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CHAPTER 1 AIRPORT MASTER PLANