential impacts identified through similar studies of airport development.

2.6.3 Socioeconomic baseline conditions

2.6.3.1 Demographics[1]

The population and households of San Salvador and its communities are summarized in **Table 2.2**.

Table 2.2: Resident Population and Households

	Population	**Households**
North Eleuthera	3247	1071

2.6.3.2 Tourism[2]

Tourism levels by island for 2011 and 2012 are presented in Table 2.3. Based on this information, the tourism activity has somewhat stagnated in Eleuthera and has dropped by over 16% in the years assessed. The activity level is for the entire island but the majority of the air activity is linked to North Eleuthera. The air travel has dropped less than the overall air and sea access totals at -5.7% and the activity at North Eleuthera, in particular, has shown strong air access traffic patterns as of late.

[1] http://statistics.bahamas.gov.bs/key.php?cat=13

[2] http://www.tourismtoday.com/docs/stats/2012TheBeginningofSomethingGreatFullYearinReviewIndustryReport2012.pdf

Table 2.3: Tourism Counts by Location

	Air and Sea			Air Only		
	2012	2011	2012 to 2011	2012	2011	2012 to 2011
Nassau/Paradise	3,285,035	3,006,077	9.30%	1,052,275	970,467	8.40%
Grand Bahama	839,490	818,289	2.60%	106,685	99,807	6.90%
Abaco	325,609	240,159	35.60%	76,994	75,596	1.80%
Andros	8,871	9,275	-4.40%	8,701	9,116	-4.60%
Berry Islands	642,309	614,063	4.60%	8,279	8,609	-3.80%
Bimini	54,036	53,216	1.50%	17,476	17,025	2.60%
Cat Cay	11,411	11,472	-0.50%	4,376	5,246	-16.60%
Cat Island	1,051	952	10.40%	1,048	921	13.80%
Eleuthera	248,348	296,940	-16.40%	31,892	33,817	-5.70%
Exuma	33,605	30,584	9.90%	32,917	30,017	9.70%
Half Moon Cay	472,892	488,925	-3.30%	-	-	0.00%
Inagua	734	779	-5.80%	175	251	-30.30%
Long Island	1,126	1,306	-13.80%	1,105	1,259	-12.20%
San Salvador	15,653	15,551	0.70%	15,508	15,411	0.60%
Total	**5,940,170**	**5,587,588**	**6.30%**	**1,357,431**	**1,267,542**	**7.10%**

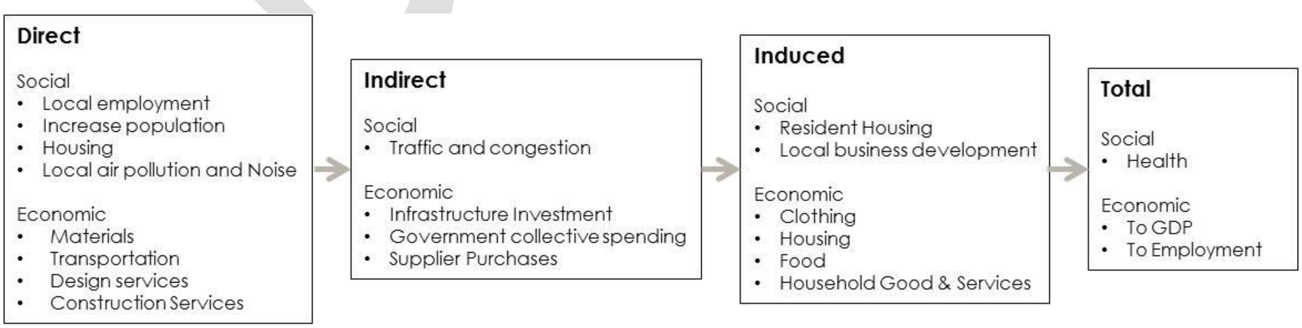
2.6.3.3 Socio-economic Effects

During construction, there will be an influx of workers responsible for construction of the new facilities. Airports of this size could see workforces of 100 or more staff for two to three years. This increase in population could have an impact on housing availability and price.

Combined with the worker employment will come re-spending effects that will increase local business activity. This will have indirect and induced impacts on the local economy.

New business opportunities were noted by local businesses with an expansion in the customer base and increased demand for goods and services.

Figure 2.4: Direct, Indirect and Induced Impacts of Airport Development



2.7 VISITOR EXPENDITURES

Visitor expenditures were estimated for individual islands for 2008, and summarized in Table 2.4. Expenditures are on average $1,232 per person per visit for the average visitor to Eleuthera. It should be noted that this is for the entire island and the average spend is likely higher at the northern region of the island associated with Harbour Island.

Table 2.4: Average Expenditures, 2008[3]

Island	Private Pilot Visitor		Average Visitor	
	Visitor Night	Visit	Visitor Night	Visit
Eleuthera	$183	$1,098	$158	$1,232

2.8 AIR TRANSPORT IMPACT ON BAHAMIAN ECONOMY

An estimate of the economic size of air transport sector for Caricom nations was developed by Warnock-Smith. This information is presented in Table 2.5 for the Bahamas. No information was found for individual airports in the Bahamas. Based on this data, airports contribute approximately 23% towards Bahaman GDP and employ 11% of the workforce.

Table 2.5: Air Transportation Sector Impact on Bahamian Economy[4]

	Gross Added Value (BD$ - mm)	Employment	Gross Added Value (% of GDP)	Employment (% of Labour Force)
Direct	419	1,096	6.86	0.62
Indirect				
Induced	998	18,685	16.35	10.6
Total	***1,417***	***19,685***	***23.2***	***11.2***

2.8.1.1 Energy and Water Effects

Increased energy and water use will be a factor in the ongoing operation of expanded facilities. This is discussed in detail in Chapter 6.

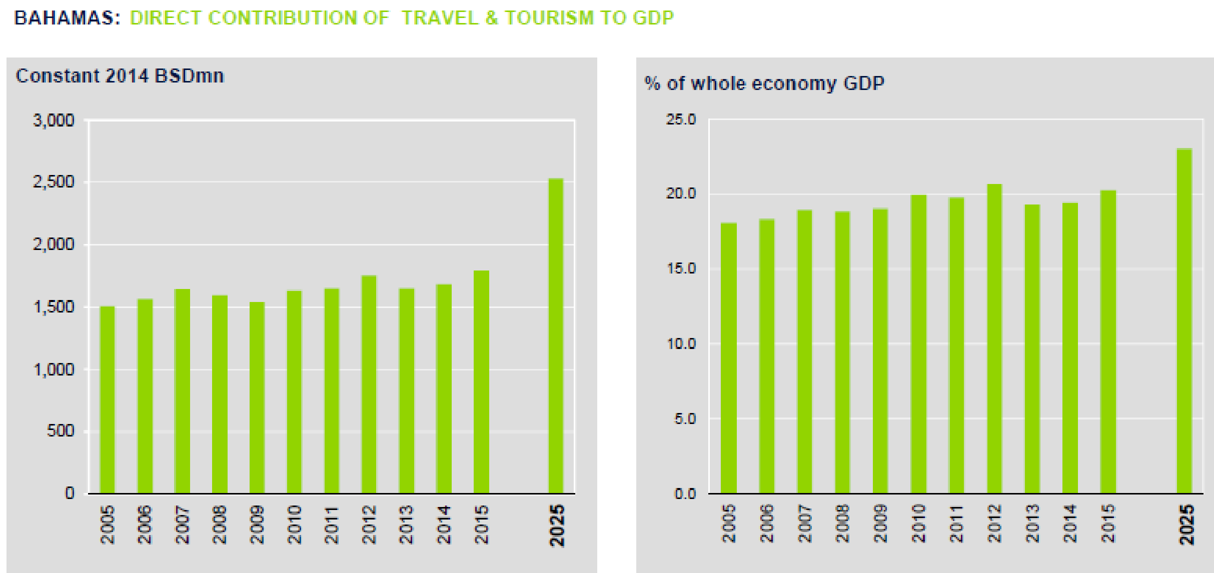
[3] Sobieralski, J.B., Economic Importance of Niche Markets for a Tourist Economy: the case of Private Pilots in the Bahamas.

[4] Warnock-Smith, D., Socio-economic impact of air transport on small Islands states: An evaluation of liberalisation gains for the Caribbean Community, Cranfield University, 2008

2.8.2 Growth Prospects: Outlook for North Eleuthera and Area

A growth forecast of tourism related contributions to GDP is presented in Figure **2.5**.

Figure 2.5: Forecast of the Contribution of Tourism to Bahamas GDP[5]



2.9 MITIGATION MEASURES TO REDUCE ANY NEGATIVE IMPACTS

To mitigate the increased use of natural resources, efficiency strategies are proposed to make the facilities sustainable. Details of proposed energy and water strategies are presented in a subsequent Chapter of this report.

2.10 RESIDUAL EFFECTS

Residual effects include on-going impacts once mitigation activities have been implemented. The most significant residual effect will be increased tourism activity on the Family Island of Eleuthera. No forecast of the impact of airport renewal associated with increased visitation has been established.

2.11 ENERGY AND SOCIAL IMPACTS

Energy and social impacts are related through the negative impacts of importing and consuming fossil fuels. Increased use of diesel may translate into increased risk of fuel spills as well as local air and noise pollution from the generating stations.

[5] World Travel and Tourism Council, Economic Impacts 2015, Bahamas

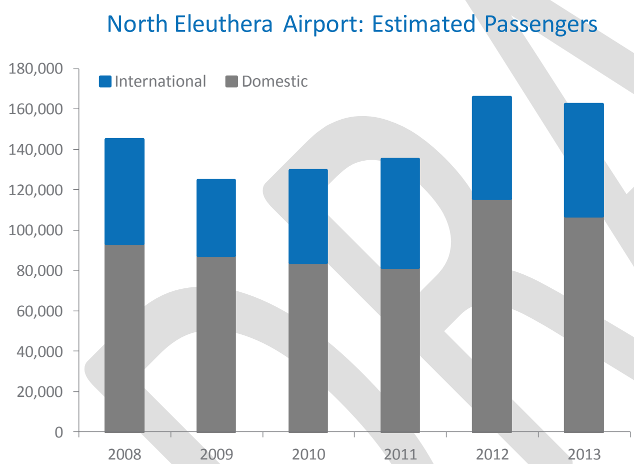
3.0 Aviation Activity and Traffic Forecast

3.1 OVERVIEW

The North Eleuthera International Airport is the main airport in Eleuthera, and is the third largest airport in the Tier 1 airports with 157,819 passengers in 2013. This airport is classified as a Port of Entry (POE) or Airport of Entry (AOE), and last year 35% of its passengers were international – a figure that has been stable over the last 5 years.

According to the OAG, in 2013 two domestic routes were served, namely Nassau and Governor's Harbour. The latter is a multi-stop route which was combined with Nassau. The international network is focused on two routes (FLL and MIA), both of the same size. The network is completed by three very small routes: Key West, West Palm Beach and Tampa Bay, all with less than 1,000 departure seats a year.

In 2013, the main carrier at the airport was Bahamasair, followed closely by Pineapple Air. Despite being the same size (about 26% market share in 2013 for both carriers), their direction in recent years has changed. Since 2008, Bahamasair has reduced its capacity by 30%, while Pineapple started to serve North Eleuthera in 2011 and has quadrupled in size over the past three years.



Source: DKMA Estimates

The airport's current and future mission is to serve the tourism market. In parallel, the airport will continue to be the main airport in Eleuthera and serve the regional population of the island, estimated at 3,247 in the 2010 census.

During the last five years, in part due to Pineapple Air's development, the domestic market has grown more rapidly than the international market (2.7% vs. 1.6%) but moving forward we expect the trend to be reversed. On-going tourism development will help reverse this trend, and the international network will continue to focus on routes to and from North America. By 2033, we expect North Eleuthera to reach 270,547 passengers, reflecting growth of 2.7% per annum, and international activities are expected to account for 38% of all passengers (compared to 35% in 2013).

3.2 PASSENGER FORECAST (2015 – 2033)

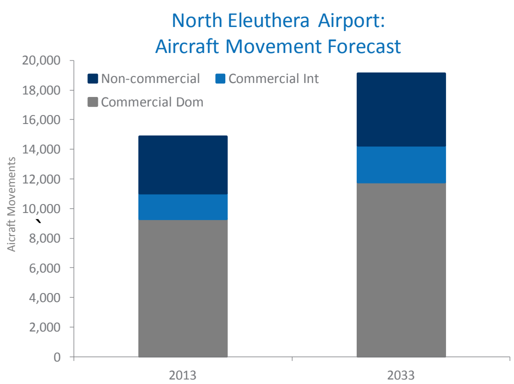
During the next two decades, passenger demand in the Family Islands is projected to increase annually by 2.4% to reach 1.7 million passengers by 2033, ***where most of the growth (1.25 million passengers) will be driven by Tier 1 airports.*** The four airports in the Master Plan study account for 784,000 of these passengers with ***North Eleuthera reaching 270,000 passengers by 2033.***

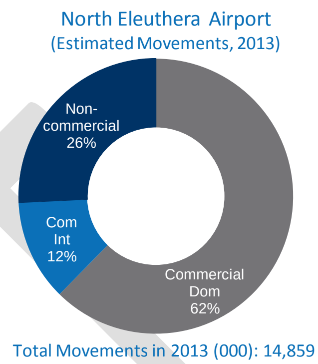
Scheduled Passengers Forecast (000), Family Islands Airports, Preliminary												
Tier	3-Letter Code	4-Letter Code	Airport Name	Domestic			Int'l			Total		
				2013	2033	%	2013	2033	%	2013	2033	%
1	MHH	MYAM	Marsh Harbour	96.3	140.8	1.9%	120.3	240.7	3.5%	216.6	381.5	2.9%
1	GGT	MYEF	Exuma/ George Town	90.4	148.5	2.5%	73.9	153.5	3.7%	164.3	302.0	3.1%
1	ELH	MYEH	North Eleuthera	102.4	168.2	2.5%	55.4	102.4	3.1%	157.8	270.5	2.7%
1	ZSA	MYSM	San Salvador	27.8	43.0	2.2%	28.6	65.8	4.2%	56.4	108.8	3.3%
1	BIM	MYSB	South Bimini	9.4	13.7	1.9%	39.0	68.0	2.8%	48.3	81.6	2.7%
1	GHB	MYEM	Governour's Habour	69.8	90.4	1.3%	8.9	12.4	1.7%	78.7	102.9	1.4%
2	RSD	MYER	Rock Sound	86.7	112.4	1.3%	1.7	2.0	0.8%	88.4	114.4	1.3%
2	LGI	MYLD	Deadman's Cay	43.5	57.5	1.4%	0.0	0.0	-	43.5	57.5	1.4%
2	TBI	MYCB	New Bight	32.5	53.3	2.5%	1.6	3.3	3.7%	34.1	56.6	2.6%
2	ASD	MYAF	Andros Town	10.7	14.2	1.4%	5.8	8.3	1.8%	16.6	22.5	1.5%
2	IGA	MYIG	Matthew Town/ Inagua	8.2	10.3	1.1%	0.4	0.4	0.7%	8.6	10.7	1.1%
2	GHC	MYBG	Great Harbour Cay	0.2	0.3	0.7%	7.6	11.2	1.9%	7.9	11.4	1.9%
2	SAQ	MYAN	San Andros	9.1	12.3	1.5%	7.7	12.6	2.5%	16.8	24.9	2.0%
3	TCB	MYAT	Treasure Cay	13.5	15.4	0.7%	34.5	38.9	0.6%	48.0	54.3	0.6%
3	MYG	MYMM	Mayaguana	1.8	1.9	0.3%	0.0	0.0	-	1.8	1.9	0.3%
3	RCY	MYRP	Rum Cay	3.7	4.0	0.4%	0.0	0.0	-	3.7	4.0	0.4%
3		MYAS	Sandy Point	0.0	0.0	-	0.0	0.0	-	0.0	0.0	-
3		MYAO	Moore's Island	0.0	0.0	-	0.0	0.0	-	0.0	0.0	-
3		MYAB	Mangrove Cay	1.6	2.1	1.3%	0.0	0.0	-	1.6	2.1	1.3%
3	SML	MYLS	Stella Maris	24.4	33.6	1.6%	1.8	2.0	0.7%	26.2	35.6	1.6%
3	TYM	MYES	Staniel Cay	0.0	0.0	-	0.0	0.0	-	0.0	0.0	-
3		MYEB	Blackpoint	0.0	0.0	-	0.0	0.0	-	0.0	0.0	-
3	MYE3		Farmer's Cay	0.0	0.0	-	0.0	0.0	-	0.0	0.0	-
3	TZN	MYAK	Congo Town	9.1	12.0	1.4%	2.9	3.2	0.4%	12.0	15.2	1.2%
3	CRI	MYCI	Crooked Island	9.1	10.7	0.8%	0.0	0.0	-	9.1	10.7	0.8%
3	AXP	MYAP	Spring Point	7.1	7.5	0.3%	0.0	0.0	-	7.1	7.5	0.3%
3	DCT	MYRD	Ragged Island	0.0	0.0	-	0.0	0.0	-	0.0	0.0	-
C	ATC	MYCA	Arthur's Town	7.6	9.0	0.9%	0.0	0.0	-	7.6	9.0	0.9%
	Total			*665.0*	*961.1*	*1.9%*	*390.1*	*724.7*	*3.1%*	*1,055.1*	*1,685.7*	*2.4%*

Stantec

3.3 AIRCRAFT MOVEMENTS

Since most of the expected route development is geared toward North American hotel chains (ex: Sands), we assume that short and medium-haul routes will expand more rapidly than long-haul routes. In parallel, aircraft movements are projected to increase annually by 1.9% overall with international at 2.4% growth per annum. ***The aircraft movements are expected to grow to 21,500 by 2033.***





Aircraft Movements Forecast (000), Family Islands Airports, Preliminary																
Tier	3-Letter Code	4-Letter Code	Airport Name	Scheduled - Dom			Scheduled - Int'l			Non-Commercial			Total			
				2013	2033	%	2013	2033	%	2013	2033	%	2013	2033	%	
1	MHH	MYAM	Marsh Harbour	4.5	5.7	1.1%	4.1	6.6	2.4%	1.1	1.4	1.3%	9.8	13.7	1.7%	
1	GGT	MYEF	Exuma/ George Town	4.4	6.4	1.9%	2.2	3.9	3.0%	0.8	1.1	1.3%	7.4	11.4	2.2%	
1	ELH	MYEH	North Eleuthera	9.3	13.8	2.0%	1.8	2.8	2.4%	3.8	4.9	1.2%	14.9	21.5	1.9%	
1	ZSA	MYSM	San Salvador	1.5	2.0	1.6%	0.3	0.5	2.7%	0.3	0.4	1.4%	2.0	2.9	1.7%	
1	BIM	MYSB	South Bimini	0.5	0.7	1.3%	0.7	1.0	1.7%	0.6	0.7	0.9%	1.8	2.3	1.3%	
1	GHB	MYEM	Governour's Habour	5.4	6.3	0.8%	0.45	0.54	0.9%	1.6	2.1	1.5%	7.4	8.9	1.0%	
2	RSD	MYER	Rock Sound	6.1	6.6	0.4%	0.14	0.14	0.3%	0.8	0.9	0.8%	7.0	7.7	0.4%	
2	LGI	MYLD	Deadman's Cay	3.5	4.2	0.8%	0.0	0.0	-	0.3	0.4	0.7%	3.9	4.5	0.8%	
2	TBI	MYCB	New Bight	2.1	3.0	1.8%	0.05	0.09	2.5%	0.10	0.12	1.2%	2.3	3.3	1.8%	
2	ASD	MYAF	Andros Town	1.3	1.6	0.9%	0.12	0.16	1.4%	4.58	6.29	1.6%	6.0	8.0	1.5%	
2	IGA	MYIG	Matthew Town/ Inagua	0.31	0.34	0.5%	0.025	0.027	0.3%	0.03	0.04	1.3%	0.36	0.41	0.6%	
2	GHC	MYBG	Great Harbour Cay	0.052	0.054	0.2%	0.36	0.44	1.0%	0.9	1.0	0.7%	1.3	1.5	0.8%	
2	SAQ	MYAN	San Andros	1.3	1.6	1.0%	0.16	0.24	2.2%	5.1	7.1	1.7%	6.5	9.0	1.6%	
3	TCB	MYAT	Treasure Cay	0.59	0.63	0.4%	0.79	0.82	0.2%	0.22	0.24	0.4%	1.6	1.7	0.3%	
3	MYG	MYMM	Mayaguana	0.23	0.24	0.2%	0.0	0.0	-	0.049	0.053	0.4%	0.28	0.29	0.2%	
3	RCY	MYRP	Rum Cay	0.36	0.38	0.2%	0.0	0.0	-	0.049	0.053	0.4%	0.41	0.44	0.3%	
3		MYAS	Sandy Point	0.0	0.0	-	0.0	0.0	-	0.28	0.32	0.7%	0.28	0.32	0.7%	
3		MYAO	Moore's Island	0.0	0.0	-	0.0	0.0	-	0.088	0.095	0.4%	0.088	0.095	0.4%	
3		MYAB	Mangrove Cay	0.7	0.9	1.1%	0.0	0.0	-	1.4	1.7	1.0%	2.1	2.6	1.0%	
3	SML	MYLS	Stella Maris	2.5	2.9	0.7%	0.20	0.22	0.5%	1.0	1.2	0.6%	3.7	4.3	0.7%	
3	TYM	MYES	Staniel Cay	0.0	0.0	-	0.0	0.0	-	4.8	5.9	1.1%	4.8	5.9	1.1%	
3		MYEB	Blackpoint	0.0	0.0	-	0.0	0.0	-	0.068	0.074	0.4%	0.068	0.074	0.4%	
3	MYE3		Farmer's Cay	0.0	0.0	-	0.0	0.0	-	0.09	0.10	0.4%	0.088	0.095	0.4%	
3	TZN	MYAK	Congo Town	0.9	1.1	1.1%	0.12	0.13	0.2%	0.37	0.42	0.6%	1.4	1.7	0.9%	
3	CRI	MYCI	Crooked Island	0.5	0.6	0.5%	0.0	0.0	-	0.01	0.01	0.4%	0.5	0.6	0.5%	
3	AXP	MYAP	Spring Point	0.32	0.33	0.2%	0.0	0.0	-	0.058	0.065	0.5%	0.38	0.40	0.2%	
3	DCT	MYRD	Ragged Island	0.0	0.0	-	0.0	0.0	-	0.058	0.065	0.5%	0.058	0.065	0.5%	
C	ATC	MYCA	Arthur's Town	0.4	0.5	0.6%	0.0	0.0	-	0.02	0.02	0.3%	0.4	0.5	0.6%	
	Total			*46.9*	*59.7*	*1.2%*	*11.5*	*17.7*	*2.2%*	*28.5*	*36.6*	*1.3%*	*86.8*	*114.1*	*1.4%*	

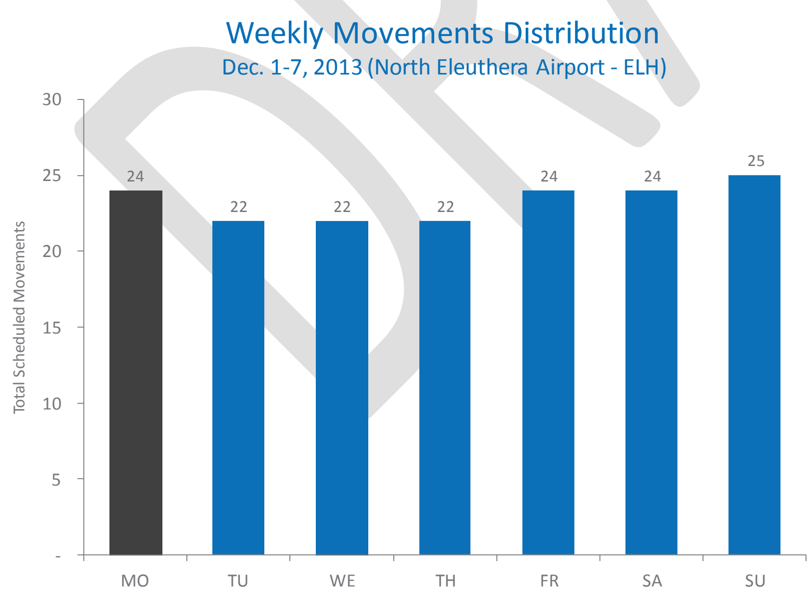
3.4 PEAK HOUR ESTIMATES

When detailed traffic statistics, typically found in the airport's Tower Log, are available airports authorities and industry experts use different methodologies to determine the peak hour for capacity planning.

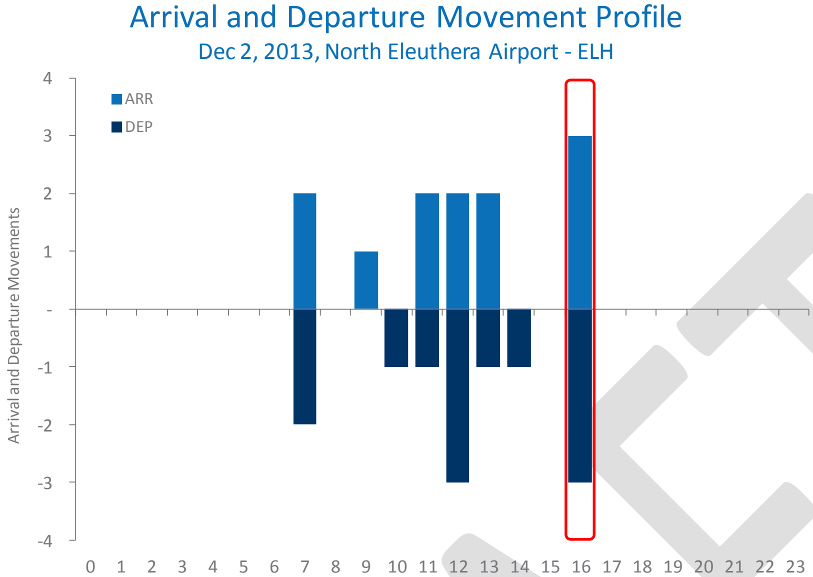
- Toronto Pearson Airport normally relies on the 95th percentile methodology; the BAA, for example, uses the "5% Busy Hour" (the hourly rate above which 5% of annual traffic in a given terminal or airport is handled), or the 30th busiest hour. Zurich airport, ADV (Germany) and ACSA in South Africa also use the 30th busiest hour while others use the 40th busiest hour.
- However, if the Tower Log in not available, as is the case for airports in the Family Islands, the classic methodology used by DKMA is to rely on the IATA methodology.
- To identify and analyse a typical busy day/ peak hour movements, based on this methodology, we construct an average week during the peak month and select the second busiest day during the average week of that peak month and this day then becomes the busy day. From this busy day we select the peak hour movements.

Our peak hour movement analysis is done for 2013 and 2015. In 2014, the team prepared a long term forecast for each of the Family Island Airports and was able to collect annual aircraft movements (commercial and GA) for 2013. Once the 2013 peak hour movement is selected this enabled us to prepare a series of peak ratios. For 2015, we have no annual movements but this will enable us to see the evolution of the peak hour movements between 2013 and 2015. Aside from the Tower Log, monthly traffic statistics by airport were also not available. This means that we cannot know with certainty when is the peak month of operation. Therefore, to select our busy day the team pulled OAG monthly movements to identify the scheduled peak month.

Based on the IATA methodology, the peak day/ peak hour should be based on the second busiest day. Based on this methodology, we selected Monday (December 2, 2013) in North Eleuthera.



As can be seen in the graphic below, the peak hour for movements at North Eleuthera is at 16:00 with 6 movements (3 arrivals and 3 departures).



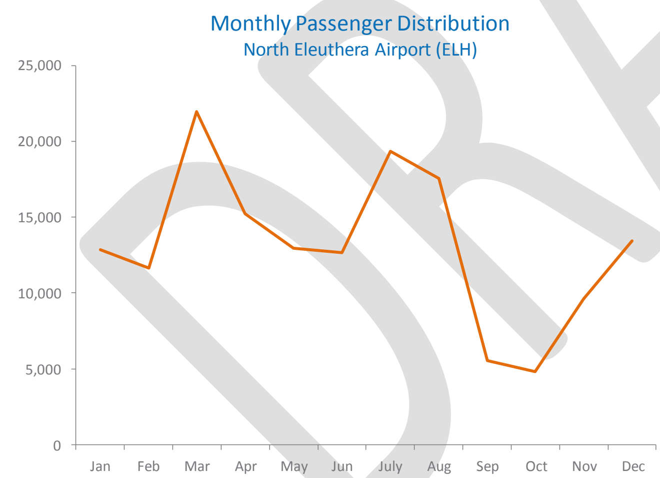
The following table shows the 'peak day to annual' and 'peak hour to annual' ratios. The table also show the original peak day and peak hour pulled for January 2013 vs. the revised one, where the exercise was done for different peak months. In some cases the figures increase and in others they decease but no significant changes are seen.

Summary of Peak Hour Movements North Eleuthera (ELH) 2013			
		Original	Revised
Annual	Schedule	7,886	7,886
	GA	3,827	3,827
	Total	11,713	11,713
Peak Day	Schedule	27	24
	GA	n/a	n/a
	Total	n/a	n/a
	Peak Day Ratio (Scheduled)	0.00342	0.00304
	Peak Day Ratio (Total)	0.00231	0.00205
Peak Hour	Arrivals	4	3
(Schedule)	Departures	2	3
	Total	6	6
	Peak Hour Ratio (Arrivals)	0.00051	0.00038
	Peak Hour Ratio (Departures)	0.00025	0.00038
	Peak Hour Ratio (Total)	0.00076	0.00076

The following table shows the evolution of the peak day and peak hour movements between 2013 and 2015.Given that all these airports are small we see variations year over year where in some cases figures increase while in others they decrease. However, we do not see major changes between the two years.

Movements: 2013 versus 2015							
Airport		Peak Day			Peak Hour		
		Original	Revised		Original	Revised	
		2013	2013	2015	2013	2013	2015
ELh	ARR				4	3	4
	DEP				2	3	3
	TOT	27	24	21	6	6	7
GGT	ARR				5	3	2
	DEP				3	3	3
	TOT	23	18	17	8	6	5
GHB	ARR				2	2	2
	DEP				1	3	1
	TOT	18	20	22	3	5	3
ZSA	ARR				1	1	2
	DEP				1	1	1
	TOT	4	6	10	2	2	3

Regarding seasonality, the peak month for North Eleuthera Airport is March which represents 13.9% of passengers in North Eleuthera.



The 20 year forecast shows the potential to ***grow to over 270,000 passengers by 2033*** (with over 38% being international). With 13.7% arriving in March and a fairly even daily flight schedule, it amounts to 1210 passengers /day. Conservatively, with 25% of the passengers at the site at a given time, by 2033 the facility could ***experience over 300 passengers arriving and 300 departing passengers at the facility at one time*** served by 2 to 3 aircraft on the ground that would handle arrival and departure flights (note: the GA fixed base operation also would handle some traffic). This is consistent with the design aircraft for the site being the A319 or B737. The terminal functional requirements and passenger activity is very similar to Exuma and design benefits can be attained. This airport has a busy General Aviation market as well and this will require a very efficient airfield.

3.5 AIR SERVICE DEVELOPMENT

The objective of this section is to provide for North Eleuthera Airport a sound understanding of the characteristics of air travel in the region surrounding the airport and to identify potential gaps between the airport's passenger demand, today and through the forecast period, and its current airline services.

The review is, in large part, based on the analysis of passenger bookings and passenger tickets. This information, which is generally not accessible to airports, enables the consulting team to examine in great detail the composition of travel markets. Specifically, the review concentrates on:

- Breaking down travel demand by true origin-destination and airport-pairs (or city-pairs); and
- Breaking down passengers by fare type to assess the relative importance of the high yield market[6].

3.5.1 Main Sources of Data

In the context of this review, two main data sources will be used. The primary source is the tickets information found in the travel agencies' computer reservation system and referred to as the MIDT[7]. The MIDT sample covers 2013 and covers only scheduled tickets sold.

The second source is the OAG[8] (scheduled airline timetables) showing scheduled departing seats including low cost airlines.

3.5.2 Aviation Demand Reviewed

The core of the review is, first, the evaluation of the true Origin and Destination (O&D) markets in the study area and, second, to see how it lines up with airline service once we have measured the passenger demand.

The evaluation of the size of the travel market, which is the heart of this review, is done by calibrating MIDT using various sources of data. The primary source is the sales of tickets issued by the travel agencies in the study area and referred to as the MIDT. For starters this data is uncalibrated and to calibrate it two additional data bases are used:

- Airport statistics; and
- The OAG.

It should be noted that normally the OAG database is used selectively by the team. In fact, it is preferable to rely first and foremost on the airport statistics, which are normally more precise since they provide actual passenger figures. However, in the case of this review, the passenger airport statistics were not actuals but, instead, are estimates. As a result, we relied equally on both sources for this study.

The MIDT database covers tickets issued for which the airports under study were either an origin, a connecting point or a final destination. Also, the MIDT covers 2013 and the reason for using this year, as opposed to 2014, is that the team had no airport statistics covering 2014. Therefore, it was impossible to calibrate the MIDT data for 2014.

[6] Since the airports under study are small the air fare information might be limited.
[7] MIDT: Marketing Information Database Tapes.
[8] OAG: Official Airline Guide.

3.5.3 The Number of Tickets Issued

The number of tickets issued in the study region was nearly 90,000 tickets in 2013, where about half of the tickets issued were for George Town/ Exuma.

The table below compares the MIDT sample with the estimated passenger airport statistics. As can be seen the MIDT coverage, for the four airports combined, is low at 22.6%. However, if we split the MIDT tickets between domestic and international it can clearly be seen that the domestic coverage is extremely low (5.3%) while the international coverage is respectable at 52.7%.

Since the MIDT database is composed of airline bookings that are done via the travel agencies in the world and compiled in the GDS (Global Distribution System), it is not surprising that the domestic figure would be so low. Indeed it is very plausible that small domestic carriers do not book their flights via the GDS and are doing it, for example, directly on their website. However, since the review focuses primarily on international route development, this is not a significant concern. The coverage is much better on the international front.

2013 Estimated Passenger Statistics vs. MIDT Database										
Airport	3-Letter	Passengers (000)			MIDT Sample			Coverage		
		Dom	Int	Total	Dom	Int	Total	Dom	Int	Total
North Eleuthera	ELH	102.4	55.4	157.8	2,610	19,312	21,922	2.5%	34.9%	13.9%
George Town/ Exuma	GGT	90.4	73.9	164.3	7,952	37,745	45,697	8.8%	51.1%	27.8%
Governor's Harbour	GHB	69.8	8.9	78.7	2,746	5,012	7,758	3.9%	56.5%	9.9%
San Salvador	ZSA	27.8	28.6	56.4	2,196	10,250	12,446	7.9%	35.8%	22.1%
Total		290.4	166.8	457.2	15,504	87,944	103,448	5.3%	52.7%	22.6%

Source: MIDT Database and Estimated Airport Statistics

3.5.4 Calibrating the MIDT

The calibration of the MIDT data with the airport statistics and the OAG data means evaluating some elements of traffic which are found either in the airport statistics and OAG but not found in the MIDT data.

The first step to calibrate the MIDT data is to add the carriers which do not appear in the MIDT which are typically low cost carriers or charter operators. The airports in this study are not served by low cost carriers but are served by charter carriers. Since the estimated passenger airport statistics do not provide us with actual passenger traffic by carrier, we had to rely on the OAG to see if some carriers appear in the OAG and not the MIDT.

From the international figures above, we estimate that the ratio between the two sources (uncalibrated MIDT and airport statistics/ OAG) is respectively for ELH, GGT, GHB and ZSA 2.87, 1.96, 1.77 and 1.11. Therefore, if our uncalibrated sample shows 19,312 international passengers for North Eleuthera in the table for example, the total international traffic should be 55,386 passengers.

3.5.5 Results

All four airports under study are dominated by domestic destinations and it is at Governor's Harbour (GHB) where the share is by far the highest. In terms of international operations, without surprise, most focus on North America and San Salvador (ZSA) is the only airport with a marked presence in Europe.

Calibrated MIDT: Final Destination by World Region (2013)								
Region	ELH		GGT		GHB		ZSA	
	Volumes	%	Volumes	%	Volumes	%	Volumes	%
Domestic	101,706	64.6%	90,401	54.8%	69,751	88.4%	27,757	49.2%
North America	54,112	34.4%	71,269	43.2%	9,019	11.4%	12,972	23.0%
Europe	1,256	0.8%	2,390	1.4%	105	0.1%	15,708	27.8%
Rest of World	441	0.3%	1,027	0.6%	30	0.0%	18	0.0%
Total	157,515		165,087		78,905		56,455	

Source: Calibrated MIDT

Today, in the airport catchment area, the airline service is offered by a variety of carriers including scheduled and charter operators. The following tables show the evolution, between 2009 and 2014, of movements, seats and aircraft size for the route network of North Eleuthera Airport. It should be noted that the analysis is based on non-stop flights. Nassau is the key airport and, given the overall size of the airport, business jets and small aircraft are in operation.

In North Eleuthera, over the last 5 years the network has been stable, where Nassau and Governor's Harbour are the main routes, followed by three destinations in Florida. It is not shown in the graphic but the main carriers operating at this airport in 2014 are respectively Southern Air Charter, Silver Airways, Pineapple, American and Bahamasair.

Annual Non-stop Flights and Departing Seats By Destination, North Eleuthera Airport (ELH)											
Airport	Seats			Share of Total Seats		Departures			Avg Seats/ Flight		
	2009	2014	AAGR	2009	2014	2009	2014	AAGR	2009	2014	AAGR
Nassau	28,301	44,438	9.4%	36.5%	43.1%	1,483	1,686	2.6%	19	26	6.7%
Governor's Harbour	24,549	20,805	-3.3%	31.6%	20.2%	741	1,095	8.1%	33	19	-10.5%
Fort Lauderdale	17,290	18,258	1.1%	22.3%	17.7%	1,163	537	-14.3%	15	34	18.0%
Miami	7,486	16,620	17.3%	9.6%	16.1%	349	336	-0.8%	21	49	18.2%
West Palm Beach		2,992		0.0%	2.9%		88			34	
Total	*77,626*	*103,113*	5.8%	100.0%	100.0%	*3,736*	*3,742*	0.0%	21	28	5.8%

Source: OAG

The next table highlights the main final destinations for the airport, the estimated passengers by route and the average fare paid by passengers. However, the fare information in the MIDT was limited and must be used with caution.

North Eleuthera Airport (ELH), Top Markets								
Rank	Route	Market	Summer		Winter		Total	
	Area	City	Passengers	Avg. Fare	Passengers	Avg. Fare	Passengers	Avg. Fare
1	Dom	Nassau	47,250	49.13	51,988	49.35	99,238	49.25
2	Dom	Marsh Harbour	469		312		781	
3	Dom	Freeport	195	30.35	586	82.36	781	66.36
		Others	158		748		906	
		Sub-Total	48,072	47.89	53,634	48.59	101,706	48.28
1	Int'l	Fort Lauderdale	6,857	153.15	7,455	174.65	14,312	165.46
2	Int'l	Miami	4,937	159.17	5,349	154.32	10,286	156.41
3	Int'l	New York	1,946	140.66	4,251	203.54	6,197	183.80
4	Int'l	Orlando	979	117.54	791	138.43	1,770	126.91
5	Int'l	Boston	280	120.20	1,011	184.40	1,291	163.00
6	Int'l	Chicago	376	255.40	795	378.96	1,171	332.63
7	Int'l	Washington	345	296.11	801	364.00	1,146	338.85
8	Int'l	Atlanta	498	157.54	553	240.18	1,051	201.94
9	Int'l	Cleveland	486	279.65	510	234.47	996	256.74
10	Int'l	Los Angeles	352	116.89	626	172.34	978	150.00
11	Int'l	Dallas	343	381.70	485	377.43	828	379.52
12	Int'l	Philadeplia	512	184.55	272	196.84	784	190.39
13	Int'l	Toronto	323	160.87	407	315.48	730	247.98
14	Int'l	Tampa	222	239.80	479	446.14	701	357.34
15	Int'l	Raleigh Durham	399	217.50	246	184.18	645	202.43
16	Int'l	Houston	299	133.84	337	250.41	636	214.38
17	Int'l	New Orleans	291	345.13	297	271.55	588	301.22
18	Int'l	Nashville	238	216.70	260	198.28	498	206.23
19	Int'l	Minneapolis/ St Paul	336	183.67	139	312.08	475	249.61
20	Int'l	Richmond	73	232.40	393	282.41	466	266.50
		Others	4,671		5,589		10,260	
		Sub-Total	24,763	176.09	31,046	210.97	55,809	195.99
		Grand Total	72,835	163.16	84,680	195.05	157,515	181.33

Source: Calibrated MIDT

3.5.6 Air Service Recommendations

It is through this data analysis that the preferred route destinations and target carriers can be identified and followed up with to expand or enhance the service offerings to North Eleuthera.

The next table shows the typical schedule offered in January 2015. Compared to the table above this one shows the typical aircraft used and the entire routes (the Pineapple Air flights are multi-stops).

Weekly Non-stop Flights and Departing Seats by Carrier and By Destination, 19-25 January 2015, North Eleuthera Airport (ELH)							
Carrier	Destination	Routing	Aircraft	Dep.	Seats	Share of Total	Avg Seats/ Flight
American	Miami	Direct	ERJ 145	7	350	21.4%	50
Bahamasair	Nassau	Direct	Dash 8-300	5	250	15.3%	50
Pineapple	Governors Harbour	NASELHGHBNAS	Beech 1900	21	200	12.2%	19
	Nassau	NASELHGHBNAS	Beech 1900		200	12.2%	19
Silver Airways	Fort Lauderdale	Direct	Saab 340	7	238	14.5%	34
Southern Air Charter	Nassau	Direct	Beech 1900	21	399	24.4%	19
	Grand Total			*61*	*1,636*	*100.0%*	*27*

Source: Calibrated MIDT

The above table displays the five (5) main carriers serving the airport and region and the frequencies for flights for the January 2015 period noted. Comparing it to the previous top Markets table, it would reflect that ***there is a potential market connecting to New York as well***.

3.5.7 Design Aircraft

The Design Aircraft is the B737 although the corporate jet market doe s see Gulfstream aircraft (G5 and 6) and they have aircraft performance requirements that are as demanding as the B737-700. The air service attraction and activity will remain a North American market and this will relate to the A319 and B737 aircraft serving these markets.

4.0 Airport Demand/Capacity Analysis

4.1 INTRODUCTION

The following section discusses the demand and capacity considerations relevant to determining the current and future infrastructure needs for North Eleuthera Airport.

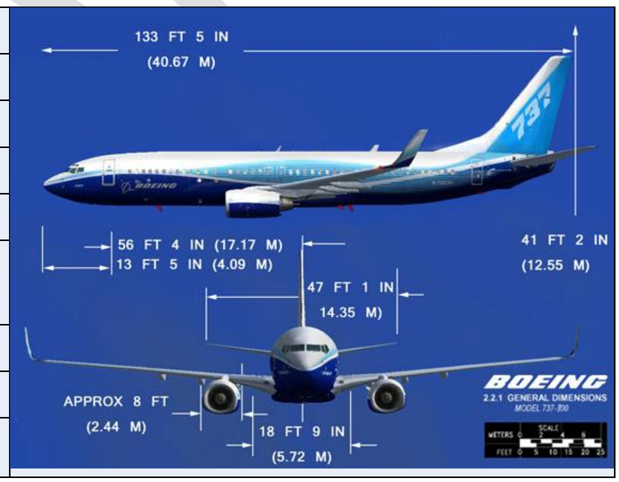
4.2 DESIGN AIRCRAFT

Airport infrastructure is designed to permit the regular operation of aircraft up to and including the most demanding aircraft in terms of size and performance characteristics, or also called the critical design aircraft. The choice of design aircraft is determined by not only the technical characteristics but the frequency of activity at the specific airport.

The recommended critical design aircraft for the Airport is the Boeing 737-800W (73H) which is typically utilized by air carriers offering seasonal air charter flights. The key physical and performance characteristics of the B737-800W are presented in the table below. Other aircraft in common use into Family Islands' airports include the Embraer E-190 (E90), Embraer E-175 (E75), De Havilland Dash 8-300 (DH3), Avions de transport régional ATR-42-600 (AT6), SAAB 340B (SF3), and the Gulfstream 5 (GJ5).

Table 4.1 B737-800W Physical and Performance Characteristics[1]

ADG (FAA-ICAO)	III-C
Wingspan	35.80 m (117.5 ft)
Length	39.50 m (129.6 ft)
Overall (Tail) Height	12.56 m (41.2 ft)
Main Gear Width2	7.00 m (23.0 ft)
Passenger Capacity	189 (Max.), 160 (2 Class)
Max. Take-off Weight	79,016 kg (174,200 lb)
Max. Operational Range	3,115 nm (5,765 km)3
Vref / Approach Speed	142 knots



Notes: 1) Source – Boeing's aircraft characteristics and performance manuals.
2) From outer edge to outer edge of the main gear.
3) Dependent on aircraft variant and engine types.

4.3 RUNWAY OPERATIONAL REQUIREMENTS

Presently, the furthest operational range conducted by scheduled or regular charter airlines is about 500 nm. However, it is believed that the market demand to North Eleuthera has been muted because of the length of the existing runway and the safety risks posed by the proximity of the runway to buildings, the access road and aircraft aprons. There are however, corporate and private aircraft operators that fly much longer routes.

Stantec

It is expected that with the development a new, longer runway designed to meet the applicable international standards, the market range will increase. It is expected that 1100 to 1200 nm routes serving the east coast of the United States and southern Ontario, Canada will become much more desirable. As illustrated in Figure 4-1, this range can serve destinations as far as Toronto (YYZ) and Chicago (ORD). We expect that this operational range will be the maximum desired throughout the planning horizon for scheduled and charter airline routes to/from North Eleuthera (MYEH).

Figure 4-1 – Representative Flight Ranges from North Eleuthera

Source: Aviotec International Inc.

During an earlier 2014 airport study which projected the aviation market demand for MYEH, it was estimated that a new 6,700 ft runway would be adequate to serve the needs of commercial and private aviation users.

A more detailed analysis was undertaken as part of this study to confirm whether a 6,700 ft runway length would be adequate to serve corporate and private GA activity and scheduled airline flights to destinations within 1200 nm. The analysis was undertaken for two aircraft types we anticipate could be used by schedule or charter airlines during the planning horizon, the Airbus A320-214 and Boeing 737-800W. The flight performance parameters for these aircraft are compared in Table 4-2.

Table 4-2 – Analysis of A320-214 & B737-800W Performance for 1130 nm Range

Aircraft Type1	Max. Take-off Weight (MTOW)	Allow. Take-off Weight1,2	Allowable Payload3	Operational Range4	Allow. Pax Capacity
Airbus A320-214	169,604 lbs	156,493 lbs	38,768 lbs	1,130 nm	177
Boeing 737-800W	174,200 lbs	153,801 lbs	44796 lbs	1,130 nm	170

Notes:
1) Based on manufacturer's aircraft characteristics and performance manuals; dependent on aircraft variant.
2) Based on a typical daytime temperature (+30°C), zero wind and runway length of 6,700 ft (2042.2 m).
3) Defined as the maximum allowable payload weight of passengers, passenger baggage and belly-hold cargo.
4) With maximum allowable passenger payload and required reserves, and no additional belly-hold cargo.

Based on an assumed runway length of 6,700 ft, an aerodrome elevation of 18 ft and reference temperature of 30.2˚C, a B737-800W (with CFM56-7B26 engines) would have a permitted maximum operational take-off weight of approximately 153,801 lbs (69,763 kg)[9,10], which results in a weight penalty of about 11.7 percent.

Similarly, an A320-214 (with CFM56-5B4 engines) would have a permitted maximum operational take-off weight of approximately 156,493 lbs (70,984 kg), which results in a weight penalty of about 7.7 percent.

Assuming a flight range of 1130 nm, as illustrated in Figure 4.1, a B737-800W could shuttle about 170 passengers with a typical baggage allowance[11] to and from a destination such as Toronto (YYZ), with no additional belly-hold cargo. In comparison, a A320-214 could accommodate about 177 passengers to and from YYZ, again with no additional belly-hold cargo.

There are however other aircraft types that could be economically viable and would not be limited by the length of runway at MYEH. Examples are provided in **Error! Reference source not found.** including some future aircraft types. The table is based on runway length calculations performed using ICAO methodology (per Document No. 9157 - Aerodrome Design Manual, Part 1, Runways) and the specific manufacturer's specifications.

The runway length requirements of specific aircraft vary depending on airport elevation, temperature, and wind conditions, and aircraft engine performance, payload, fuel load, and intended range. These variables affect aircraft performance and capabilities. The analysis considered the balanced field length requirements of aircraft at maximum take-off weight (MTOW) for both dry and wet runway conditions. The balanced field length requirement of an aircraft is the length where the accelerate-stop distance is equal to the take-off distance (to an altitude of 35 feet above ground level). The accelerate-stop distance is the runway length required to accelerate an airplane to the take-off decision speed, and assuming failure of the critical engine at the instant the take-off decision speed is attained, to bring the airplane to a complete stop on the runway.

9 Calculations based on Standard Day Temperature of 13.7˚C for YAM, wet runway conditions, zero wind and required fuel reserves.

10 The actual operational MTOW for a B737-800 is dependent on the actual aircraft variant and the approved Aircraft Flight Manual.

11 Assumes 105 kg (231 lb.) of combined passenger, carry-on and checked baggage which is typical of medium-haul, international travel.

Table4-3 – Aircraft Types Capable of Operating from MYEH at MTOW

Aircraft Name	ICAO Code	Aircraft Group Number	Aircraft Physical Characteristics: Wingspan (ft)	Length (ft)	Height (ft)	Engine Type	MTOW (lb)	Approach Speed (kts)	Takeoff Distance (ft)[5]: Published Length[2]	Adjusted Length[3]	Wet Rwy Condition[4]	Landing Distance (ft)[5]: Published Length[2]	Adjusted Length[3]	Wet Rwy Condition[4]
A-318	A318	IIIB	111.9	103.2	41.2	Jet	130,073	138	4593	5380	6187	4265	4995	5745
A-319	A319	IIIB	111.9	111.2	38.6	Jet	141,096	138	5742	6725	7733	4429	5188	5966
A-320	A320	IIIB	111.9	123.3	38.6	Jet	162,040	138	7185	8415	9678	4724	5533	6363
A-321	A321	IIIB	111.9	146.0	38.6	Jet	182,984	138	7251	8492	9766	5249	6148	7070
ATR-42-600	AT46	IIIA	80.6	74.5	24.9	Turboprop	41,005	104	3822	4476	5148	3694	4327	4976
ATR-72-600	AT76	IIIA	88.7	89.1	25.1	Turboprop	50,265	113	4373	5122	5890	3501	4101	4716
Avro 748	A748	IIIA	98.2	66.9	24.9	Turboprop	46,495	100	3281	3843	4419	2034	2382	2740
Jetsream 31	JS31	II	52.0	47.1	17.5	Turboprop	15,562	125	5906	6917	7954	4265	4995	5745
Jetsream 41	JS41	II	60.4	63.4	18.4	Turboprop	24,000	120	4921	5764	6629	4265	4995	5745
B737-700	B737	IIIB	112.6	110.3	40.8	Jet	146,211	130	5906	6917	7954	4593	5380	6187
B737-800	B738	IIIB	112.6	129.5	40.6	Jet	155,492	141	7546	8838	10164	5249	6148	7070
BD-700 Global Express	GLEX	IIIB	93.8	99.4	24.9	Jet	98,106	126	6135	7186	8264	1358	1591	1830
BAE-146-200	B462	IIIB	86.4	93.7	28.2	Jet	93,035	125	3379	3958	4552	4052	4746	5457
RJ-100 Regional Jet	CRJ1	II	69.6	87.9	20.7	Jet	47,399	135	5249	6148	7070	4593	5380	6187
RJ-200 Regional Jet	CRJ2	II	69.6	87.9	20.7	Jet	47,399	135	5249	6148	7070	4593	5380	6187
RJ-700 Regional Jet	CRJ7	II	76.2	106.7	24.8	Jet	72,753	135	5249	6148	7070	4849	5679	6531
RJ-900 Regional Jet	CRJ9	II	76.4	118.8	24.6	Jet	80,491	150	6168	7224	8308	5118	5995	6894
500 Citation	C500	I	47.2	43.6	14.4	Jet	10,847	125	3274	3835	4410	1870	2190	2519
Cessna 525 Citation CJ1	C525	I	46.9	42.7	13.8	Jet	10,399	107	3081	3608	4149	2749	3220	3703
Cessna 550 Citation 2	C550	II	52.2	47.2	15.1	Jet	15,102	108	3281	3843	4419	3002	3516	4043
Cessna 560 Citation 5 Ultra	C560	I	45.3	48.9	13.8	Jet	15,895	108	3159	3700	4255	2920	3420	3933
Cessna 650 Citation 3	C650	II	53.5	55.4	16.8	Jet	30,997	114	5249	6148	7070	2953	3458	3977
Cessna 750 Citation 10	C750	II	64.0	72.2	19.0	Jet	35,699	130	5709	6686	7689	3819	4473	5144
Citation Excel	C56X	II	55.8	51.8	17.1	Jet	19,200	125	3461	4054	4662	2920	3420	3933
Falcon 2000	F2TH	II	63.3	66.3	23.3	Jet	35,803	114	5249	6148	7070	5249	6148	7070
Falcon 50	FA50	II	61.9	60.8	29.4	Jet	38,801	113	4593	5380	6187	3609	4227	4861
Falcon 900	F900	II	63.3	66.3	24.9	Jet	46,738	100	4921	5764	6629	2297	2690	3093
DHC-8-300 Dash 8	DH8C	IIIA	89.9	84.3	24.6	Turboprop	41,099	90	3609	4227	4861	3281	3843	4419
DHC-8-400 Dash 8	DH8D	IIIA	93.2	107.6	27.2	Turboprop	63,930	115	4265	4995	5745	3609	4227	4861
EMB-120 Brasilia	E120	II	65.0	65.6	21.0	Turboprop	26,455	120	4593	5380	6187	4593	5380	6187
ERJ-140ER	E140	II	65.7	93.3	22.1	Jet	46,518	135	5184	6072	6982	4528	5303	6099
ERJ-135ER	E135	II	65.7	86.4	22.2	Jet	44,070	130	5381	6302	7248	4462	5226	6010
E-170-AR	E170	IIIB	85.3	98.1	32.3	Jet	79,344	145	5394	6318	7265	4072	4769	5485
E-190-AR	E190	IIIB	94.2	118.9	34.7	Jet	114,119	145	6890	8070	9280	4081	4780	5497
Fairchild-Dornier 328	D328	II	68.8	69.3	23.9	Turboprop	30,843	110	3281	3843	4419	3937	4611	5303
Fokker 100	F100	IIIB	92.2	116.5	27.9	Jet	95,659	130	5577	6532	7512	4593	5380	6187
G-1159A Gulfstream 3	GLF3	II	77.8	83.0	24.6	Jet	69,710	136	5906	6917	7954	3281	3843	4419
G-1159C Gulfstream 4	GLF4	II	77.8	88.3	24.3	Jet	73,193	128	5249	6148	7070	3281	3843	4419
G-1159D Gulfstream 5	GLF5	IIIB	93.5	96.5	25.9	Jet	90,689	145	5151	6033	6938	2900	3397	3906
Learjet 45	LJ45	I	47.9	58.1	14.1	Jet	19,511	140	4265	4995	5745	2953	3458	3977
Learjet 55	LJ55	I	43.6	55.1	14.8	Jet	21,010	140	4593	5380	6187	3281	3843	4419
Learjet 60	LJ60	I	44.0	58.7	14.8	Jet	23,104	140	5249	6148	7070	3609	4227	4861
Bae 125-1000	H25C	II	51.5	53.8	17.1	Jet	30,997	132	6234	7301	8396	2917	3416	3929
Bae 125-700/800	H25B	II	54.5	51.2	18.0	Jet	27,403	125	5577	6532	7512	2953	3458	3977
Beech 1900	B190	II	58.1	57.7	15.4	Turboprop	16,954	113	3773	4419	5082	2707	3170	3646
Beech 36 Bonanza	BE36	I	27.6	26.6	8.5	Piston	3,638	75	1148	1345	1547	1476	1729	1989
Beech 58 Baron	BE58	I	37.7	29.9	9.7	Piston	5,512	96	2297	2690	3093	1969	2306	2651
Super King Air 200	BE20	II	54.5	44.0	14.8	Turboprop	12,500	103	1870	2190	2519	1772	2075	2386
Super King Air 350	B350	II	58.1	46.6	14.4	Turboprop	14,991	110	3281	3843	4419	2690	3151	3624
SAAB 340	SF34	II	70.2	64.6	23.0	Turboprop	28,440	115	4265	4995	5745	3609	4227	4861
Fairchild 300	SW3	I	46.3	42.3	16.7	Turboprop	12,566	120	4265	4995	5745	4265	4995	5745

Aerodrome Parameters: **+30.20** Celcius; Reference Elevation = **18.00** ft above MSL; Runway gradient = **0.154%**

1. Reference Field Lengths are as published by aircraft maufacturers assuming ISA (e.g. mean sea level & +15 Celcius) and for dry runway, zero wind, and zero effective runway gradient
2. Field lengths indicated are calculated based on Maximum Takeoff Weight (MTOW) for the designated aircraft. Actual runway length requirement may vary by specific variant and engine type.
3. ICAO method (per Doc. #9157 - Aerodrome Design Manual - Part 1 - Runway) has been used to adjust runway length using actual aerodrome elevation, temperature and runway gradient.
4. Runway length for wet conditions are equal to the length required in dry conditions increased by 15%. A runway is considered "wet" when the surface is covered with water, or equivalent, less than specified for a contaminated runway, or when there is sufficient moisture on the runway surface to cause it to appear reflective, but without significant areas of standing water.
5. Actual aircraft performance will vary according to the individual operator's aircraft specification (i.e. dependent on engine type, associated performance ratings and structural limit options, etc.), as well as the aircraft operator's procedures (i.e. prescribed take-off speed ratios), hence the minimum runway lengths are provided for planning purposes only.

Balanced field length requirements were adjusted to reflect local conditions at MYEH in accordance with the ICAO methodology, which recommends increasing the runway length requirements as follows:

- 7% for every 300 meters the runway elevation exceeds mean sea level;

- 1% for every 1° Centigrade (C) that the aerodrome reference temperature exceeds the temperature in the standard atmosphere for the aerodrome elevation (temperature at the airport will significantly affect runway length requirements); and
- 10% for each 1% of positive (e.g., uphill) runway slope in the direction of takeoff.

However, it is important to note the most aircraft operating at MYEH will not be at MTOW since they are neither operating to their maximum flight range (thus carrying less fuel) nor carrying the maximum number of passengers and cargo. Therefore, a number of aircraft listed in Table 4-3 could safely operate on a 6,700 ft runway under the right circumstances.

The analysis above clearly demonstrates that the proposed 6,700 ft runway is adequate to serve the expected market demand of the airport through the 20-year planning horizon. Nevertheless, the Airport should preserve and protect the lands necessary for at least a 1,000 ft extension. Given the fact that a runway extension of 1,000 ft could have a rough order of magnitude capital cost of about USD 5.5 million, it would be important to have a solid business case prior to committing to such an investment.

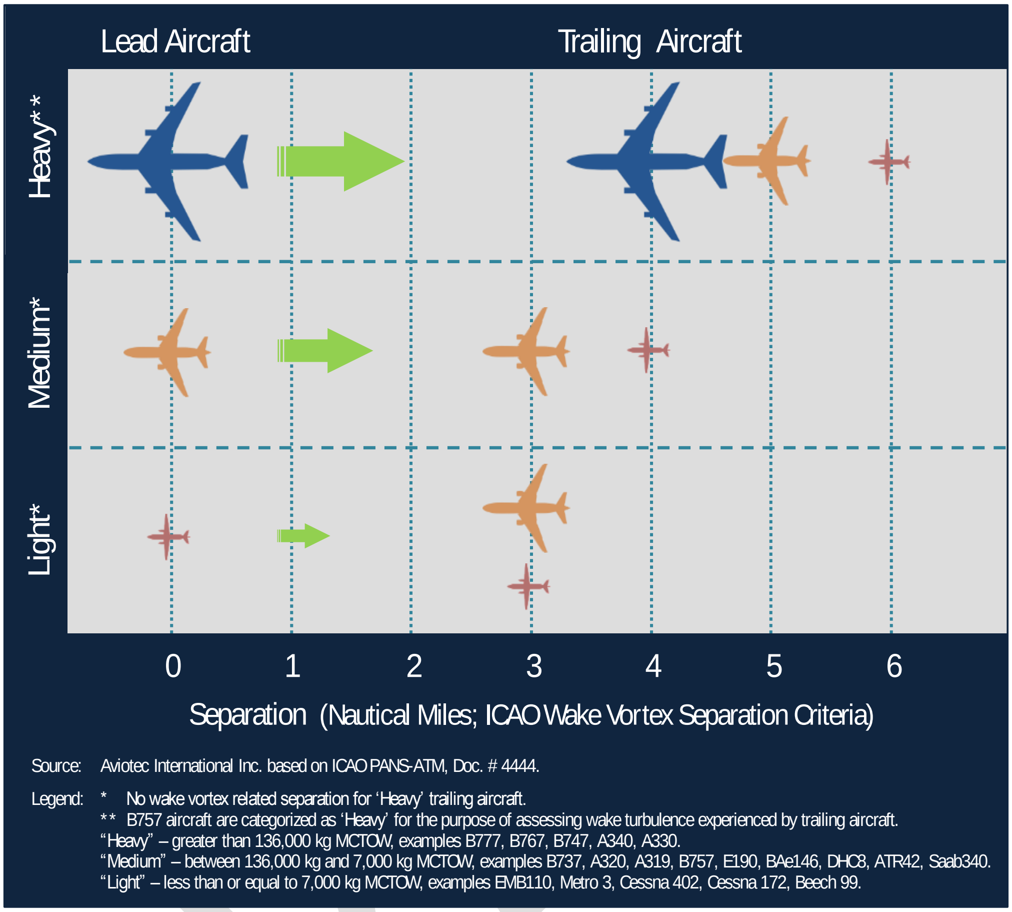
4.4 RUNWAY DEMAND/CAPACITY ANALYSIS

A runway's capacity is generally driven by the approach and departure separations between aircraft (which are determined by air traffic control) and by the required runway occupancy times (ROT) of the aircraft operating on the runway. These runway occupancy times are defined as follows:

- Arrival ROT begins when an arriving aircraft passes over the runway threshold and ends when it exits the runway.
- Departure ROT begins when a departing aircraft enters the runway and begins the take-off roll and passes over the threshold point at the opposite end.
- ROTs for a typical runway system and aircraft mix are in the range of 40 to 50 seconds for arrivals and 30 to 40 seconds for departures. ROT during landing will vary depending on the location of the runway exits, wind speed and direction, runway surface conditions, and ground taxi patterns.

Minimum aircraft separations for operations at MYEH are most likely 5 nm or greater. Minimum separation for non-heavy aircraft operations at various airports around the world is typically 4 nm. At some airports, particularly in the U.S. and Europe, the separations on final approach can be as low as 2.5 nm, with 3 nm being more common. The minimum separations are principally governed by wake turbulence criteria. Exhibit 4-2 graphically illustrates the minimum aircraft separations prescribed by ICAO based on wake turbulence.

Figure 4-2 – Minimum Aircraft Approach Separations



The theoretical runway saturation capacity of a single runway is typically in the range of 46 to 48 movements (comprised of 45% arrivals and 55% departures). However, it is important to note that in order to achieve throughput rates at or near the ultimate theoretical runway capacity, there would need to be (i.) a full length parallel taxiway, (ii.) 2 to 3 appropriately located taxiway exits (either rapid exit or 90 degree connections), and (iii.) arriving and departing aircraft would need to be properly grouped and sequenced to optimize the wake turbulence separation requirements. The later factor would necessitate that ATC operational personnel be available to perform the grouping functions and advise pilots accordingly (which presently does not exist).

When designing a new runway, it is important to understand the impact that the market will have on the frequency of movements which will in turn be the most important determinant in quantifying the amount of runway system capacity which will be needed through the planning period. An analysis of MYEH's aircraft movement logs for December 2014 and January 2015 suggest that ***the current peak hour aircraft movements (arrivals and departures combined) is 18 to 19.*** Assuming that the peak hour will grow at the same rate as annual movement***, it is projected that by 2025, the peak hour aircraft movements will grow to 22, and to 26 by 2035.***

However, aircraft movement logs do not include notations regarding the arrival and/or departure runway information. As a result, the runway end usage was estimated based on an analysis of historical

meteorological data (to determine prevailing winds and permissible cross-wind limits), consultations with relevant airport stakeholders, and site observations of operations.

Table 4-4 presents the estimated distribution of aircraft movements by runway end and flight paths. Flight paths are as described in Section 4.3. It has been assumed that the distribution will remain unchanged during the planning period.

Table4-4 – Distribution of Aircraft Movements by Runway End

Runway Designation	Type of Operation	Percentage of Aircraft Movements
07	Approach	40.0%
	Departure	40.0%
25	Approach	10.0%
	Departure	10.0%

Source: Aviotec International Inc.

Based on methodology and criteria contained in the U.S. FAA's *Advisory Circular 150/5060-5 - Airport Capacity and Delay*, the planning team assessment a number of different runway configurations to determine the most cost-effective and operationally efficient while providing sufficient capacity to meet the aircraft movement demand through the planning period.

It was determined that a runway configuration with ***one intermediate exit taxiway and a partial parallel taxiway will provide an estimated maximum throughput rate of 29 aircraft movements per hour (16 arrivals, 13 departures)*** before unacceptable delays are experienced. The intermediate exit taxiway would need to be positioned to capture a large percentage of the arriving aircraft without the need to back-track on the runway.

4.5 AIR TERMINAL DEMAND/CAPACITY ANALYSIS

4.5.1 Terminal Space Standards

An internationally accepted standard for establishing passenger terminal space requirements may be found in the International Air Transport Association's (IATA) Airport Development Reference Manual (9th Edition, 2004). The manual use a range of level of service measures from A through to F. Level of service (LOS) defines the comfort and quality of the passenger experience. Some are related to crowding in queuing areas, while others define the amount of time a passenger must wait for processing. Table4-4 outlines the basic level of service standards relevant to the master planning study.

Table4-4 – IATA Air Terminal Level of Service Standards

Terminal Areas / Level of Service (LOS)[1]	Area (m^2) of Peak Hour Occupants				
	A	B	C	D	E
Check-in Queue Area (1-2 pieces of luggage)	1.8	1.5	1.3	1.2	1.1
Passenger Holdroom (Standing)	1.4	1.2	1.0	0.8	0.6
Bag Claim Area (excl. claim device)	2.6	2.0	1.7	1.3	1.0
Federal Inspection Services	1.4	1.2	1.0	0.8	0.6

Notes: "A" – Excellent levels of service; conditions of free flow; excellent level of comfort.

"B" – High level of service; condition of stable flow; very few delays; high level of comfort.

"C" – Good level of service; condition of stable flow; acceptable delay; good level of comfort.

"D" – Adequate level of service; condition of unstable flow; acceptable delays for short periods of time; adequate level of comfort.

"E" – Inadequate level of service; condition of unstable flow; unacceptable delays; inadequate comfort.

"F" – Unacceptable levels of service; conditions of cross flows, system breakdown and unacceptable delays; unacceptable levels of comfort. (No area standards are established for LOS "F".).

These standards are based on the number of passengers forecast during an airport's peak hour. Functional terminal building spaces are typically designed to achieve a LOS of "C" at the mid-point of the facility's design life. Thus, during the first few years, the facility should achieve a LOS of "A" or "B", while during the last few years, the facility should achieve a LOS of "D" or "E" (prior to being expanded or redeveloped).

Based on observations of the Air Terminal Building (ATB) operation and the Consultant Team's experience, it is believed that overall the MYEH ATB is currently at a LOS "C/D". The Terminal Hold room is just at an acceptable LOS "C" for scheduled traffic but is undersized for the charter activity and drifts down to a LOS "D" or lower.

4.5.2 Passenger Terminal Demand

The level of passenger activity estimated for the peak hour passenger level for **North Eleuthera** would see it reach **398 passengers** and this cannot be handled with the existing facility. The level is very similar to the activity levels at Exuma and this has allowed the design to utilize the same functional programming for both sites with address of site specific aesthetics.

4.6 TERMINAL APRON DEMAND

As part of an aviation traffic forecast prepared by DKMA, the planning peak hour movements[12] for scheduled activity at MYEH was determined for 2015 to be seven (4 arrivals and 3 departures). The peak month is December and the peak hour is 1600 to 1700. Based on observations and consultations with airport stakeholders, there is a current requirement to provide apron parking stands for two (2) turboprop and one (1) regional jet aircraft. In addition, the terminal receives corporate jets and small charter aircraft (itinerant movements) on an ad-hoc basis which typically require a maximum of two to three additional apron parking positions. (Itinerant aircraft generally stay parked on the apron for a much longer period than do scheduled aircraft. Arriving scheduled aircraft, if not based at an airport, will turn-around and depart within a maximum 60 minute period.) All other itinerant aircraft are processed through the FBO (White Crown) facility.

The traffic forecast projected that aircraft movements would increase annually by 1.61%. Assuming that peak hour movements will increase at the same rate, by 2023, it is projected that the demand for apron parking stands will increase to two (2) turboprop and two (2) jet (AGN III or smaller) aircraft. As well, it is projected that the demand for itinerant parking stands at the terminal will increase at a much higher rate once new and modern facilities and amenities are available at the terminal building.

Table 4-6 summarises the existing and projected peak hour scheduled aircraft movements and the corresponding requirement for aircraft parking stands.

Table 4-6 – Current and Projected Aircraft Parking Stand Requirements

Planning Year	Peak Hour Period	Peak Hour Scheduled Movements			No. of Aircraft Parking Stands		
		Arriving	Departing	Combined 1	Turboprop	Jet2	Itinerant
2015	1600-1700	4	3	7	2	1	2
2025	1600-1700	4	4	8	2	2	3
2035	1600-1700	5	5	10	3	2	5

Note 1) Combined represents the total arriving and departing scheduled aircraft during the peak hour period.
2) AGN III or smaller aircraft (comparable to ICAO Code C or smaller).

4.7 LANDSIDE PARKING

The existing MYEH landside parking is comprised of about 40 unstructured and unmarked surface spaces, located immediately south of the existing public roadway, flanking the terminal building. In addition, the sole FBO operator, White Crown, also has about 37 parking spaces. These spaces handle public vehicles, car rental companies, and airport and tenant staff, as shown in Figure 4-3. These spaces are neither convenient for users nor safe, due to the proximity of the roadway. There may be other airport related parking occurring throughout the local community, which is not immediately evident, particularly related to car rental and taxis.

Since the Airport does not keep statistics regarding vehicle parking nor collect parking fees, it is not possible to accurately determine the current peak demand for landside parking. Based on site

[12] The planning peak hour for airside planning is typically taken as the 95th percentile busiest hour of the year for aircraft movements.

observations and stakeholder consultations, it is understood that during typical busy periods, the current parking spaces are full. Also, a high percentage of travellers come to/from the airport via taxi services.

Based on experience, it is believed that the current level of passenger traffic could support about 55 public parking spaces, 10 staff spaces and about 15 rental car spaces. (These figures do not include the requirements for the FBO.) Normally the demand for terminal parking spaces increases at close to the growth in passenger traffic, which in the case of MYEH is projected to be 1.3% per annum. However, based experience, we believe that the rental car component will increase at double the rate (2.6%) as the tourism market on Eleuthera matures. Table 4-5 below presents the current and projected demand for terminal parking spaces.

Figure 4-3 – Existing Landside Parking

Source: Google Earth and Aviotec International Inc.

Table 4-7– Current and Projected Terminal Parking Demand

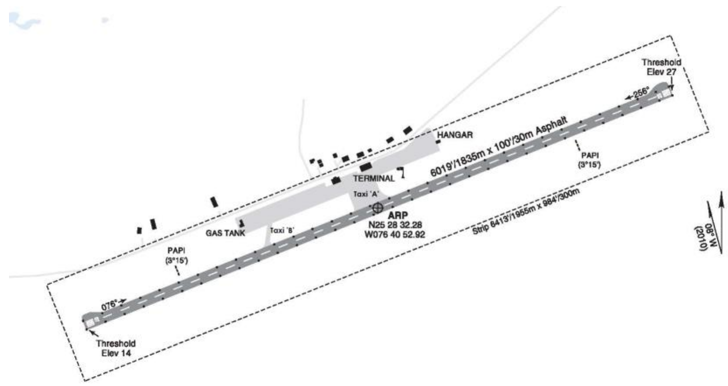
Planning Year	Number of Terminal Parking Spaces		
	Public	Staff	Rental Car
2015	55	10	15
2025	63	11	19
2035	72	13	25

Source: Aviotec International Inc.

5.0 Airside Infrastructure

5.1 AIRFIELD INTRODUCTION

The North Eleuthera International Airport has one runway, two taxiways, and a public apron. Runway 07-25 is a 6019 ft. long runway with taxiways Alpha and Bravo connect the runway and the main apron. Taxiway ‘A’ is considered the primary taxiway and is used numerous times daily. Taxiway ‘B’ is used with reagards to the type/size of aircraft and the number/location of aircraft parked on the apron.

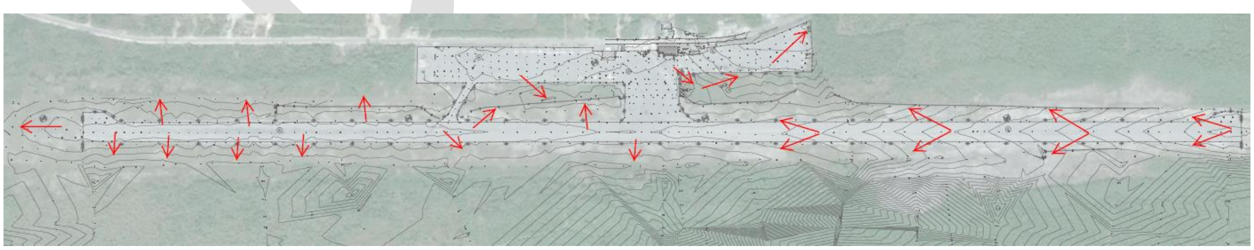


The airfield is the key focus for all airport planning and each of these important Tier 1 sites and their airside infrastructure has been evaluated in a greater detail than the visual inspection that occurred during the ICAO compliance assessments. This has included a thorough review of all pavements as well as topographic surveys and geo-technical work to ensure the subgrade and soil conditions are known and the appropriate infrastructure solution is identified and costed.

5.2 DRAINAGE

The Airport is located on the island of Eleuthera in the Bahamas. The catchment areas for the east side of the airport draind towards the north east. The west sode of the airport natruallt drains to the west.

Stormwater on the Airport is conveyed on site through open ditches, natural channels and existing culverts.



5.2.1 Ditches, Catch Basins and Existing Culverts

During the field assessments the following conditions were identified:

Description	Image
Existing ditch on the east side of the apron needs to be cleaned of the substantial growth the brush. The top soil and grass will also need to be properly graded to drain the water off of the apron.	
Poor grading on the apron has formed puddles of water.	
asphalt swale	

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Grass growing in asphalt swale	

No culverts were witnessed onsite. It is assumed that any culverts may be buried. There was no evidence of a culvert draining the area between the taxiways.

There were no catch basins located on airport property. The water is supposed to sheet drain off of the asphalt surfaces.

5.3 PARALLEL TAXIWAY SYSTEM

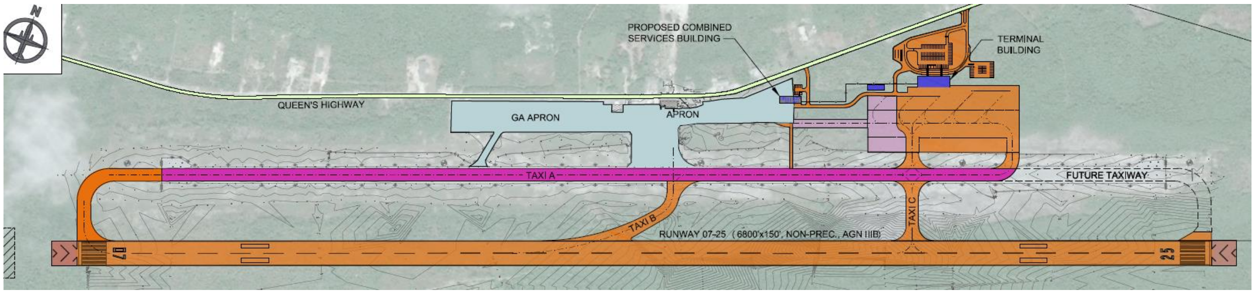
The most significant capacity-limiting factor at the North Eleuthera Airport is the lack of a full parallel taxiway system on Runway 07-25. The requirement for backtracking increases runway occupancy times and forces air traffic controllers to increase aircraft separations.

In the case of arrivals, a normal separation of 5 nautical miles (nm) increases to 10 nm for turboprop and smaller aircraft. Even further increases in separation are required for jet aircraft because of the longer runway occupancy times that occur because of the increased backtracking distances.

In the case of departures, the requirement to backtrack aircraft to the departure threshold reduces the departure rate from approximately 30 movements an hour to a range of 15 to 20 departures depending on the traffic mix.

Although the existing delays are minimal, potential capacity problems could arise during times associated with the arrival and departure of courier aircraft. This is because the larger jet aircraft require runway lengths that increase the need for backtracking both on departure and arrival. With most of the courier activity occurring at night, the provision of appropriate separations between aircraft is a major safety concern that must be considered.

Based on ICAO planning standards, the provision of parallel taxiways should be considered when peak hour itinerant movements exceed 20 or when annual movements exceed 50,000. Given the forecasted aircraft movements identified in the Plan earlier, ***a parallel taxiway would be required somewhere prior to 2022.***



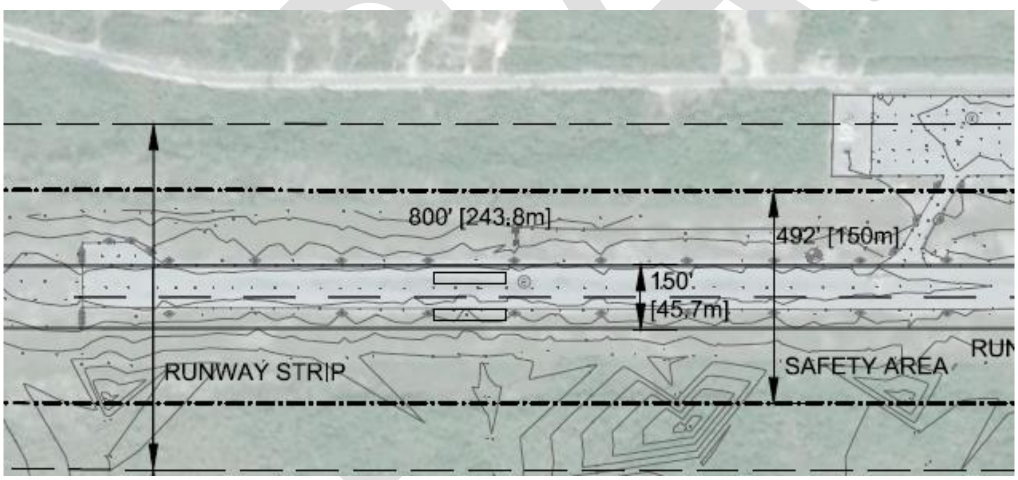
Because of the high aircraft movements and the proximity of the existing runway to the apron, it is recommended that that airport construct a new runway and convert the existing runway into a parallel taxiway.

5.4 RUNWAY STRIP AND SAFETY AREA

A runway safety area (RSA) or runway end safety area (RESA) is defined as "the surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway."

An object situated on a runway strip which may endanger aeroplanes should be regarded as an obstacle and should, as far as practicable, be removed.

ICAO and other standards indicated that no fixed object, other than visual aids required for air navigation purposes and satisfying the relevant frangibility requirements shall be permitted on a runway strip:



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During the site assessment the following items were identified within the runway safety area (RSA):

Description	Image
Trees within the runway safety area (RSA)	
PAPI construction that was abandoned. Open trenches, open base forms, and uneven ground.	
PAPI construction that was abandoned. Open trenches, open base forms, and uneven ground.	

PAPI construction that was abandoned. Open trenches, open base forms, and uneven ground.	
Construction that was abandoned and left an open utility trenches and uneven ground.	
Weather station located within the runway safety area with no frangible base. This will need to be relocated.	

Additional weather equipment located within the runway safety area with no frangible base. This will need to be relocated.	
Un-lit windsock with no frangible base.	
Damaged solar panels and camera located with the runway safety area. This has to be cleaned up and removed off the airport property. Debris can become FOD and can cause damage to aircrafts.	

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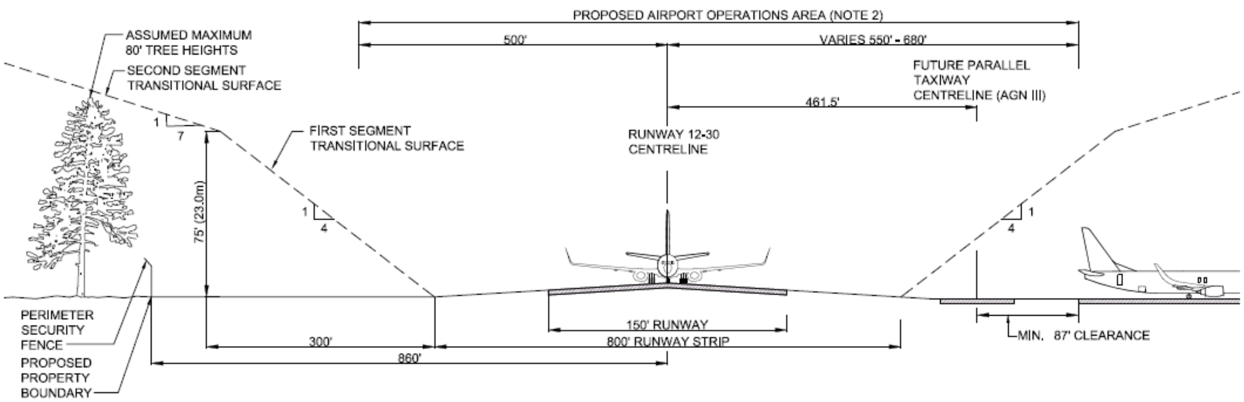
Car battery located with the runway safety area. This item has been in the runway safety area for over a year. This need to be removed off site immediately.	

During the site assessment there were trees located inside and outside the safety area within the runway strip. Some of the trees have heights that are within the airspace. It is recommended that an obstruction limitation survey be done on the airfield to determine which trees should be removed.



5.5 PAVEMENT CONDITION REPORTING

The North Eleuthera Airport has an existing hot mix asphalt (HMA) surfaced runway, taxiway and apron, with a portion of the existing apron using a sand sealed pavement structure. It is our understanding that the runway is to be relocated and newly re-constructed. The existing HMA apron was also reviewed with the following design information as follows:

Design Information:

Design aircraft	B737-700	E190
Design annual departures	100	400

Existing HMA pavement structure

Asphalt	105-125mm

Granular	200mm

Existing Sand Seal pavement structure

Asphalt:	12mm
Granular:	300mm
Subgrade:	Well compacted native limestone
Subgrade strength:	CBR of 15%
Required PCN:	38

5.5.1 Pavement Site Assessment

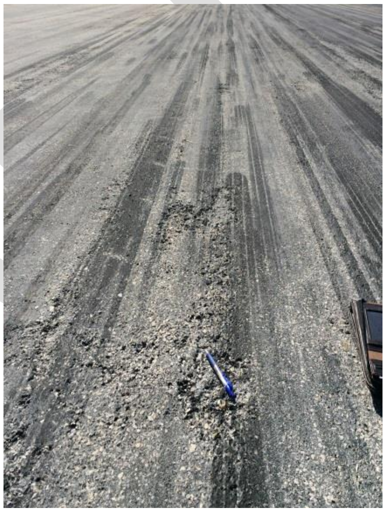
During a site visit the following pavement assessment was observed:

Description	Image
Cracking and depressions observed.	
Apron asphalt with alligator cracking.	

Apron asphalt with alligator cracking.	
Large spalled area of asphalt with alligator cracking. Note pad can fit in the pot hole.	
Cracking and debris found on asphalt.	

Large oil/fuel leak area.	
Inadequate drainage observed on apron.	
Overgrown area observed in taxiway.	

Rutting and patches in taxiway 'B'. Possible soft spot below the asphalt.	
Utility trench across the taxiway	
Pothole in the runway	

Rutting and poor asphalt in the turnaround area at the 07 runway end.	
Spalled asphalt on the runway	
Excessive rubber on the runway, This needs to be removed because it reduces friction on the runway.	

Runway has no paint markings. No centreline marking, threshold marking, runway numbers, etc.	

5.5.2 Recommendation

New Runway and Sand Sealed Apron

Based on the information outlined above, to achieve a pavement classification number of 38, the apron will require reconstruction. There are two proposed options as follows:

Material	HMA with Granular	HMA with Cement Treated Base
HMA	125 mm	125 mm
Granular	380 mm	---
Cement Treated Local Limestone	---	270 mm

HMA Apron

In order to achieve a pavement classification number of 38, the existing HMA pavements require a 120 mm asphalt overlay.

Painting

The airfield must be painted as per ICAO standards.

5.6 AIRFIELD LIGHTING, VISUAL AND NAVIGATIONAL AIDS

North Eleuthera Airport is currently provided with GPS-based (RNAV-GNSS) instrument non-precision approaches on Runway 07 and Runway 25. Visual Aids include medium intensity runway edge lights on both Runways 07 and 25.

High-mast floodlighting illuminates the Apron although the poles and luminaire are not fitted with obstruction lights and the poles themselves are not frangible. These luminaire are controlled manually, with no automatic photocell control. ***North Eleuthera Airport is not currently provided with PAPI lights, approach lights, glide slope/approach path indicators, runway end identification lights or airside guidance signs.*** High-mast floodlighting illuminates the Apron although the poles and luminaires are not fitted with obstruction lights and the poles themselves are not frangible. These luminaire are controlled manually, with no photocell control. The airport has one wind direction indicator. The cone and fabric are in poor condition. Although the runway and taxiways are outfitted with medium-intensity incandescent edge lights, ***the airside system as a whole is in a state of disrepair***. Many fixtures are non-operational, knocked over, seriously damaged, or in some cases missing entirely. Other fixtures have incorrect lenses.

5.6.1 Airfield Lighting Assessment

The airside lighting system as a whole is in a state of disrepair and most equipment has aged beyond the end of its useful life. Many fixtures are incorrectly lensed, non-operational, knocked over, seriously damaged, or in some cases missing entirely.

In direct conflict with the recommended approach to standards (similar to Transport Canada model - TP312) and ICAO standards are the following items:

- Runway edge lighting is lensed incorrectly for distance on the runway >1200m long.
- Many fixtures are not mounted on frangible bases including but not limited to: apron flood lighting and windsock, etc.
- Missing and broken lights and lights overgrown with vegetation may not be clearly visible to approaching aircraft.
- No PAPI units for approaching aircraft and area is overgrown with vegetation may not be clearly visible to approaching aircraft.
- Windsock is un-lit.

Additionally, ***there are abandoned solar power devices situated immediately east of each of the two taxiways. It is believed that these devices were motion sensors and cameras used to record aircraft tail markings and the time of apron entry/exit.*** These devices and especially solar panels are severely damaged and are situated within the taxiway strip and should be removed.

Description	Image
Wrong type of fixture on the runway light. Lens is held on with electrical tape.	
Runway edge lighting fixtures that are non-operational, knocked over, and seriously damaged.	
Taxy edge lighting fixtures that are non-operational, knocked over, and seriously damaged.	

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Lighting fixtures that are non-operational, knocked over, and seriously damaged at the end of the runway.	
No PAPI lighting. Construction work was abandoned.	
Abandoned solar power devices situated immediately east of each of the two taxiways. It is believed that these devices were motion sensors and cameras used to record aircraft tail markings and the time of apron entry/exit. These devices and especially solar panels are severely damaged and are situated within the taxiway strip and should be removed.	

Poor constructed utility trench across the apron.	
No taxiway edge lighting, Wig Wag lighting, hold short lines, and signage on Taxiway 'B'.	
No Wig Wag lighting, hold short lines, signage and broken edge lighting on Taxiway 'A'.	

Windsock is un-lit and needs to be replaced.	

5.6.2 Recommended Visual Aids

The aging and poorly maintained airfield lighting system should be replaced in its entirety due to the condition of the equipment and the lights. All incandescent fixtures should be replaced with LED fixtures wherever possible to reduce the load on the utility supply. The minimum recommended installation includes:

- Medium-intensity LED runway edge lighting
- Medium-intensity LED taxiway edge lighting
- Medium intensity LED apron edge lighting
- Apron floor lighting
- ODALS on runways 07 & 25
- PAPIs on runways 07 & 25
- Illuminated Airfield Guidance Signage
- Illuminated windsocks

5.7 OTHER OBSERVED ITEMS

During the assessment we have noted some other items that should not be located in the infield:

Description	Image
Garbage/Trash airside. Small items, if blow around may cause FOD and be injected into an aircraft engine. This should be cleaned up as soon as possible.	
Garbage/Trash airside beside the terminal building. Small items, if blow around may cause FOD and be injected into an aircraft engine. This should be cleaned up as soon as possible.	

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The airfield requires regular maintenance and the following inspection checklist can be a good tool for the airport in managing its infrastructure.

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Aviation Inspection Checklist

Ministry of Transport and Aviation and Department of Civil Aviation

Name of Inspector: ____________________
Date (D/M/Y): ____________________
Time of Inspection: ____________________

Airport: **San Salvador**
Grading: [A] = Acceptable ; [U] = Unacceptable ; [C] = Corrected

Airside Pavements	**A**	**U**	**C**	**N/A**	**Comments**
Runways (Damage, Wildlife, FOD, Ponding)					
Apron(s), Taxiway(s) and Emergency Routes Clear					
Culverts and Drainage					
Heliport					
Passenger Walkways (sand, debris, etc)					
Field Condtions	**A**	**U**	**C**	**N/A**	**Comments**
Apron Lights					
Taxiway Lights					
Threshold Lights					
PAPI					
Approach Lights					
Edge Lights					
Wind Direction Indicators					
Guidance Signs					
Airside Markings, Markers and Franginble Signs					
Facility and Apron Lighting (when applicable)					
Rotating Beacon					
Grass					
Aircraft Parking					
Groundside (Daily)	**A**	**U**	**C**	**N/A**	**Comments**
Traffic Signs (visible and in good repair)					
Road Conditions (pot holes)					
Walkways (Terminal and maintenance)					
Parking Lots (debris/potholes/etc.)					
Fencing and Gates - Functional					
Lighting					
Ditches and Culverts - Drainage					
Grass					
Airside During Weather Events	**A**	**U**	**C**	**N/A**	**Comments**
Obstacle Limitation Surfaces and Obstacle Lights					
Wet Surface Condition (action required); Rainfall (mm)					
Airfield Safety Area Conditions (Runway,Taxiway,RESA's)					
Construction/Special Events (As required)	**A**	**U**	**C**	**N/A**	**Comments**
Project/Work/Event Site (barricaded)					
Obstacles/Equipment (barracade and lights)					
Excavations (barricades/lights) Vehicles etc.					

Airport Lead Hand Initials: ____________ **Inspectors Initials:** ____________

Additional Comments:

5.8 AIR TRAFFIC MANAGEMENT

Presently, the Airport does not have local air traffic service capabilities. Typically, local air traffic services personnel serve two primary functions – ground control and local air control.

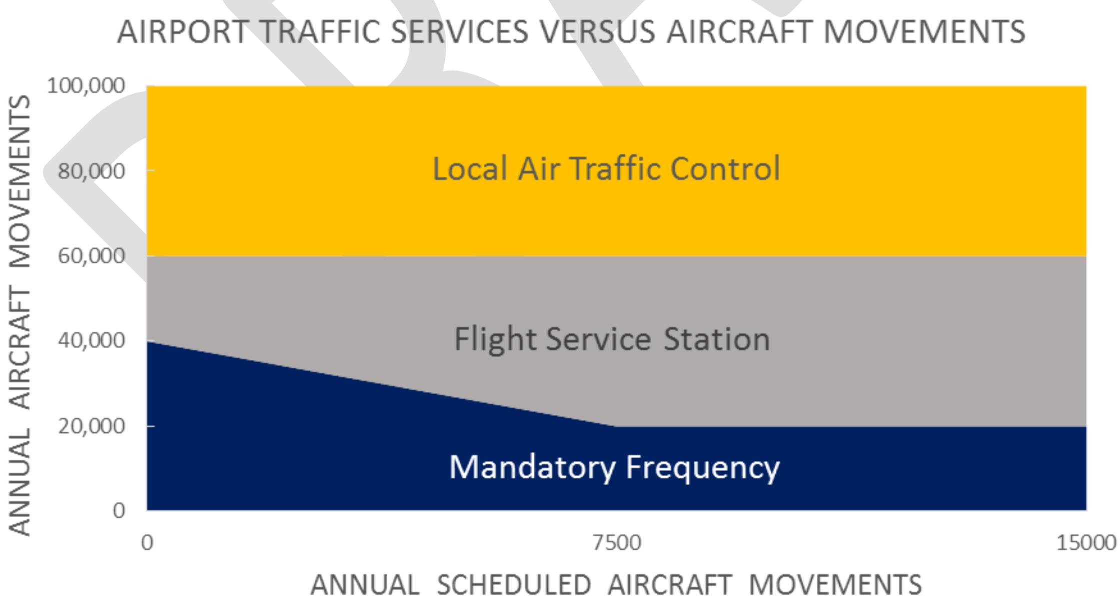
In the case of ground control, the objective is to monitor and control aircraft on the airside maneuvering areas (runways, taxiways and some apron taxi lanes), prevent collisions between aircraft and other objects, sequence aircraft for optimized departure separations and ensure the general efficiency of aircraft movements in order to maintain runway and taxiway capacity.

In the case of local air control, the principal responsibilities include clearing aircraft for take-off or landing and ensuring that aircraft are maintaining the prescribed separations during the final phases of arrival and during the initial take-off phase.

5.8.1 Determining the Level of Local Air Traffic Service

Due to the significant investment required for a local air traffic service in the form of infrastructure (e.g. tower) and personnel (e.g. training and operational costs), most Air Navigation Service Providers (ANSP) undertake a benefit-cost assessment using a complex set of inputs and criteria in order to determine whether local air traffic services should be provided at an airport. For example, the criteria can include the airspace classification, the volume and frequency of airport air traffic, the number of runways in simultaneous use, and the complexity of the airfield layout. In addition to the specific benefit-cost assessment at the local level, the ANSP should periodically undertake a Level of Service review for a grouping of airports or the system as a whole. Such a review ensures that the resources of the ANSP are optimized and allocated to areas of highest risk.

For example, Nav Canada, the ANSP for air traffic in Canada, has three levels of airport traffic services – (i.) mandatory frequency, (ii.) flight service station and (iii.) local air traffic control. The chart below illustrates the traffic level thresholds that typically apply to determine the qualification for certain levels air traffic service. The specific traffic levels in combination with an aeronautical study to assess the level of risk and benefit-cost for various types of service ultimately are used to determine the type of service to be employed.



Source: Aviotec International Inc. adapted from Nav Canada Level of Service Standards and Guidelines.

5.8.2 Implications of Night time Operations

At present, the airport is not certified by BCAD to operate during nighttime hours except for emergencies and air ambulance operations. It has been suggested at certain levels of Government that a number of the busier Tier 1 airports should be available for regular nighttime operations.

Although nighttime operations do tend to increase the level of risk associated with airport air traffic operations, in and of itself, it does not trigger the need to introduce a higher level of air traffic service. Ultimately, an aeronautical study should be performed by the ANSP to assist in determining the appropriate level of air traffic service.

5.8.3 Air Traffic Services for the Airport

Based on the type, size and frequency of traffic levels at the airport expected during the 20-year planning horizon is recommended in the short-term that a Mandatory Frequency be introduced at the airport. The MF operator may be local or remote of the airport. A MF will require that aircraft operating into and out of the airport have the appropriate type of radio. For example, for inbound radio-equipped aircraft, pilots are required to:

- Report before entering the MF area at least five minutes before entering the area;
- Report when joining the aerodrome traffic circuit;
- Report when on downwind leg, if applicable;
- Report when on final approach; and
- Report when clear of the surface on which the aircraft has landed.

This is not to say that non-radio-equipped aircraft cannot operate into an airport with a mandatory frequency, but they must follow very specific procedures in order to maintain the level of safety.

Although, ***the need for local air traffic control services is not expected to be required during the planning horizon of this study, the planning team has protected for a future air traffic control tower, including the siting for a potential location.***

5.8.4 Air Traffic Control Tower Siting

For reasons of economy and efficiency, it was decided jointly with BCAD that a "Combined Services" approach would be followed for all Tier 1 airports in order to accommodate (i.) aircraft rescue and firefighting (ARFF) services, (ii.) air traffic control (ATC) services, and (iii.) airport equipment maintenance and storage services; in a single, co-located Combined Services Building (CSB). This is an approach that has been successfully followed in other countries, such as Canada. Therefore, ultimately, the site selection process must achieve a balance between the needs of these three services.

The effective provision of air traffic control services at an airport requires a clear and unobstructed view of the entire movement area (runways, taxiways and aprons) and of air traffic in the vicinity of the airport.

A site selection process was followed taking into consideration the future development of the runway and other infrastructure. The planning and site selection considerations included such elements as:

- The need to avoid sun glare;
- The maintenance of sight lines over the movement areas;
- Cable requirements associated with the control and monitoring of airport lighting systems and visual aids;
- The provision of meteorological information and runway visual range.
- The possible future provision of local radar;
- The provision of communications, as detailed below;
- Security arrangements;
- Space available in the tower cab for the appropriate number of control positions, associated equipment and devices, and the number of personnel;
- Space requirements for offices, equipment rooms and rest areas; and
- Special arrangements for sensitive equipment.

The minimum communications requirements for a local air traffic service are typically:

- Air-to-Ground Communications (also called aeronautical mobile service) – communications equipment to enable direct, rapid, continuous, and static-free two-way communication to take place between the control tower and appropriately equipped aircraft operated within 24 nautical miles of the airport;
- Ground-to-Ground Communications (also called aeronautical fixed service) – provision for speech communications and for those situations requiring a record, written communications between the control tower and a flight information center, approach and departure control, area control center, rescue and firefighting unit, etc.; and
- Monitoring of navigational aids and aeronautical facilities.

5.9 COMBINED SERVICES BUILDING (CSB)

The Combined Services Building for North Eleuthera is well positioned in a central location between the new apron and the existing apron areas that will handle the expanding General Aviation activity. This location maintains good visibility and access to both aprons as well as quick access to the runway. The facility design accommodates maintenance, emergency response and any Air Navigational support staffing requirements (see Appendix 10). The building is designed for drive through facilities for emergency response vehicles and it is sized for the new equipment that the airport will be receiving in the New Year.

5.10 AVIATION FUELLING

5.10.1 Fixed Base Operators

The airport has an active fuelling market and facilities with White Crown having fuelling facilities and a nice fixed base operation. This is relevant as it is necessary to put in place a parallel runway to properly comply with aviation standards and zoning and not require a complete relocation of all activity on landside including the FBO anad its fuelling facilities. White Crown is a well-established operator in the Bahamas and this is an excellent service that will grow as the airport facilities encourage new tourism and market development in the Eleuthera market with expanded air service attraction.

6.0 Land-Use Planning

6.1 OVERVIEW

The development of land use and appropriate zoning controls for the study airports will foster development opportunities while protecting the existing and future on-airport operations and surrounding land uses. This requires verification and review of available documents and mapping that was sourced to determine the amount of potentially developable lands as well as any aeronautical and regulatory constraints that impact those sites such as runway approach and departure clearance and building height limitations.

External lands have been assessed to determine if land use and zoning controls should be enacted to protect the long-term interests and growth potential of the study airports. The assessments take into account future traffic volumes, patterns and aircraft types, and the necessity for precision/instrument approaches, night-time activity, etc.

6.2 THE AIRPORT AND VICINITY LAND USE

The proposed Airport Land Use Plan (see Appendix 3) ensures that no residential development will occur within greater than 30 NEF zone; although under some scenarios, a small area of residential use northwest of the airport (north side of airport access road) will be exposes to >30 NEF (refer to the companion document – North Eleuthera Airport Noise Management Study).

The Airport Land Use Plan protects airspace (Obstacle Limitation Surfaces) from obstacle hazards, principally trees (Caribbean Pines typically grow to 20-30 metres or 60-100 ft). The plan also provides a nature buffer from other Commonage area (see Appendix 4).

Plan protects for a future 1000 ft runway extension to the west (to a total length of 7,800 ft).

All land use areas have been established to preserve and protect specific areas for long-term requirements well beyond the planning horizon of the Master Plan.

Core Aviation Operational Area includes all proposed and future runway strip and taxiway strip areas and protection of OLS transition and approaches from infringements by fence line, parked aircraft, and mobile vehicles and objects.

The proposed Terminal Area has been located to the east of the existing terminal building in order to provide a greater area for future development and related groundside uses. Flanked on either side of the Terminal Area is terminal reserve for future expansion. The relocation and development of a new terminal will also provide additional space for expansion or development of General Aviation Facilities; including the existing FBO operator (see Appendix 5).

The Commercial Development Zone is intended to accommodate development of future Aircraft Maintenance and Overhaul (AMO) facilities, cargo facilities, charter/scheduled air carrier bases, aircraft storage hangars, etc.

An alternative to acquiring all of the lands indicated on the plan, BCAD could simply secure "avigation" agreements for the designated natural buffer lands. Avigation easements would provide the right of overflight in the airspace above or in the vicinity of a particular property, as well as the right to create such noise or other effects as may result from the lawful operation of aircraft in such airspace and the right to remove any obstructions to such overflight. This in effect would prevent the property owner's from building above a set height or requires the trimming of trees.

On-airport lands are subject to the detailed requirements necessary to comply with airport certification standards for runways, taxiways and aprons, as well as those applying to navigation aids and electronic equipment. Airport tenants are required to comply with the regulations as a condition in their lease. This will lead to the preparation of an Airport Development Plan for each study airport which includes:

- A feasibility assessment of those site conditions that will affect the development capacity of each airport site for aeronautical and non-aeronautical development including, but not limited to, environmental issues and utility capacities and locations as well as existing land use compatibility.
- Assessment of current airside and groundside infrastructure within the Airport and the adjacent lands (not necessarily under government ownership).
- Based on land use and development recommendations, discuss necessary infrastructure improvements and provide related cost estimates.

6.3 ECONOMIC AND LAND DEVELOPMENT

The property values in the area around the airport will change dependent on the nature of the land use. The residential areas are deliberately restricted in the vicinity as they would otherwise see their values decrease due to loss of some 'quiet enjoyment' of their property. The increased activity will also increase the land value and lease rates for the airport in the vicinity and on airport lands. The approaches to leasing and land development require a review as ***the airport revenue potential is underserved in today's environment.*** The climate for development has identified current and expected market conditions that may influence demand for commercial land at the Airport. Airports play a significant role in being the "front door" for a region's tourism product and this is a key driver for the capacity triggers for the Master Planning work. The unique element of the development around the North Eleuthera Airport is the Commonage lands to the south. Development is not aggressively pursued in this area but there still is a strong opportunity to build ***an opportunity for future participation in development in and around the airport area with the commonage owners***.

6.3.1 Commercial Activity

The commercial development activity at North Eleuthera International Airport is fairly good although it is cluttered and ***lacking in both available space to meet the demand as well as lost revenue potential***. There is a limited inventory of land availability along the highway that can be incorporated into the land use planning for the site going forward with more plentiful lands for airside/aviation use lands. The existing approach to Leasing land at the site is not managed effectively today. This requires a stronger oversight of property management practices and renewed or new agreements put in place with tenants related to the opportunity to move to new space and adjusting to a current market rate.

The old terminal can play a part in providing space for airline offices, expanded FBO operations or other airside related activity.

7.0 Energy and Water Efficiency

7.1 DEFINING SUSTAINABILITY FOR FAMILY ISLANDS AIRPORTS

The Civil Aviation Department has expressed a strong commitment to sustainability in general and energy and water efficiency in particular. In context of Civil Aviation, sustainability includes resource efficiency as well as the need for operational sustainability where equipment is reliable and can be maintained in a manner that is cost effective and does not require highly specialised support.

7.2 UTILITY RATES

Utility rates for energy and water are presented in **Table 6** for energy and water. This information is used in subsequent analysis to perform business casing of energy and water conservation measures.

Table 6: Electricity, Water and Sewer Rates

Service	Rate
Electricity	$0.35/ kWh[13] (including Fuel Charge)
Water	$60/ 3000 Gallon (Per Quarter)
Sewer	$9.18/3000 gallons (per Quarter)

Electricity rates are significantly higher than on the continental United States. This increases the cost effectiveness of energy conservation, as well as improving the economics of self-generation through on site renewable resources. A recent summary of the cost of renewable based electricity is summarized in Table 7. Based on this data, the cost of renewable based electricity is significantly lower than the current utility rate for diesel powered electricity.

Table 7: Annualized, costs of delivered electricity (2013 U.S. $ per kWh-delivered)[14]

Resource	Levelized Cost of Energy, 2013 [$/kWh]
Municipal Solid Waste	$0.24
On-shore Wind	$0.09
Off-shore wind	$0.16
PV Utility Scale	$0.09
PV Rooftop Scale	$0.13
Wave Power	$0.24

[13] http://www.bahamaselectricity.com/rates.cfm

[14] Ref Jacobson et Al, 100% clean and renewable wind water and sunlight all sector energy roadmaps for the 50 United States

7.3 SITE OBSERVATIONS

This section provides a summary of observations of the site visits for the North Eleuthera Airport as it relates to its facility and operational practices for energy water and sustainability.

7.3.1 North Eleuthera Airport

<table>
<tr><th>Description</th><th>Image</th></tr>
<tr><td>Site visit for North Eleuthera Airport was conducted on February 10 and 11, 2015.</td><td>
</td></tr>
<tr><td>Airside waiting area. Note limited seating area and exposed conditions.

Building is in fair condition however, capacity of facility is limited during peak flight arrival and departure periods. Electrical and plumbing fixtures were observed to be obsolete and inefficient.</td><td>
</td></tr>
</table>

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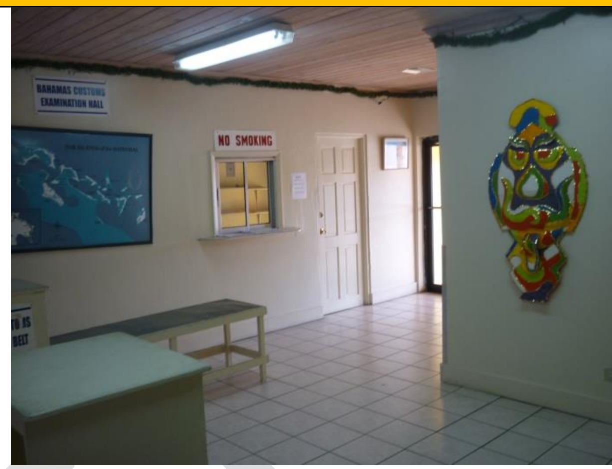
Description	Image
Back-up generator installed. Unit was confirmed to be operational.	
Over-crowding of departures lounge was observed during schedule flight departure times. While seating is provided inside the departures area, it is not sufficient to accommodate peak traffic periods. Functionally, the flow of the space is poor.	
Electrical equipment is installed in exposed locations in boxes that do not appear to be hurricane-proof. Boxes are starting to corrode. Concern for the potential for water entry and shorting of electrical equipment exists.	

Description	Image
Pedestrian area at terminal entrance. Over-crowding and conflicts between pedestrian and vehicles observed.	
Housekeeping around the building is poor, making access to critical infrastructure a challenge. Abandoned radio antenna should be removed or repaired.	
Over-crowding of office space and inadequate storage was observed.	

Description	Image
Lighting equipment is manual and centrally controlled eliminating potential for day-lighting of perimeter spaces.	
Cistern used for water supply to airport. It was observed that the electrical service to the pump were tangled in trees and vulnerable to power outage from wind events.	

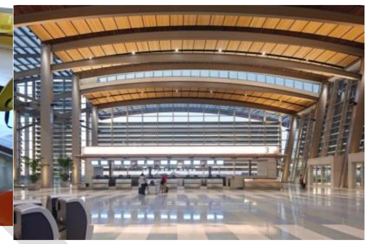
7.3.2 General Observations on Condition of the North Eleuthera Airport

In general, it was observed that the existing buildings are functionally obsolete and nearing the end of their design service life. Overcrowding of the buildings was widespread, resulting in passenger confusion and inconvenience. Housekeeping in and around buildings was poor resulting in health and safety concerns. Physical deterioration of the building structures was observed in multiple locations, including rot, and moisture damage. At North Eleuthera, the water supply for the airport is provided by a well, however, the electrical supply for the pump was not protected.

7.4 ENERGY AND WATER USING EQUIPMENT AT FAMILY ISLANDS AIRPORTS

The following section is applicable to all four (4) airports that have had Master Plans prepared in 2015 and is not specific to San Salvador only, although all the recommendations are extremely important to its future design and programming. ***Current and Proposed Electricity Using Equipment is summarised in Table 8. Current and Proposed Water Using Equipment is presented in Table 9.***

Table 8: Current and Proposed Energy Equipment

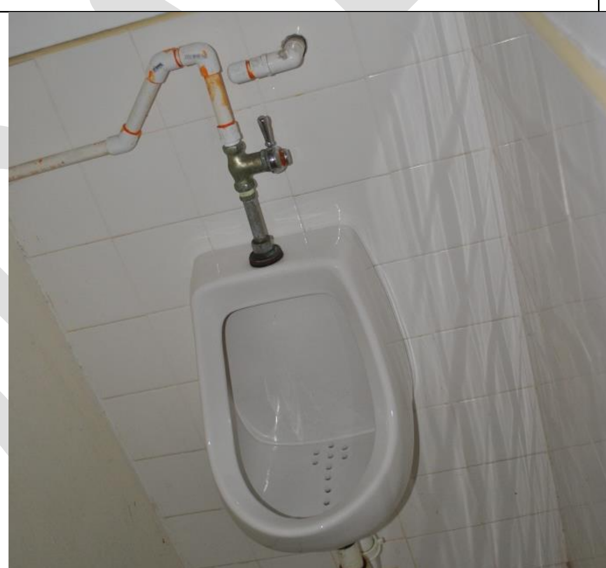
End Use	Description	Proposed
Interior Lighting Interior lighting is in general T12 fixtures with two lamps. It is assumed that ballasts are magnetic. Controls for lighting are manual and there are no occupancy sensors or daylight controls on the equipment.		Daylighting of interior spaces through suitable location, size and performance of glazing can be used to significantly reduce energy consumption and has the aethetic appeal of daylight spaces. 
Exterior Lighting Exterior lighting appears to use two lamp T12 fixtures. Based on the visual review, these fixtures appear to be for interior use only. Exterior lighting appears to use manual controls and it was observed that in some facilities, the exterior lights were operating during daylight hours.		Use of LED panel lighting will reduce power consumption and provide increased service life. 
Runway Lights Runway lights are a mixture of photovoltaic and incandescent units		The use of photovoltaic units is recommended for some aspects of the airside operations but there are areas of airfield lighting design that are best suited to hard wired installations.

Space Cooling Space cooling includes a mixture of split ductless systems as well as through the wall units. Air conditioning equipment appears to be of older vintages that use CFC refrigerants and have low levels of energy efficiency ratings.	  	A mixture of passive and active cooling strategies is recommended. Managing glazing orientation and amount, providing exterior shading and use of cross flow ventilation is recommended to minimize the requirement for operating cooling equipment. Thermal massing of the building is also an important strategy. During peak occupancy periods and during summer months, active cooling is required. Use of energy efficient products such as Energy Star labeled equipment is recommended.

Building Enclosures Buildings are constructed of concrete, concrete block and wood. Windows are generally single glazed and do not have reflective coatings. Roofs are in general concrete tile or asphalt shingles. In many locations it was observed that windows and doors remain open even while cooling equipment is operating. Ensuring windows and doors remain closed is important to the proper operation of air conditioning equipment.		Concrete aand concrete block construction remains an excellent choice due to the high thermal mass of the materials.
Manual thermostat used to control cooling equipment Air conditioning equipment is controlled using non-programmable thermostats. Due to protective covers, cooling equipment appears to run continuously, even when buildings are not occupied.		Control technologies have evolved significantly over the last ten years allowing buildings to operate much more efficiently. It is recommended that daylight and occupancy controls be consided for all temperature control equipment as well as lighting. Similarly CO_2 sensors are recommended for ventilation equipment.

Backup generator Backup generators used to provide emergency power are installed at a number of the airports; however, no information was available on the condition or operating practices of the units.		Back-up generators on site will likely need to be re-sized to accommodate larger facilities. It is recommmended that voltage regulators and power quality filters be added to reduce spikes and drops in voltage. Furthermore, it is recommmended to include tie-ins to permit renewable electricity generation on site.

Table 9: Current and Proposed Water Using Equipment

End Use	Description	Proposed
Toilet Toilets appear to be 4.7 gal per flush units at most of the facilities.		Water efficient toilts use 1.2 to 1.6 gallons per flush, saving 70% of water. 
Urinals Men's washrooms are equipped with tank style urinals using manual flush valves. Older style units consume approximately 3.2 gal per flush.		Water efficient urinals have flows ranging from 0.125 gallons per flush to 1 gallon per flush with savings of up to 96%. 

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Faucet Washrooms are generally equipped with faucets. Older units consume approximately 3.2 gal per minute.		

7.5 PRIORITY ENERGY CONSERVATION MEASURES

7.5.1 Cool Roofs

Cool roofs are recommended for roofs with insulation entirely above deck and for metal building roofs. In order to be considered a cool roof for climate zones 1–3, the roof must have a high reflectance and a high thermal emittance. One measure of these properties is the solar reflectance index (SRI). An SRI of 78 or higher is recommended, as determined by ASTM E 1980. The radiative property values should represent long-term performance, such as three-year aged values to account for aging and soiling of roofs. Ratings should be determined by a laboratory accredited by the Cool Roof Rating Council.

7.5.2 Glazing

For north and south facing windows, windows should be selected with a low SHGC and an appropriate visible light transmission. Certain window coatings, called *selective low-e*, transmit the visible portions of the solar spectrum selectively, rejecting the nonvisible infrared sections. These glass and coating selections provide superior view and daylighting while minimizing solar heat gain. Window manufacturers market special “solar low-e” windows for warm climates. For buildings in warm climates that do not utilize daylight-responsive lighting controls, glazing should be selected with a SHGC of no more than 0.44. All values are for the entire fenestration assembly, in compliance with NFRC procedures, and are not simply center-of-glass values. For warm climates, a low SHGC is much more important for low building energy consumption than the window assembly U-factor. Windows with low SHGC values will tend to have a low centre of glass U-factor, however, because they are designed to reduce the conduction of the solar heat gain absorbed on the outer light of glass through to the inside of the window.

7.5.3 Passive Solar

Passive solar energy-saving strategies should be limited to non-sales and non-office spaces, such as lobbies and circulation areas, unless these strategies are designed so that workers and customers do not directly view interior sun patches or see them reflected on merchandise or work surfaces. Consider reflective blinds in warm climates. In spaces where glare is not an issue, the usefulness of the solar heat

gain collected by windows can be increased by using massive thermally conductive floor surfaces, such as tile or concrete, in locations where the transmitted sunlight will fall. These floor surfaces absorb the transmitted solar heat gain and release it slowly over time, to provide a more gradual heating of the structure. Consider low-e glazing with exterior overhangs.

7.5.4 Savings and Occupant Acceptance

Daylight in buildings can save energy if the electric lighting is switched or dimmed in response to changes in daylight levels in the store. Automatic lighting controls increase the probability that daylighting will save energy. It is also important that heat gain and loss through glazing be controlled. In addition, glare and contrast must be controlled so occupants are comfortable and will not override electric lighting controls. See additional comments related to skylight design and placement.

7.5.5 Surface Reflectance

The use of light-colored materials and matte finishes in all daylighted spaces increases efficiency through inter-reflections and greatly increases visual comfort.

7.5.6 Occupancy Sensors

Use occupancy sensors in all non-sales areas. The greatest energy savings are achieved with manual on/automatic off occupancy sensors if daylight is present. This avoids unnecessary operation when electric lights are not needed and greatly reduces the frequency of switching. In non-daylighted areas, ceiling-mounted occupancy sensors are preferred. In every application it should not be possible for the occupant to override the automatic OFF setting, even if set for manual ON. Unless otherwise recommended, factory- set occupancy sensors should be set for medium to high sensitivity and a 15-minute time delay (the optimum time to achieve energy savings without excessive loss of lamp life). Review manufacturer's data for proper placement and coverage. The two primary types of occupancy sensors are *infrared* and *ultrasonic*. Infrared sensors can only see in a line-of-sight and should not be used in rooms where the user cannot see the sensor (e.g., storage areas with multiple aisles, restrooms with stalls). Ultrasonic sensors can be disrupted by high airflow and should not be used near air duct outlets.

7.6 RECOMMENDATIONS FOR AIRPORT DESIGN TO ACHIEVE 30% BELOW ASHRAE 90.1-2010

The American Society for Heating Refrigeration and Air Conditioning Engineers (ASHRAE) publishes a standard for the design of energy efficient new buildings. This standard provides cost effective and technically feasible opportunities to manage energy use of buildings. Given the high price of electricity in the Bahamas, however, additional consideration is recommended to optimize the design of new airports. A 30% savings below ASHRAE 90.1 has been demonstrated to be cost effective through adoption of modest energy conservation measures, as summarized in Table 10.

Table 10: Assemblies and Systems to Achieve 30% saving Below ASHRAE 90.1

Assembly/Component	Construction	Recommendation
Roof Insulation	Entirely above deck Metal building Attic and other Single rafter Solar reflectance index (SRI)	R-15 Continuous Insulation R-19 R-30 R-30 78
Walls Mass	(HC > 7 Btu/ft2) Metal building Steel framed Wood framed and other	No recommendation R-13 R-13 R-13
Below-grade walls		No recommendation
Floors	Floors Mass Steel framed Wood framed and other Unheated Slabs Heated Slabs	R-4.2 c.i. R-19 R-19 No recommendation R-7.5 for 12 in.
Doors	Opaque Swinging Non-swinging	U-0.70 U-1.45
Vertical Glazing Including Doors	Area (percent of gross wall) Thermal transmittance Solar heat gain coefficient (SHGC) Exterior sun control (S, E, W only) Skylights Area (percent of gross roof) Skylight thermal transmittance Skylight solar heat gain coefficient (SHGC)	40% U-0.69 N, S, E, W - 0.44; N only—0.44 Projection factor > 0.5 3% U-1.36 0.19

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Assembly/Component	Construction	Recommendation
Interior Lighting	Lighting power density (LPD) Linear fluorescent with high-performance electronic ballast All other sources Daylight Controls Occupancy controls Interior room surface reflectances in locations with daylighting	1.3 W/ft^2 91 mean lm/W 50 mean lm/W Dimming controls for daylight harvesting under Skylights Dim fixtures within 10 ft of skylight edge Occupancy controls Auto-off all non-sales rooms 80%+ on ceilings, 70%+ on walls
Exterior Lighting	Façade and externally illuminated signage lighting	0.2 W/ft2
HVAC	Air conditioner	(0-65 kBtuh) 13.0 SEER (>65-135 kBtuh) 11.3 EER/11.5 IPLV (>135-240 kBtuh) 11.0 EER/11.5 IPLV (>240 kBtuh) 10.6 EER/11.2 IPLV
Economizer Air conditioners & heat pumps		No recommendation
Ventilation	Controls Ducts Friction rate Duct Leakage Duct Location Duct Insulation level	Outdoor air damper Motorized control Demand control CO2 sensors 0.08 in. w.c./100 ft Sealing Seal class B Interior only R-6
Service Water Heating	Electric storage	(≤ 12 kW and > 20 gal) EF >

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Assembly/Component	Construction	Recommendation
		0.99 – 0.0012xVolume
	Pipe insulation	d < 1½ in./ d ≥ 1½ in.) 1 in./ 1½ in.

7.7 RENEWABLE ENERGY RESOURCE OPPORTUNITIES

Analysis of renewable energy options were completed, including solar photovoltaic, wind generated electricity and solar thermal hot water. An evaluation of these technologies is presented in Appendix 2. Of the three renewable energy options investigated, solar photovoltaic systems have the greatest potential application. The wind regime in the Bahamas is insufficient to generate continuous power and the hot water loads at the Family Islands Airports is not sufficient to warrant solar hot water systems.

In contrast, solar photovoltaic systems are suited to the climate and load profiles of the Family Islands Airports. In the short term, photovoltaic systems can be designed to stand alone equipment such as certain airfield lighting and outdoor illumination.

7.7.1 Regulatory Context

7.7.1.1 BEC

The Bahamas Electricity Corporation (BEC) is commencing a Solar PV Supplemental Power initiative. This program will allow for the installation of grid tied systems in the range of 110 to 15 kW. The Bahamas require that any engineering work done for these systems have the direct involvement of and be signed off on by local licensed engineers in the appropriate discipline. Additionally, all electrical installation permits, for any electrical installations or modification to existing installations, must be submitted by suitably (single or three phase) licensed electrical contractors. This contractor would therefore be held responsible for the installation with respect to in meeting the local electrical code (CEC) and any specific requirements of the local authorities.

7.7.1.2 Federal Aviation Administration (FAA)

The Bahamas Airports operate within the regulatory framework of the FAA. The FAA has recently established requirements for installation of Solar Energy System Projects on Federally Obligated Airports. In conjunction with the United States Department of Energy (DOE), the FAA has determined that glint and glare from solar energy systems could result in an ocular impact to pilots and/or air traffic control (ATC) facilities and compromise the safety of the air transportation system. While the FAA supports solar energy systems on airports, the FAA seeks to ensure safety by eliminating the potential for ocular impact to pilots and/or air traffic control facilities due to glare from such projects.

Based on current requirements, a sponsor of a federally-obligated airport must request FAA review and approval to depict certain proposed solar installations (e.g., ground-based installations and collocated installations that increase the footprint of the collocated building or structure) on its airport layout plan (ALP), before construction begins.

A sponsor of a federally-obligated airport must notify the FAA of its intent to construct any solar installation by filing FAA Form 7460-1, "Notice of Proposed Construction or Alteration" under 14 CFR

Part 77 for a Non-Rulemaking case (NRA) 3 4 . The sponsor's obligation to obtain FAA review and approval to depict certain proposed solar energy installation projects at an airport is found in 49 U.S.C. 47107(a)(16) and Sponsor Grant Assurance 29, “Airport Layout Plan” (ALP). Under these latter provisions, the sponsor may not make or permit any changes or alterations in the airport or any of its facilities which are not in conformity with the ALP as approved by the FAA and which might, in the opinion of the FAA, adversely affect the safety, utility or efficiency of the airport.

Airport sponsors and project proponents must comply with the policies and procedures in this notice to demonstrate to the FAA that a proposed solar energy system will not result in an ocular impact that compromises the safety of the air transportation system. This process enables the FAA to approve amendment of the ALP to depict certain solar energy projects or issue a “no objection” finding to a filed 7460-1 form. The FAA expects to continue to update these policies and procedures as part of an iterative process as new information and technologies become available.

Solar energy systems located on an airport that is not federally-obligated or located outside the property of a federally-obligated airport are not subject to this policy. Proponents of solar energy systems located off-airport property or on non-federally-obligated airports are strongly encouraged to consider the requirements of this policy when siting such systems.

7.7.2 Use of LEED for the design of the new Airports

Leadership in Energy and Environmental Design (LEED) is an environmental rating assessment tool used by designers to improve the performance of their buildings. LEED includes seven categories that include prerequisites and points.

- Sustainable Sites
- Water Efficiency
- Energy and Atmosphere
- Regional Priority
- Materials and Resources
- Indoor Environment
- Innovation in Design Process

A sample LEED scorecard is presented in Figure 7. LEED has transformed the market for green buildings in North America. While the energy and water categories are directly transferable to the Family Islands airports, other categories may be problematic, in particular for materials since recycling and local materials are difficult. Further discussion is recommended on the cost and practicality of LEED registration for the airports.

Figure 7: Sample LEED Scorecard

52	4	54	Total Project Score	Possible Points	110

Certified 40 to 49 points   Silver 50 to 59 points   **Gold 60 to 79 points**   Platinum 80 or more points

3	1	22	d/C	Sustainable Sites	Possible Points	26
Y	?	N				
Y			C	Prereq 1	**Construction Activity Pollution Prevention**	
1			d	Credit 1	**Site Selection**	1
		5	d	Credit 2	**Development Density and Community Connectivity**	3, 5
		1	d	Credit 3	**Brownfield Redevelopment**	1
		6	d	Credit 4.1	**Alternative Transportation**, Public Transportation Access	3, 6
		1	d	Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
		3	d	Credit 4.3	**Alternative Transportation**, Low-Emitting & Fuel-Efficient Vehic	3
2			d	Credit 4.4	**Alternative Transportation**, Parking Capacity	2
		1	C	Credit 5.1	**Site Development**, Protect and Restore Habitat	1
		1	d	Credit 5.2	**Site Development**, Maximize Open Space	1
		1	d	Credit 6.1	**Stormwater Design**, Quantity Control	1
		1	d	Credit 6.2	**Stormwater Management**, Quality Control	1
		1	C	Credit 7.1	**Heat Island Effect**, Non-Roof	1
		1	d	Credit 7.2	**Heat Island Effect**, Roof	1
	1		d	Credit 8	**Light Pollution Reduction**	1

3		7	d/C	Water Efficiency	Possible Points	10
Y	?	N				
Y			d	Prereq 1	**Water Use Reduction**	
		4	d	Credit 1	**Water Efficient Landscaping**, Reduce by 50%	2, 4
		2	d	Credit 2	**Innovative Wastewater Technologies**	2
3		1	d	Credit 3.1	**Water Use Reduction**	2-4

26		9	d/C	Energy & Atmosphere	Possible Points	35
Y	?	N				
Y			C	Prereq 1	**Fundamental Commissioning of Bldg Energy Systems**	
Y			d	Prereq 2	**Minimum Energy Performance**	
Y			d	Prereq 3	**Fundamental Refrigerant Management**	
19			d	Credit 1	**Optimize Energy Performance**, 25% to 56% Energy Cost Saving	1-19
		7	d	Credit 2	**On-Site Renewable Energy**, 1% to 13%	1-7
2			C	Credit 3	**Enhanced Commissioning**	2
2			d	Credit 4	**Enhanced Refrigerant Management**	2
3			C	Credit 5	**Measurement & Verification**	3
		2	C	Credit 6	**Green Power**	2

3		1	d/C	Regional Priority	Possible Points	4
Y	?	N				
		1	C	Credit 1	**Durable Building**	1
1			C	Credit 2	**Regional Priority Credit**: EAc1, Optimize Energy Performance >3	1
1			C	Credit 2	**Regional Priority Credit**: EAc3, Enhanced Commissioning	1
1			C	Credit 2	**Regional Priority Credit**: EAc5, Measurement & Verification	1

1	3	10	d/C	Materials & Resources	Possible Points	14
Y	?	N				
Y			C	Prereq 1	**Storage & Collection of Recyclables**	
		3	C	Credit 1.1	**Building Reuse**, Maintain Exisitng Walls, Floors & Roof	1-3
		1	C	Credit 1.2	**Building Reuse**, Maintain Interior Non-Structural Elements	1
	1	1	C	Credit 2	**Construction Waste Management**, Divert 50% or 75%	1-2
		2	C	Credit 3	**Materials Reuse**, Specify 5% or 10%	1-2
1	1		C	Credit 4	**Recycled Content**, Specify 10% or 20%	1-2
	1	1	C	Credit 5	**Regional Materials**, 20% or 30% Extracted & Manufactured Regior	1-2
		1	C	Credit 6	**Rapidly Renewable Materials**	1
		1	C	Credit 7	**Certified Wood**	1

10		5	d/C	Indoor Environmental Quality	Possible Points	15
Y	?	N				
Y			d	Prereq 1	**Minimum IAQ Performance**	
Y			d	Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	
1			d	Credit 1	**Outdoor Air Delivery Monitoring**	1
		1	d	Credit 2	**Increased Ventilation**	1
1			C	Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
1			C	Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
1			C	Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
1			C	Credit 4.2	**Low-Emitting Materials**, Paints and Coating	1
1			C	Credit 4.3	**Low-Emitting Materials**, Flooring Systems	1
1			C	Credit 4.4	**Low-Emitting Materials**, Composite Wood and Agrifibre Produc	1
1			C	Credit 5	**Indoor Chemical & Pollutant Source Control**	1
		1	C	Credit 6.1	**Controllability of System:** Lighting	1
		1	C	Credit 6.2	**Controllability of Systems:** Thermal Comfort	1
1			C	Credit 7.1	**Thermal Comfort**, Design	1
1			C	Credit 7.2	**Thermal Comfort**, Verification	1
		1	C	Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
		1	C	Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1

6			d/C	Innovation & Design Process	Possible Points	6
Y	?	N				
1			C	Credit 1	**Innovation in Design:** Exemplary Performance, EAc1 > 58%	1
1			C	Credit 1	**Innovation in Design:** Integrated Project Planning + Design	1
1			C	Credit 1	**Innovation in Design:** Green Education	1
1			C	Credit 1	**Innovation in Design:** Green Housekeeping	1
1			C	Credit 1	**Innovation in Design:** LEED Pilot Credit Option	1
1			C	Credit 2	**LEED™ Accredited Professional**	1

8.0 Passenger Terminal Development

The existing airport terminal facility at North Eleuthera is currently unable to meet the island's demands for air travel and it offers no options to address the projected increase in air arrivals to the island.

It is with this in mind that we were able to explore two primary options in resolving this issue,

A. Expansion of the existing terminal

B. Develop a completely new terminal solution on a green field site.

The existing facility is tired and froth with maintenance and repair issues, and it has limited value in re-using the facility as a base for a major expansion for the growth of the passenger market in North Eleuthera. The building itself is located too close to the aircraft activity and there is not a large enough adjacent land nearby to make the current location suitable. It is with this in mind that a ***new green field solution was explored for a new terminal facility in North Eleuthura***. In this case it was fitting to try to work with the existing facility as a service base facility to support a new terminal and/or provide space for airline operations. ***This solution also allows for the existing operation to continue with minimal interruptions while the new facility is being built.*** The ground transportation was also redesigned and involves a substantially reconfigured landside parking and access road system for the airport and its heavy rental car and transportation services users.

The new terminal would be designed to meet the projected passenger demands and would utilize a similar design and programming capacity as for Exuma to reduce both time and costs for detailed design. The team developed plans with sustainability in mind, both financially and environmentally.

While sustainable design has rapidly become the norm for many North American building types, designers of airport and aviation facilities face particular challenges when attempting to employ sustainable design principles. Stantec is active in the ACI-NA Technical Subcommittee on Sustainable Design. We have over 460 LEED® Accredited Professionals on staff, have achieved LEED certification on a number of projects (at every level from Certified to Platinum), and are responsible for the first airport terminal project in Canada to formally go through LEED certification. We bring the results of our ongoing research into sustainable design solutions to the benefit of all our airport projects.

8.1 AIR TERMINAL PASSENGER DEMAND

Even though the sizing of the terminal is streamlined for today's economy, the ability of the terminal to meet the demands of the feature is equally important. As a result, the terminal design was right sized to allow the facility to adapt to the projected demand. It has a terminal reserve capacity that will be adaptable and flexible to expand as demand increases.

8.2 FUTURE TERMINAL BUILDING DEVELOPMENT STRATEGY

The goals for airport terminal design projects fall into three categories: functional, business, and aesthetic. Our design approach is to work with our clients to find the unique intersection point of these three broad goals for each of our clients.

We understand functional issues relating to the entire range of user and technical requirements that have to be met in the design of airport terminal buildings. The passenger flows and airline and airport functions, as well as the relationships between each space, and of course security considerations, all of which guide our approach to a terminal's functional layout. With respect to business goals, our airport clients work within financial and schedule constraints. We understand the need to design within these constraints, and also to design to maximize revenue generation and minimize life cycle costs. Airport terminal architecture and interior design conveys aesthetic messages about your brand, image and values, as well as the aspirations of the local community. Our objectives for the Airport Master Plans for each site are:

1. Create an overall Architectural identity for the Island airports gateways. And if possible a Standard Terminal Expansion Plan (STEP) design & implementation program.

2. Create a unique sense of place by providing distinctive architecture while preserving and enhancing the natural assets of the property.

The functional programming is close to the same requirements as experienced in Exuma and the design team is utilizing the same floor plan to provide expedited design and cost savings on the new facility.

North Eleuthera				
Design Year:	existing	Total Peak Hour Passenger (PHP):	312	[Arr+Dep]
Annual Passenger:		Dep. Peak Hour Passenger (PHP):	165	
Design Level of Service (LOS):	"B"	Arr. Peak Hour Passenger (PHP):	147	

Process Elements	Program Req'mt	Actual	Difference (m^2)	Notes/Remarks
Check-in Counters	6.0	6.0		
Passenger Screening Lines	2.0	2.0		
Departure Gates - Ground-Loaded	2.0	2.0		
Departure Gates - Bridged				
Baggage Claim Devices	2.0	2.0		

The existing terminal is well under-served and the airport can be better served with a new terminal that will expand the size from 3674 sq ft. to 21,122 sq.ft.. This will provide the airport with a wonderful new facility that will accommodate its passenger activity well into the future as well as providing a safer environment for the general aviation activity at the airport.

Area Description	PHP	PHP Ratio	Criteria Value	Criteria Units	Program Area (m^2)	Actual Area (m^2)	Difference (m^2)	Notes/Remarks
Check-in Queuing	165.0	1.0	1.2	m^2/pax	198.0	228.0	30.0	1-2 pieces of luggage.
Departure Hall/Circulation	165.0	1.0	1.2	m^2/pax	198.0	249.0	51.0	Includes outside patios
Passenger Holdroom (Standing)	165.0	0.6	1.2	m^2/pax	118.8	118.8		
Passenger Holdroom (Siting)	165.0	0.4	1.7	m^2/pax	112.2	117.2	5.0	
Baggage Claim	147.0	0.8	1.6	m^2/pax	176.4	223.0	46.6	no carts, adj. for carry-on only passengers
Custom/Immigration	147.0	1.0	1.2	m^2/pax	176.4	223.0	46.6	
Passenger Screening	165.0	0.7	1.2	m^2/pax	130.7	148.0	17.3	2 lanes, linear processing, no carts
Hold Baggage Screening	165.0			m^2/pax		55.0	55.0	
Airline Offices				m^2/pax				
Rental Car Offices				m^2/pax				
Concessions/Retail - Groundside				m^2/pax				
Concessions/Retail - Airside				m^2/pax				
Airport Administration Offices				m^2/pax				
Security and Other Services				m^2/pax				
General Circulation and Waiting				m^2/pax				
			Total Terminal Areas		1,110.5	1,362.0	251.5	

Existing airport terminal	**3674SQ.FT.**
Total area of new terminal	**21122SQ.FT.**

8.2.1 Baggage Handling Systems

Of all of the systems in an airport terminal, the baggage system is the most complex, and the least flexible. There are strict limits to the tightness of turns in a baggage system and the interface between the baggage system and the building is particularly important when considering such issues as security, fire separations, noise, and accessibility for maintenance. We have incorporated the bag systems into the terminal to provide flexibility for both domestic and international passenger travel requirements and sterile processing requirements. This dictates the space adjacencies for several functional areas of the facility and these have been designed to accommodate future growth and expansion. The aim has been to design baggage systems that deliver maximum flexibility and functionality while minimizing capital and operational costs.

8.2.2 Concession Management

Many progressive airports have realized the value of increasing revenues and enhancing the passenger experience through creative concessions planning and design. A well-conceived concessions program is one of the defining characteristics that passengers remember and associate with their impression of an airport. We believe that for tier one airport in these locations to ***become completely self-supporting or perhaps revenue generating it must capitalize on its non-aeronautical revenues streams***. To this end we are looking to bring a unique perspective and expertise on airport concessions planning. Understanding the needs of tenants and the need for tenants, providing spaces for Advertisers, and other related services in the islands is key to successful financial sustainability. The design has provided several nicely sized concession areas and a very exciting 2nd level restaurant area that will be a very attractive spot to watch the aviation activity at the airport. The aspect of Duty Free should also be dramatically improved.

8.2.3 Rental Cars

The rental car market is a potential growth area if the development market expands with the new resort and boutique hotels that are anticipated. As it stands today, it is a busy area but not as efficient as it should be and space in the terminal and airport property for staging vehicles for passenger pick-up and drop off adjacent to the terminal are designed in the landside plans.

8.2.4 Buses

The parking and safe circulation and transferring of passengers by bus has been addressed in the landside parking design.

8.3 ACCESS ROADS

The landside infrastructure development has explored a new access road concept and associated parking and it will also address the improvements to the parking areas as well.

9.0 Capital and Implementation Plan

9.1 CAPITAL PLAN

Project: **Airport Master Plan**
Airport: North Eleuthera International Airport

Estimate By: BMZ
Date: 12/4/2015
Reviewed By: JJD
Date: 12/4/2015

Cost estimate is based on 2015 USD.

	Capital Works Item - Description	Timing	Quantity	Units	Unit Rate	Subtotal
A.	**AIRSIDE**					**$30,778,602**
A.1	Clearing and grubbing of lands and disposal off-site	short-term	188	acres	$3,000.00	$564,000
A.2	Topsoil stripping and stockpiling for new runway, taxiways, apron and terminal.	short-term	87,200	cu. yard	$10.00	$872,000
A.3	Earthworks (cutting, filling and compaction for new runway, taxiways, apron and terminal building.	short-term	517,806	cu. yard	$15.00	$7,767,090
A.4	Construct new Runway 07/25 (hot mix asphalt and granulars)	short-term	11,587	sq. yard	$89.10	$9,942,372
A.5	Construct runway blast pad (hot mix asphalt and granulars)	short-term	,973	sq. yard	$23.00	$114,387
A.6	Construct new taxiway section at Rwy 07 threshold (hot mix asphalt and granulars)	short-term	,592	sq. yard	$86.30	$655,170
A.7	Construct new rapid exit taxiway (earthworks, HMA, granulars and edge lighting)	medium-term	6,480	sq. yard	$114.00	$738,720
A.8	Construct new runway to taxiway connection (hot mix asphalt and granulars)	short-term	3,776	sq. yard	$86.30	$325,898
A.9	Decommission former runway for use as new parallel taxiway	short-term	1	lump sum	$85,000.00	$85,000
A.10	Narrow and rehabilitate former runway to taxiway standard	medium-term	42,647	sq. yard	$35.00	$1,492,641
A.11	New terminal aircraft apron and taxiway connections (hot mix asphalt and granulars)	short-term	33,344	sq. yard	$86.30	$2,877,626
A.12	Terminal aircraft apron expansion and taxiway connection to GA apron including edge lighting and restoration	long-term	9,742	lump sum	$109.00	$1,061,878
A.13	Fine grading, topsoiling, seeding and general restoration following initial runway and taxiway and apron construction	short-term	626,425	lump sum	$2.40	$1,503,421
A.14	New airfield lighting system for runway and taxiways including cables in duct, edge/end/thresh. lights, approach lights, PAPIs, windsocks, aerodrome beacon, etc.	short-term	1	lump sum	$2,778,400.00	$2,778,400
B.	**PASSENGER TERMINAL BUILDING & LANDSIDE**					**$15,685,555**
B.1	New Passenger Terminal Building including siteworks, mechanical, electrical, plumbing, fire protection, HVAC, specialities and baggage conveyors	short-term	1,122	sq. feet	$615.00	$12,990,030
B.2	New Passenger Terminal Building - furniture, fitings and fixtures including security equipment	short-term	1	lump sum	$475,000.00	$475,000
B.3	1200 kW back-up diesel generator including controls and fuel tank	short-term	1	lump sum	$430,000.00	$430,000
B.4	Rental car lot and taxi holding area	short-term	1,428	sq. yard	$84.00	$119,933
B.5	Remote bus parking lot and entrance	medium-term	1,528	sq. yard	$84.00	$128,352
B.6	Terminal frontage road (one-way, single lane plus loading/unloading lane)	short-term	2,671	sq. yard	$84.00	$224,355
B.7	Public parking lot (75 spaces) including lighting	short-term	3,379	sq. yard	$105.00	$354,772
B.8	Terminal frontage concrete walkway	short-term	722	sq. yard	$71.00	$51,278
B.9	Airside GSE pavement and connection road between landside and airside	short-term	3,871	sq. yard	$84.00	$325,136
B.10	Airside passenger concrete walkway	short-term	200	sq. yard	$62.00	$12,400
B.11	Terminal building site services (power, sewage, water supply, communications)	short-term	1	lump sum	$300,000.00	$300,000
B.12	General grading , topsoiling, seeding and restoration	short-term	21,111	sq. yard	$3.60	$76,000
B.13	General lansdscaping and protection curbs	short-term	1	lump sum	$100,000.00	$100,000
B.14	New 8 ft high perimeter security fence with barb wire	short-term	1,675	feet	$36.00	$60,300
B.15	New airside access gate (motorized slide gate) including power supply and controls	short-term	1	each	$38,000.00	$38,000
C.	**COMBINED SERVICES BUILDING**					**$2,080,680**
C.1	New Combined Services Building including siteworks, mechanical, electrical, plumbing, fire protection, HVAC, specialities and provisions for future air traffic control cab	short-term	5,670	sq. feet	$291.00	$1,649,970
C.2	500 kW back-up diesel generator with controls and fuel tank	short-term	1	lump sum	$240,000.00	$240,000
C.3	New water reservoir including pump, wiring and distribution piping	short-term	1	lump sum	$40,000.00	$40,000
C.4	Connection to water supply and sewage outfall.	short-term	1	lump sum	$12,000.00	$12,000
C.5	Building power and communication services from main supply	short-term	1	lump sum	$13,000.00	$13,000
C.6	Airside access and maneuvering pavements	short-term	667	sq. yard	$75.00	$50,000
C.7	New 8 ft high perimeter security fence with barb wire	short-term	370	feet	$36.00	$13,320
C.8	Staff parking lot and road entrance pavement	short-term	848	sq. feet	$71.00	$60,224
C.9	Concrete walkway	short-term	36	sq. yard	$60.00	$2,167
		SUBTOTAL DIRECT CAPITAL CONSTRUCTION COST				**$48,544,838**

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The overall costs of this substantial development are over $60 million and split fairly evenly between airside and landside development costs but the airport will be a wonderful gateway to North Eleuthera.

Location Factor (Note 2)	3.00%	$1,456,345
Project Management and Architectural/Engineering Costs (Note 1)	15.00%	$7,281,726
Design Contingency	10.00%	$4,854,484
Construction Contingency	5.00%	$2,427,242
SUBTOTAL PROJECT SOFT COSTS		**$16,019,796**
Estimate of Probable Capital Costs - Total		**$64,564,634**
Short-term Capital Works (1-3 Years)		**$60,013,918**
Medium-term Capital Works (4-10 Years)		**$3,138,418**
Long-term Capital Works (11-20 Years)		**$1,412,298**
CAPITAL PLAN WORKS - TOTAL		**$64,564,634**

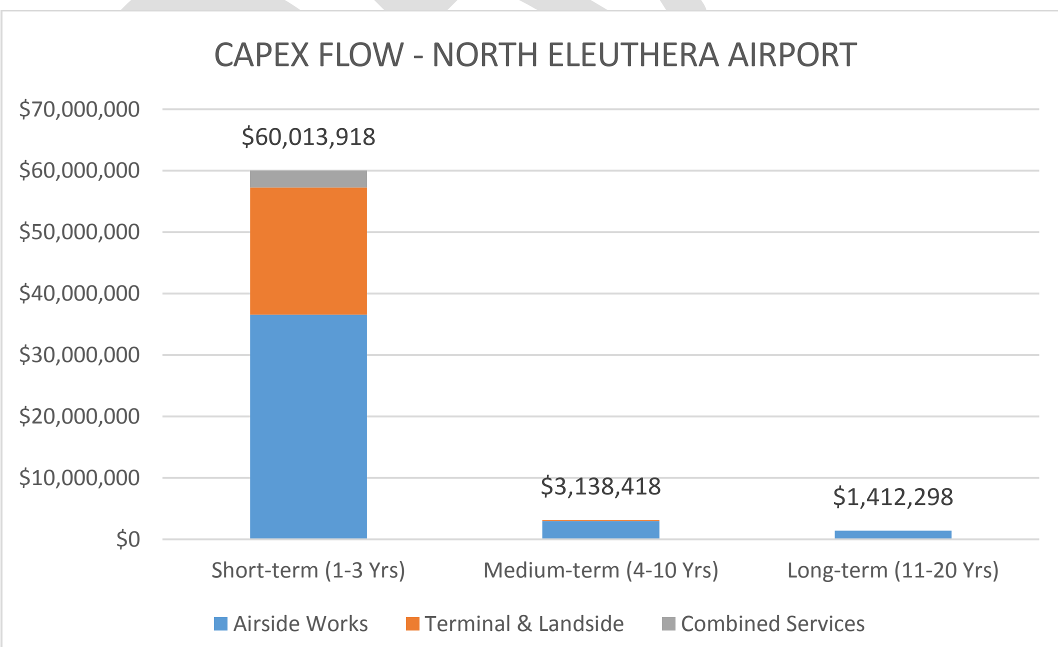
Notes:

1. Includes costs related to pre-engineering surveys, geotechnical investigations, architectural/engineering design, approvals, tendering, construction supervision and inspections, and commissioning and certification.
2. Location factor represents the additional costs associated with the remoteness of the project site and lack of local trades, which may include the additional costs for shipping of materials and equipment and airfare, room and board for project staff.

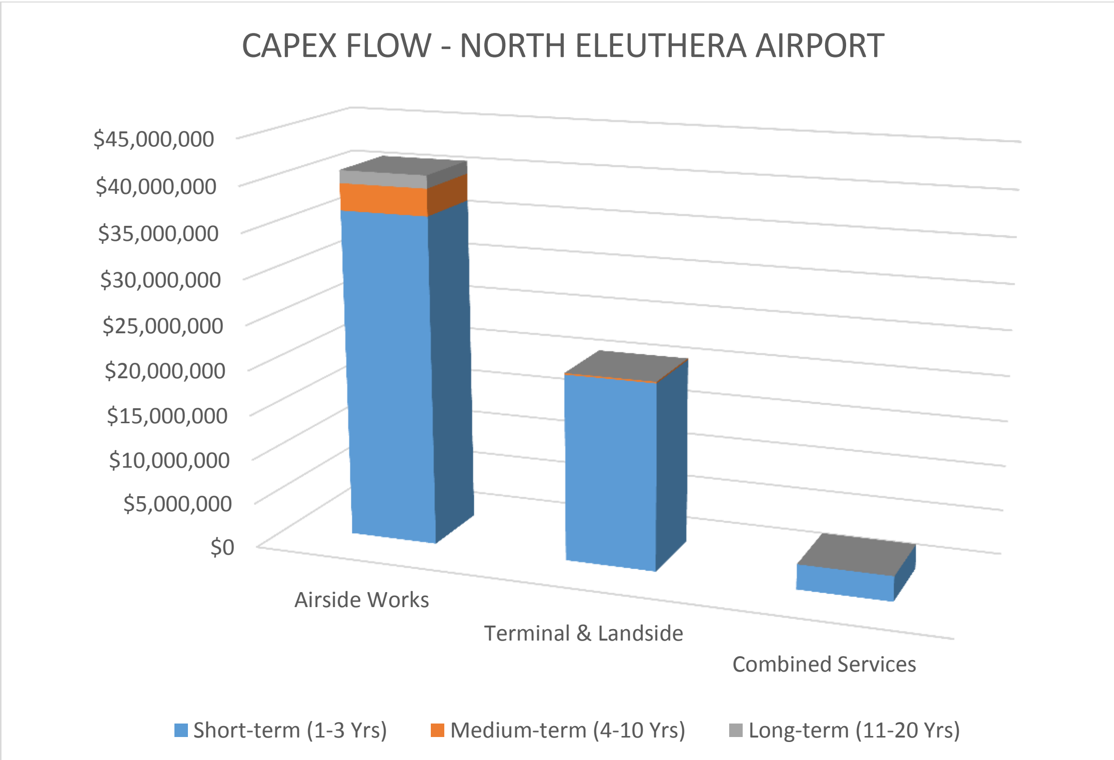
9.2 IMPLEMENTATION PLAN AND STRATEGY

The airport has a significant airside infrastructure challenge and the recommended solution is a new runway with a conversion of the existing runway into a parallel taxiway. There are significant issues related to both facility deficiencies and capacity on passenger processing. The priority is to build a new runway and, in parallel, design a new terminal adjacent to a new apron. A combined services facility is also required. This is a significant investment and the costliest of the airport developments but the spend will basically provide the government with a new airport.

There will be very little remedial airside work needed in the future.



Even though the priority is the airside, the need and impact of a new terminal and landside areas (as well as the CSB) provides a new gateway to North Eleuthera and will heighten the region's attractive tourism market and instill new development potential into the region.



Appendix 1: Structured Interview Form

1. In general, how do you believe that the Airport is viewed by the local business community? Provide suitable adjectives.

2. In general, how do you believe that the Airport is viewed by the general public and leisure travellers? Provide suitable adjectives.

3. How well do you believe that the Airport is currently serving the needs of the local business community and benefiting the Region's economy? If not well, how could the Airport better serve the business community and/or local economy?

4. How well do you believe that the Airport is currently serving the needs of leisure travellers and benefiting the tourism industry within the Region? If not well, how could the Airport better serve the leisure traveller?

5. Following on from the foregoing questions, what do you believe will be the key external factors which will drive passenger and cargo traffic growth in the future (next 5-10 years) at San Salvador Airport? And why?
    - Changes in industrial activity or realization of new industrial / commercial opportunities.
    - Changes in tourism related activities / initiatives.
    - Changes in Federal or Provincial regulations and/or initiatives.
    - Changes in airline / service provider levels of service and frequency.
    - Changes in population demographics (i.e. increase in aging population, etc.)
    - Other changes. Please specify.

The Airport has a relatively large overall land base. As a result, there is a reasonable amount of excess lands which the airport can use to generate additional non-aeronautical revenues. What do you believe are worthwhile opportunities for these excess lands which the airport should explore? And why?

- Business Park.
- Residential subdivision, potentially with aviation access.
- Divest of excess lands (sell-off to other parties).
- Natural buffer (treed/vegetated).

Over the past few years, the accessibility to greater scheduled airline choices and competitive pricing has increased the local demand for air travel. What factors or influences do you believe would have the greatest impact on further increasing demand for passenger and/or cargo activity? And why?

- Direct passenger connections to North American destinations.
- Increase in scheduled flight frequency (daily or weekly).
- Greater competition / choice among airlines / service providers
- Improved terminal facilities and services (passenger and cargo).

- Greater accessibility to the Airport and its services.
- Better promotion of the Airport and its services.
- Other factors or influences. Explain.

What specific on-Airport services or infrastructure do you believe are presently lacking or not existent which could increase the demand for and viability of the Airport?

Are there positive linkages between the Airport and business / industries / organizations which have yet to be explored and nurtured?

Are there local businesses or industries which you believe could significantly benefit from increased use of Airport services? Explain.

Appendix 2: Renewable Energy Technical Assessment Outputs

Photovoltaic Assessment

RETScreen Energy Model - Power project

☐ Show alternative units

Proposed case power system | **Incremental initial costs**

Technology		Photovoltaic	
Analysis type		◉ Method 1 ○ Method 2	
Photovoltaic			
Power capacity	kW	10.00	$ 25,000
Manufacturer			
Model			
Capacity factor	%	25.0%	
Electricity exported to grid	MWh	21.9	
Electricity export rate	$/MWh	34.00	

See product database

Emission Analysis

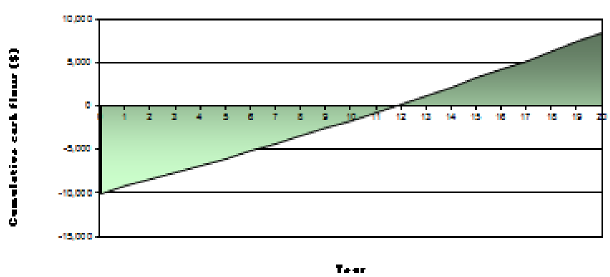
Base case electricity system (Baseline) Country - region	Fuel type	GHG emission factor (excl. T&D) tCO2/MWh	T&D losses %	GHG emission factor tCO2/MWh
Bahamas	Oil (#6)	0.700	15.0%	0.824
Electricity exported to grid	MWh	22	T&D losses	

GHG emission					
Base case	tCO2	18.0			
Proposed case	tCO2	0.0			
Gross annual GHG emission reduction	tCO2	18.0			
GHG credits transaction fee	%				
Net annual GHG emission reduction	tCO2	18.0	is equivalent to	3.3	Cars & light trucks not used
GHG reduction income					
GHG reduction credit rate	$/tCO2				

Financial Analysis

Financial parameters			
Inflation rate	%	2.0%	
Project life	yr	20	
Debt ratio	%	60%	
Debt interest rate	%		
Debt term	yr		
Initial costs			
Power system	$	25,000	100.0%
Other	$		0.0%
Total initial costs	$	25,000	100.0%
Incentives and grants	$		0.0%
Annual costs and debt payments			
O&M (savings) costs	$		
Fuel cost - proposed case	$	0	
Debt payments - 0 yrs	$	#NUM!	
	$		
Total annual costs	$	#NUM!	
Annual savings and income			
Fuel cost - base case	$	0	
Electricity export income	$	745	
	$		
Total annual savings and income	$	745	
Financial viability			
Pre-tax IRR - equity	%	6.2%	
Pre-tax IRR - assets	%	-2.6%	
Simple payback	yr		
Equity payback	yr	11.8	

Cumulative cash flows graph



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Wind Turbine Assessment

RETScreen Energy Model - Power project

☐ Show alternative units

Proposed case power system

Incremental initial costs

Technology		Wind turbine		
Analysis type		◉ Method 1 ○ Method 2 ○ Method 3		
Wind turbine				
Power capacity	kW	4.0	$ 25,000	See product database
Manufacturer		Atlantic Orient		
Model		AOC 8/12 - 25m	1 unit(s)	
Capacity factor	%	60.0%		
Electricity exported to grid	MWh	21		
Electricity export rate	$/MWh	34.00		

Emission Analysis

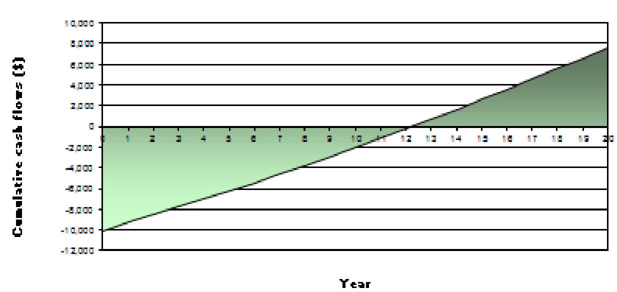
Base case electricity system (Baseline) **Country - region**	**Fuel type**	**GHG emission factor (excl. T&D)** **tCO2/MWh**	**T&D losses** **%**	**GHG emission factor** **tCO2/MWh**
Bahamas	Oil (#6)	0.700	15.0%	0.824

Electricity exported to grid	MWh	21	T&D losses		
GHG emission					
Base case	tCO2	17.3			
Proposed case	tCO2	0.0			
Gross annual GHG emission reduction	tCO2	17.3			
GHG credits transaction fee	%				
Net annual GHG emission reduction	tCO2	17.3	is equivalent to	3.2	Cars & light trucks not used
GHG reduction income					
GHG reduction credit rate	$/tCO2				

Financial Analysis

Financial parameters			
Inflation rate	%	2.0%	
Project life	yr	20	
Debt ratio	%	60%	
Debt interest rate	%		
Debt term	yr		
Initial costs			
Power system	$	25,000	100.0%
Other	$		0.0%
Total initial costs	$	25,000	100.0%
Incentives and grants	$		0.0%
Annual costs and debt payments			
O&M (savings) costs	$		
Fuel cost - proposed case	$	0	
Debt payments - 0 yrs	$	#NUM!	
	$		
Total annual costs	$	#NUM!	
Annual savings and income			
Fuel cost - base case	$	0	
Electricity export income	$	715	
	$		
Total annual savings and income	$	715	
Financial viability			
Pre-tax IRR - equity	%	5.7%	
Pre-tax IRR - assets	%	-2.3%	
Simple payback	yr		
Equity payback	yr	12.2	

Cumulative cash flows graph



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Solar Domestic Hot Water Assessment

RETScreen Energy Model - Heating project

Heating project

Technology		**Solar water heater**				
Load characteristics						
Application		○ Swimming pool				
		◉ Hot water				
	Unit	**Base case**	**Proposed**			
Load type		Other				
Daily hot water use	L/d	1,000	1,000			
Temperature	°C	35	35			
Operating days per week	d	80	80			
☐ **Percent of month used**						
Supply temperature method		Formula				
Water temperature - minimum	°C	25.0				
Water temperature - maximum	°C	26.1				
	Unit	**Base case**	**Proposed case**	**Energy saved**	**Incremental initial costs**	
Heating	MWh	4.0	4.0	0%		
Resource assessment						
Solar tracking mode		Fixed				
Slope	°	35.0				
Azimuth	°	0.0				
☐ **Show data**						
Solar water heater						
Type		Glazed			$ 8,000	See technical note
Manufacturer		ACR Solar International				See product database
Model		Fireball Fireball 2001				
Gross area per solar collector	m²	1.87				
Aperture area per solar collector	m²	1.72				
Fr (tau alpha) coefficient		0.60				
Fr UL coefficient	(W/m²)/°C	3.73				
Temperature coefficient for Fr UL	(W/m²)/°C²	0.000				
Number of collectors		1	1			
Solar collector area	m²	1.87				
Capacity	kW	1.20				
Miscellaneous losses	%	10.0%				
Balance of system & miscellaneous						
Storage		No				
Heat exchanger	yes/no	No				
Miscellaneous losses	%	10.0%				
Pump power / solar collector area	W/m²	10.00				
Electricity rate	$/kWh	0.350				
Summary						
Electricity - pump	MWh	0.1				
Heating delivered	MWh	1.9				
Solar fraction	%	48%				
Heating system						
☐ Project verification		**Base case**	**Proposed**			
Fuel type		Electricity	Electricity			
Seasonal efficiency		80%	80%			
Fuel consumption - annual	MWh	5.0	2.6	MWh		
Fuel rate	$/kWh	0.350	0.350	$/kWh		
Fuel cost	$	1,755	910			

Emission Analysis

Base case electricity system (Baseline)

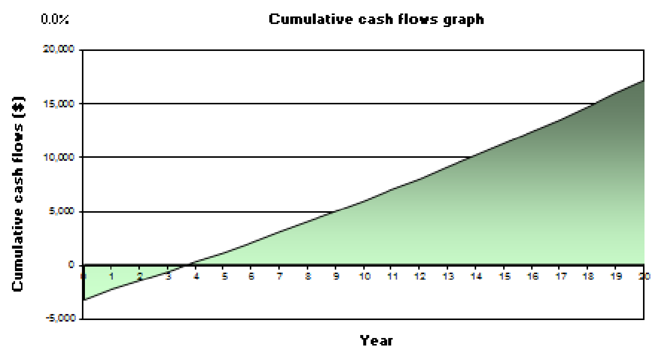
Country - region	Fuel type	GHG emission factor (tCO2/MWh)	T&D losses (%)	GHG emission factor (tCO2/MWh)
Bahamas	Oil (#6)	0.700	15.0%	0.824

GHG emission				
Base case	tCO2	4.1		
Proposed case	tCO2	2.2		
Gross annual GHG emission reducti	tCO2	1.9		
GHG credits transaction fee	%			
Net annual GHG emission reduction	tCO2	1.9	is equivalent to	0.4 Cars & light trucks not used

GHG reduction income		
GHG reduction credit rate	$/tCO2	

Financial Analysis

Financial parameters			
Inflation rate	%	2.0%	
Project life	yr	20	
Debt ratio	%	60%	
Debt interest rate	%		
Debt term	yr		
Initial costs			
Heating system	$	8,000	100.0%
Other	$		0.0%
Total initial costs	$	8,000	100.0%
Incentives and grants	$		0.0%
Annual costs and debt payments			
O&M (savings) costs	$		
Fuel cost - proposed case	$	932	
Debt payments - 0 yrs	$	#NUM!	
Other	$		
Total annual costs	$	#NUM!	
Annual savings and income			
Fuel cost - base case	$	1,755	
Other	$		
Total annual savings and income	$	1,755	
Financial viability			
Pre-tax IRR - equity	%	28.0%	
Pre-tax IRR - assets	%	10.3%	
Simple payback	yr		
Equity payback	yr	3.7	



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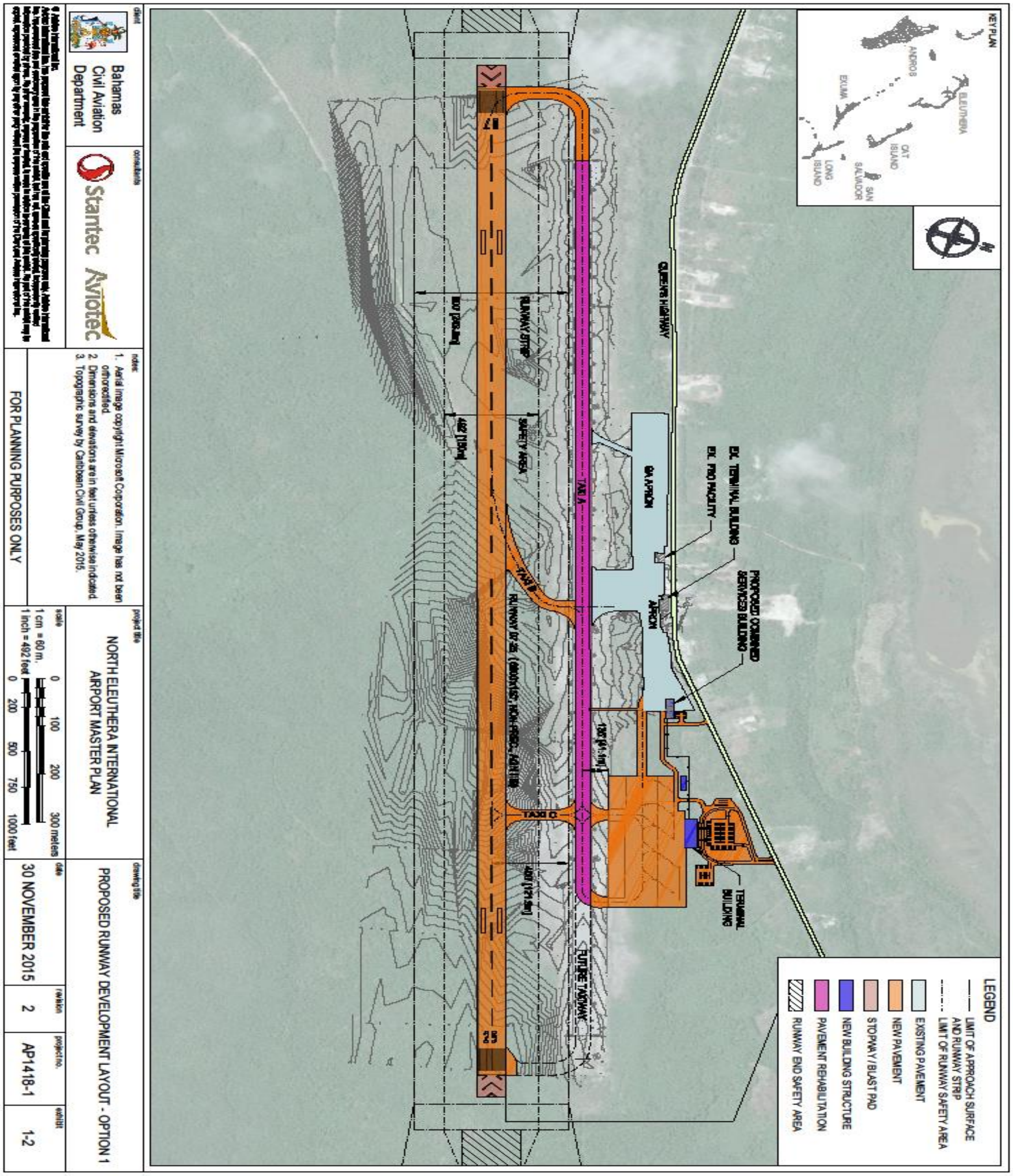
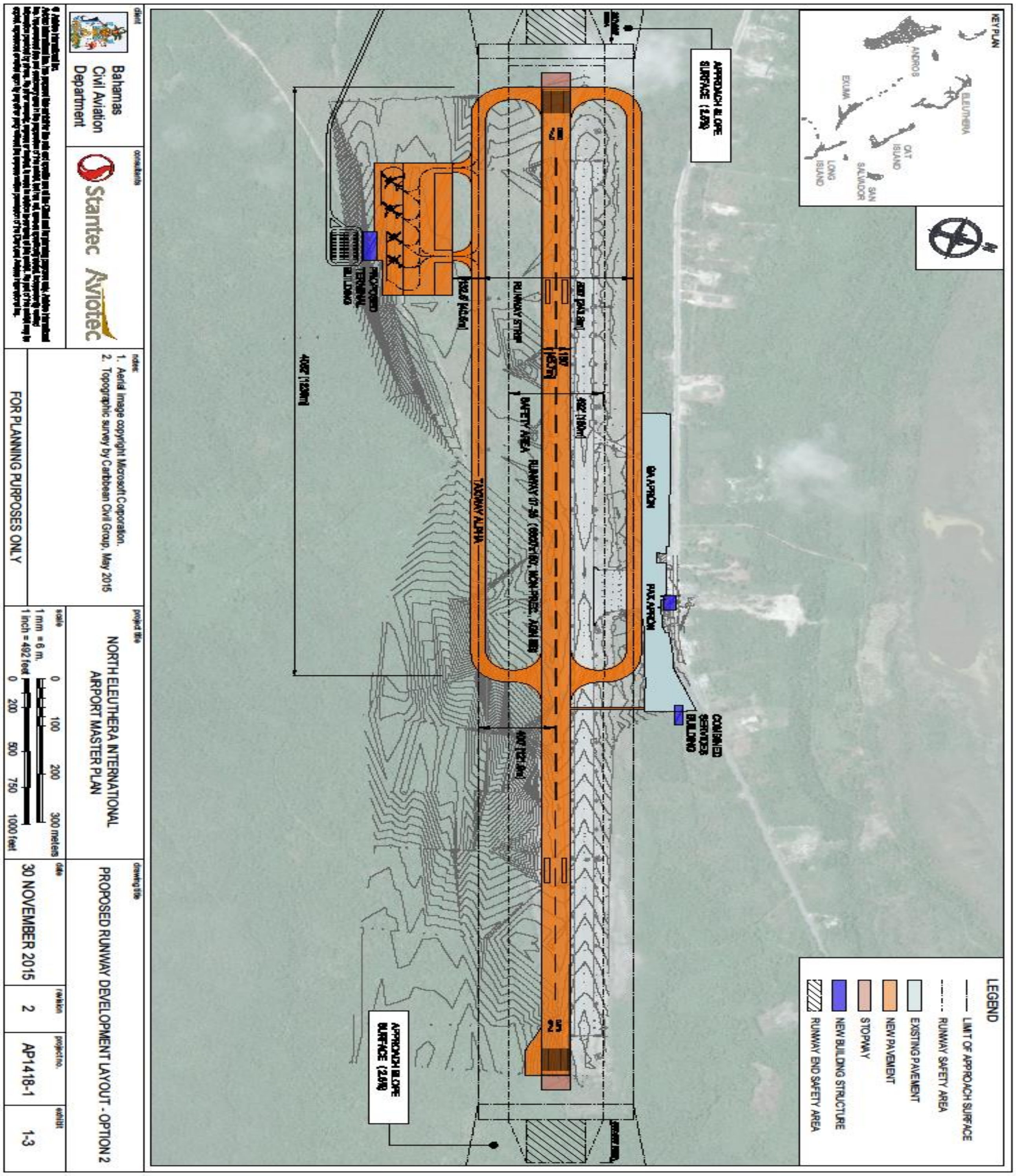
Appendix 3: Proposed Rwy Development Layout – Option 1



Appendix 4: Proposed Rwy Development Layout – Option 2



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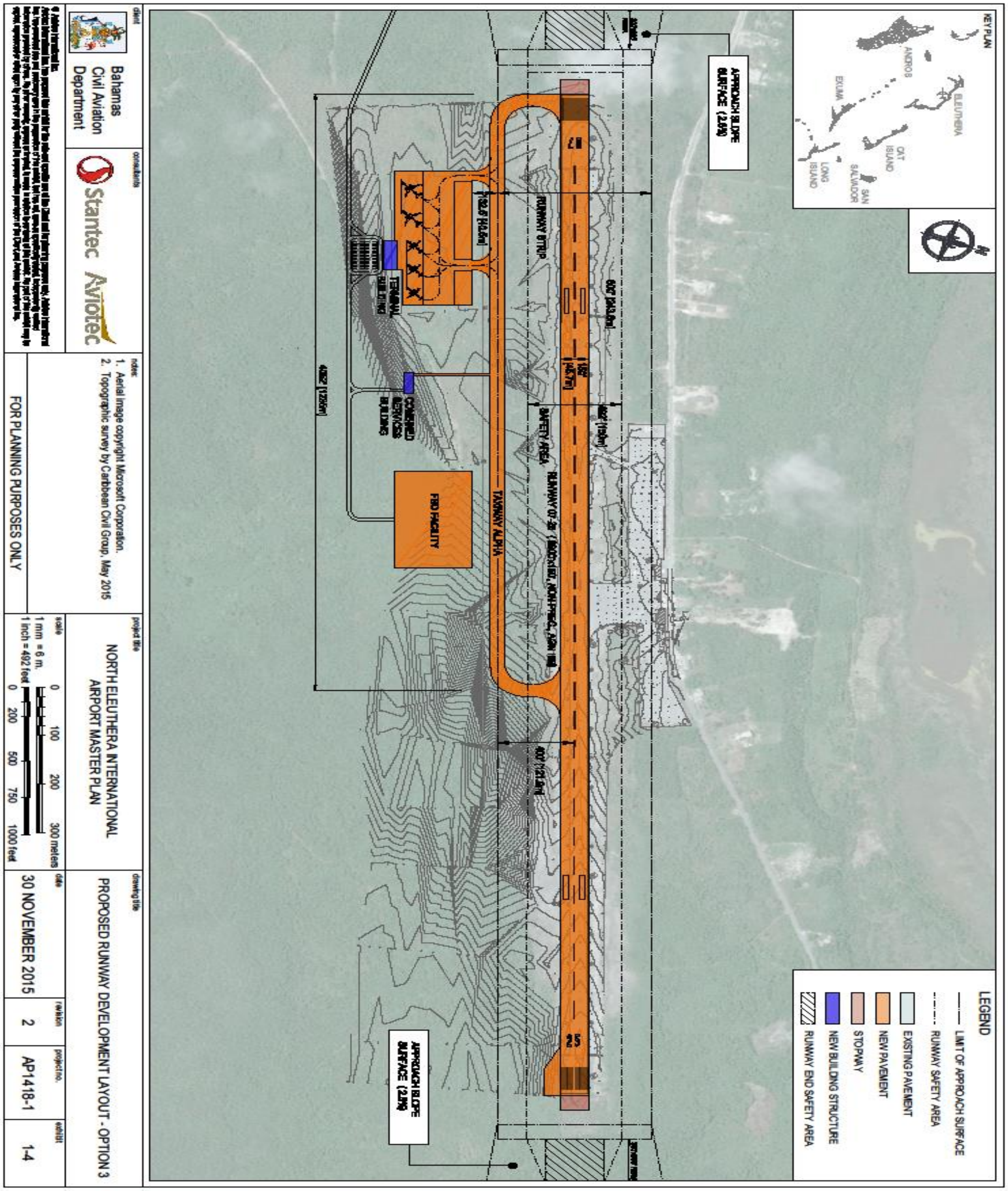
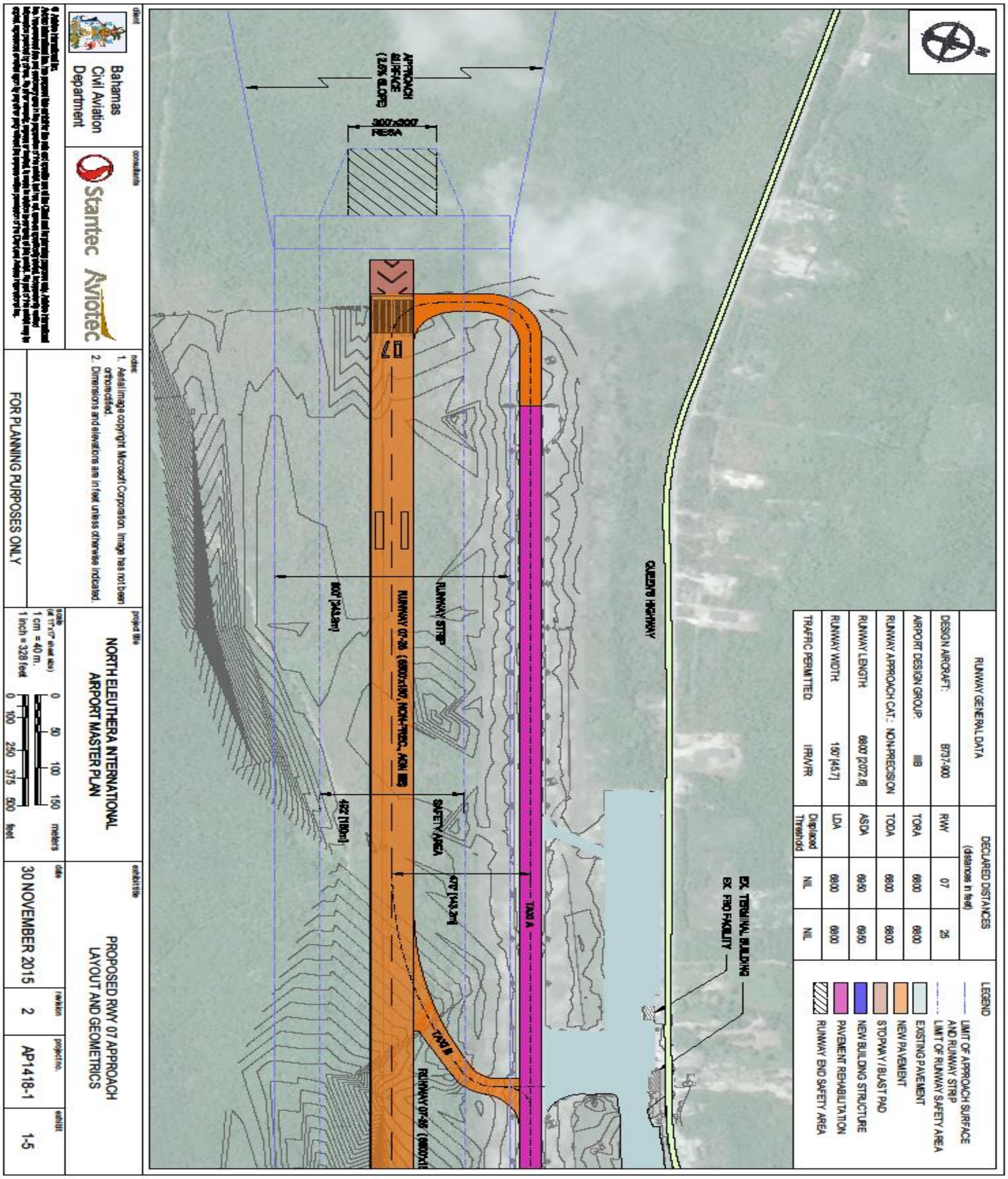
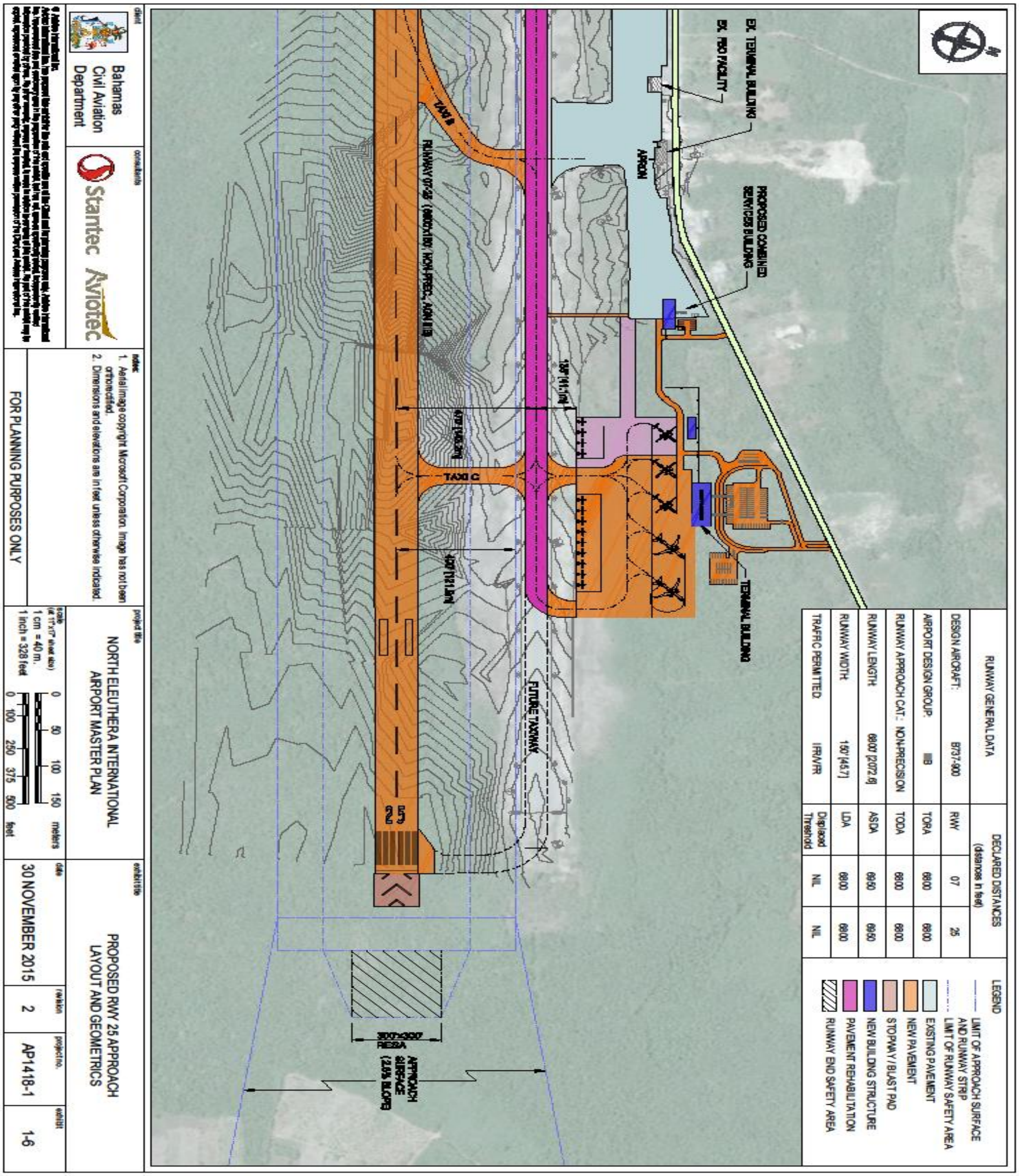
Appendix 5: Proposed Rwy Development Layout – Option 3



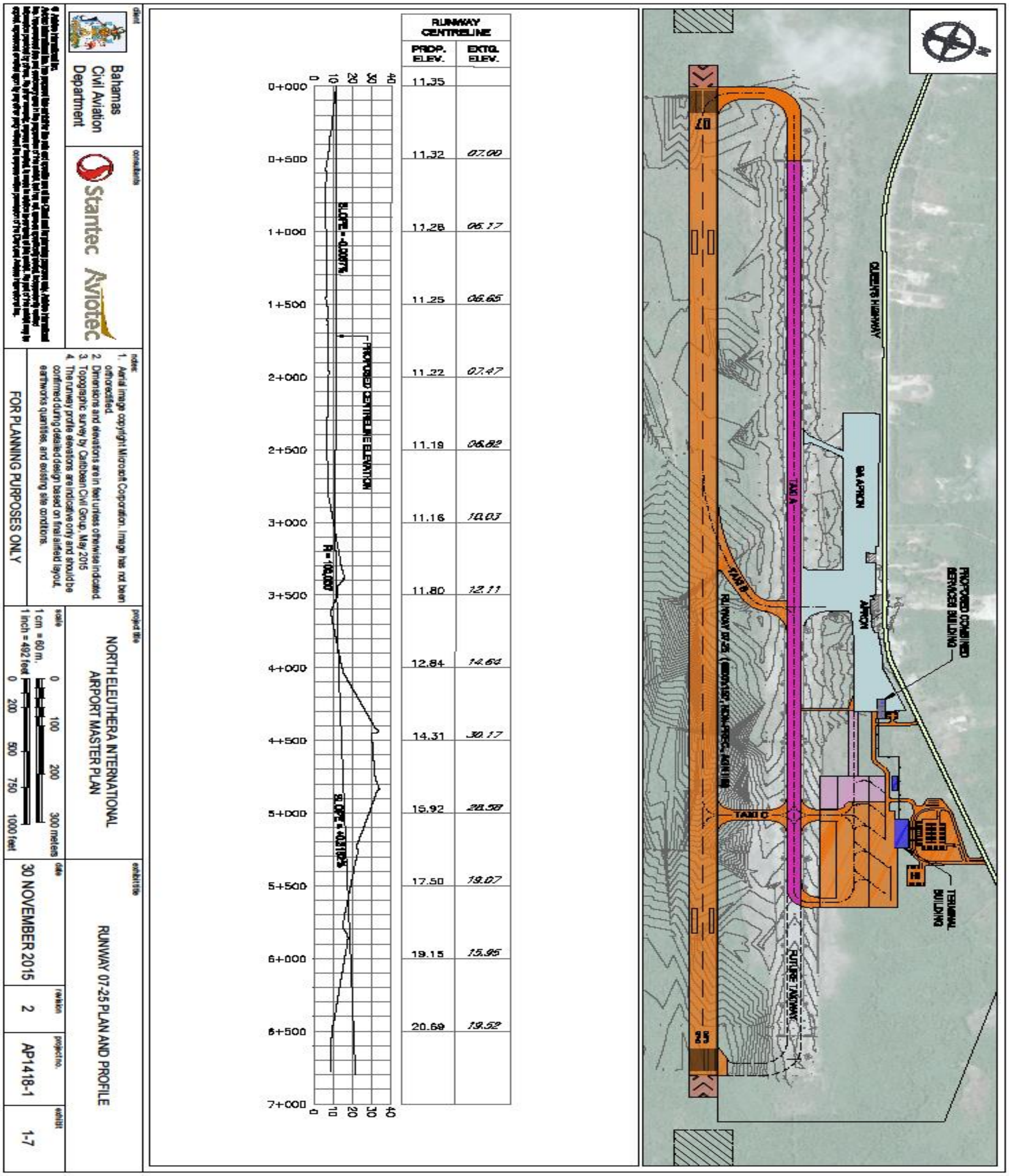
Appendix 6: Proposed Rwy 07 Approach Layout & Geometrics



Appendix 7: Proposed Rwy 25 Approach Layout & Geometrics



Appendix 8: Runway 07 - 25 Plan and Profile



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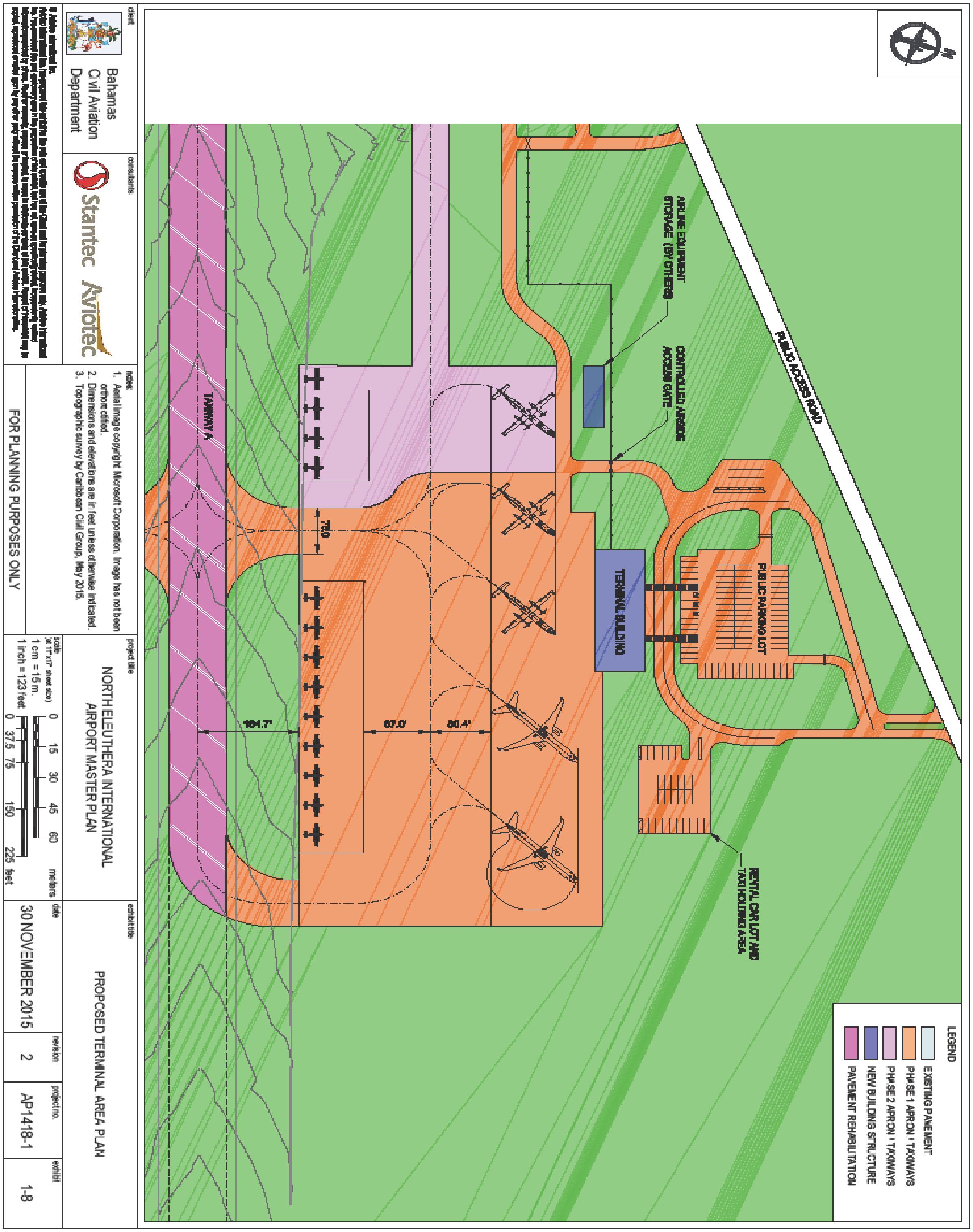
Appendix 9: Proposed Terminal Apron Plan



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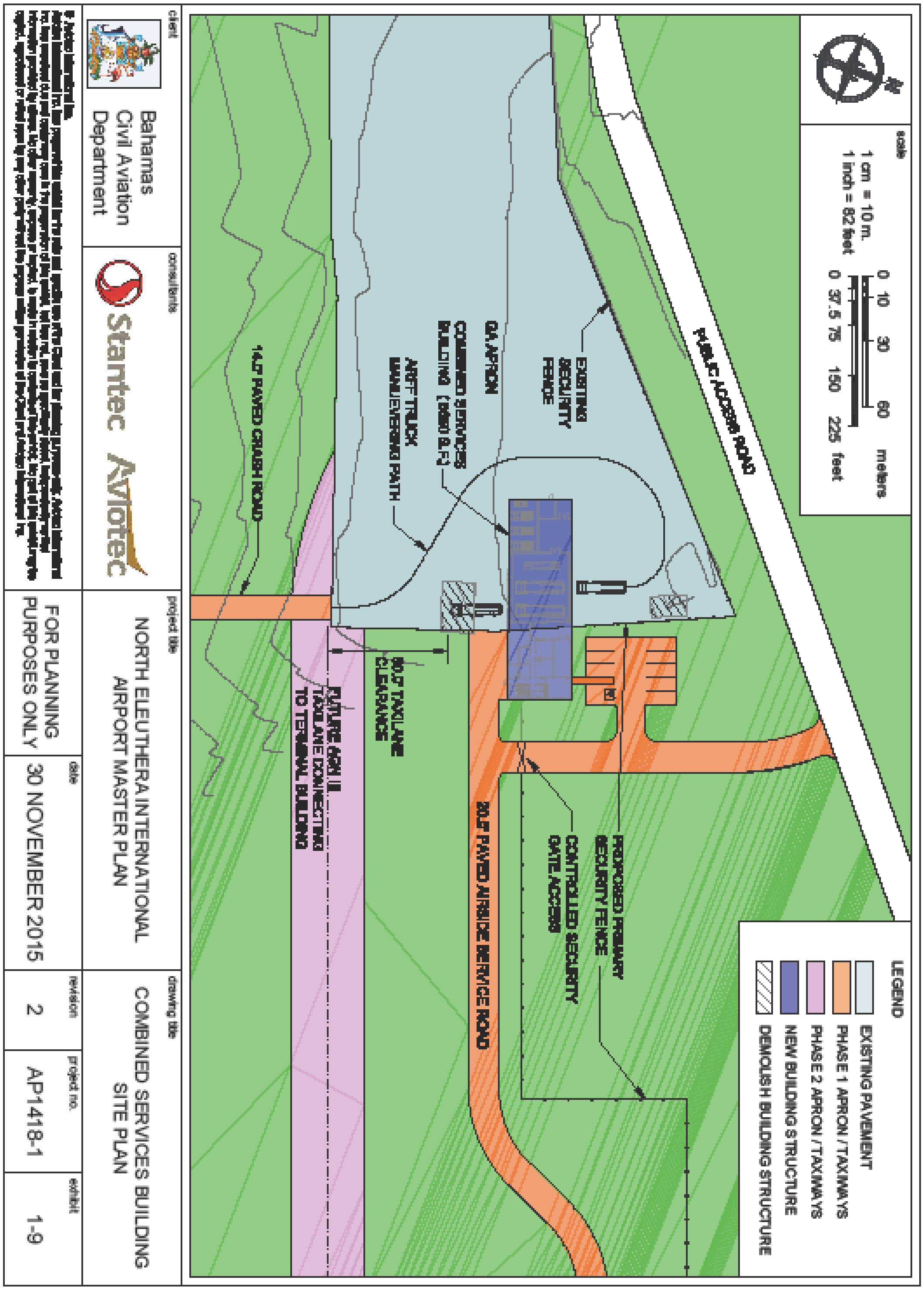
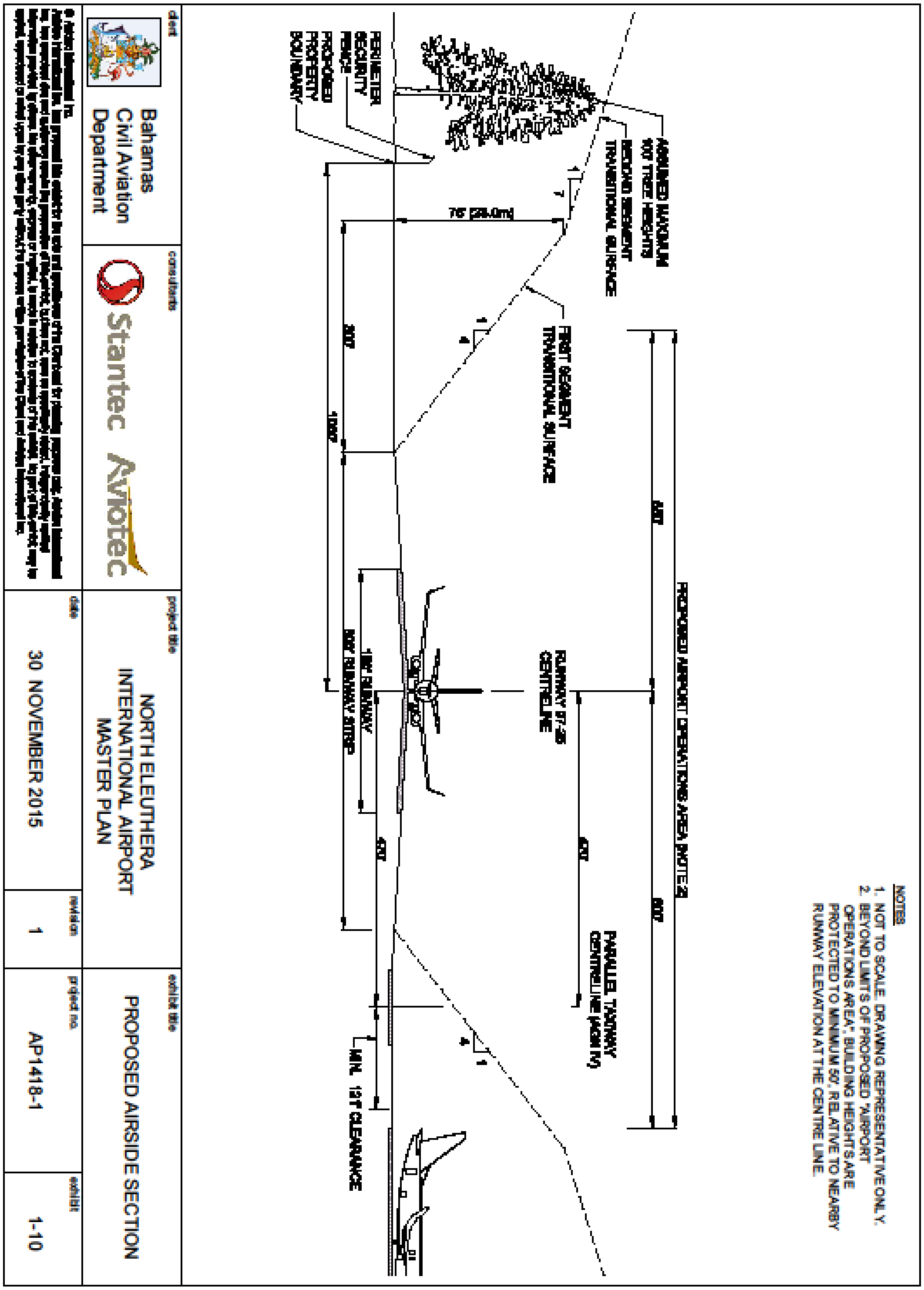
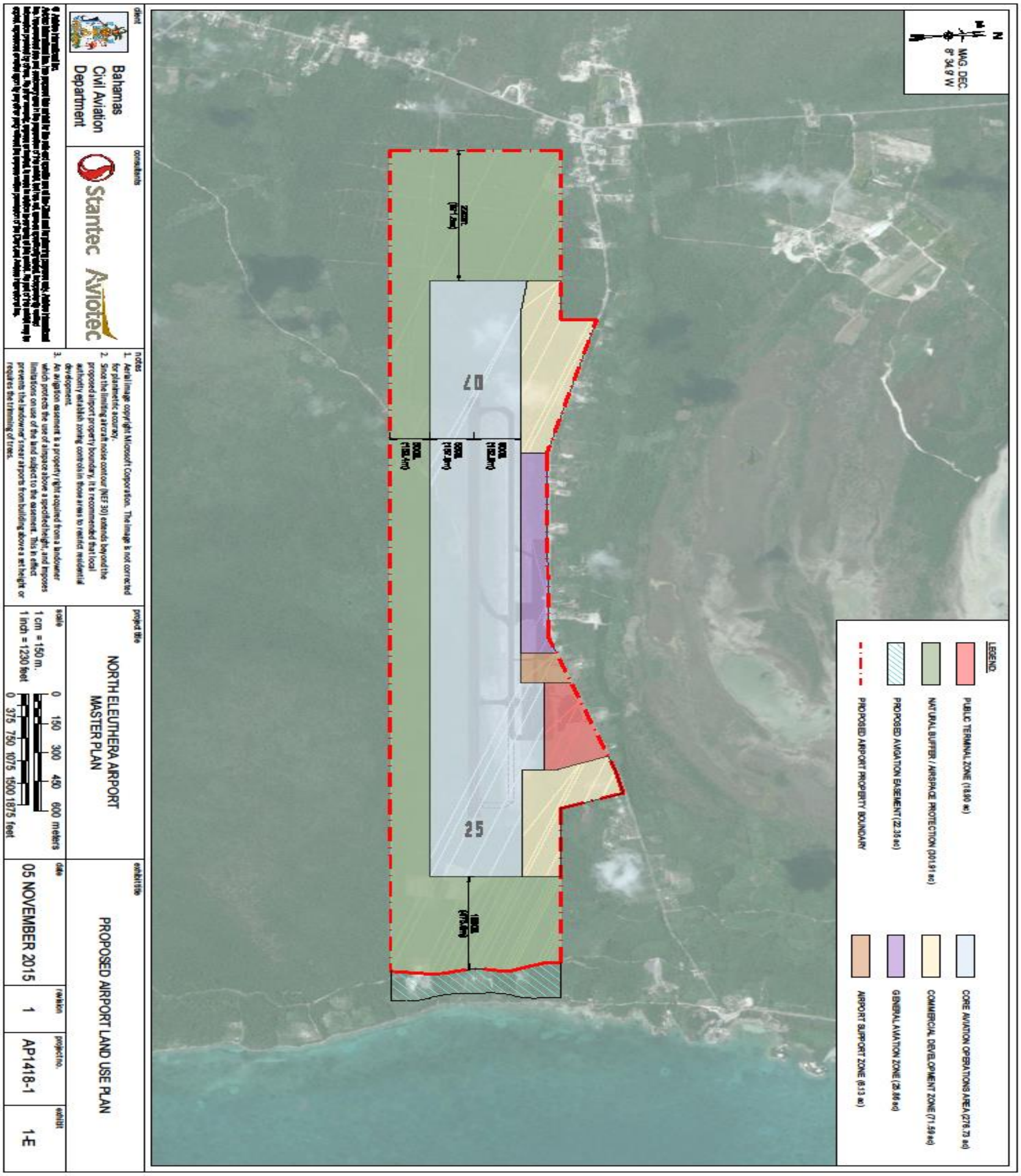
Appendix 10: Combined Services Building Site Plan



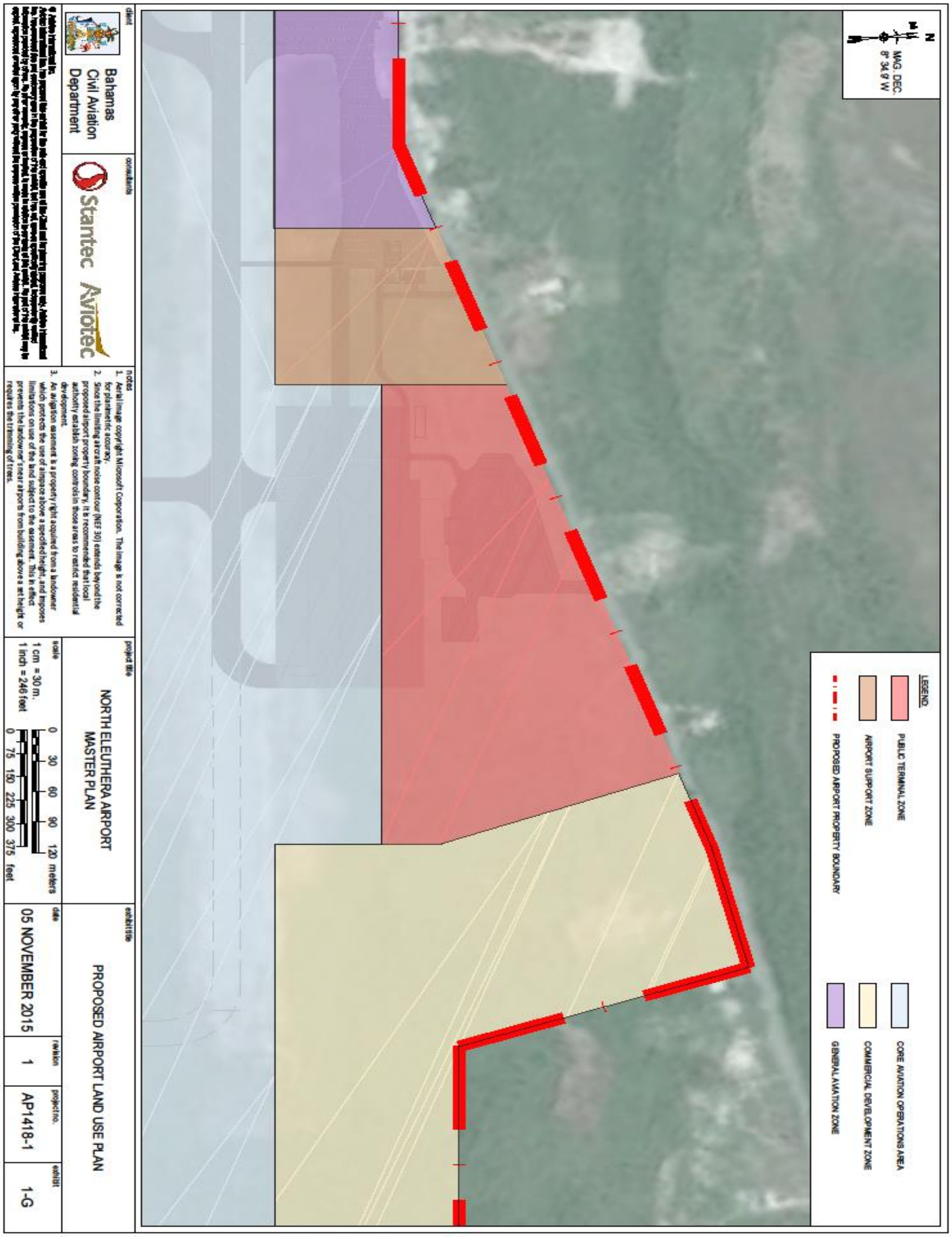
Appendix 11: Proposed Airside Section



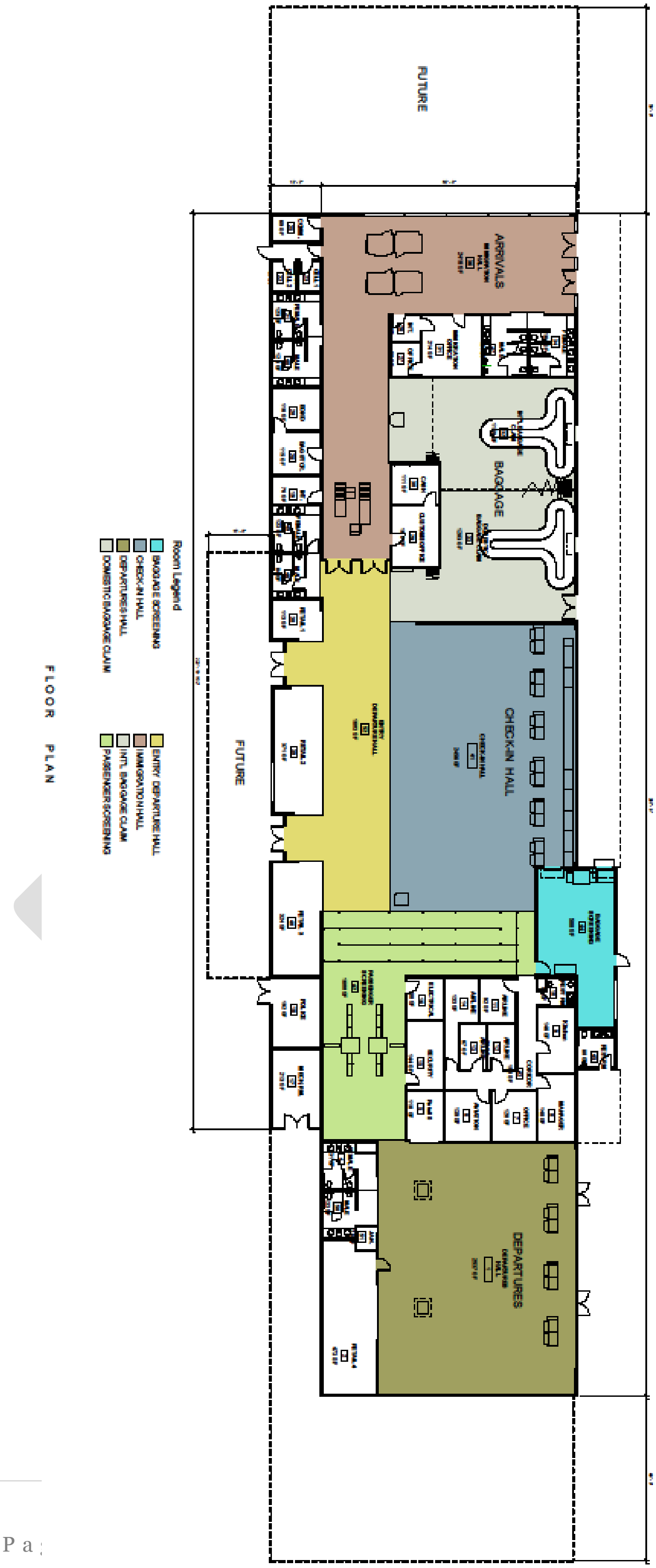
Appendix 12: Proposed Airport Land Use Plan



Appendix 13: Proposed Terminal Area Land Use Plan

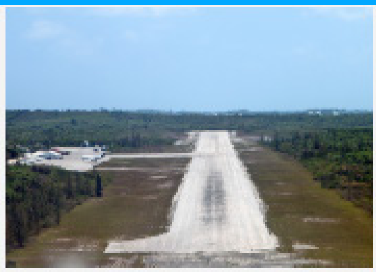


Appendix 14: Proposed Terminal Layout



Ministry of Transport and Aviation and Department of Civil Aviation

North Eleuthera Airport Master Plan
Eleuthera, Family Islands, Bahamas



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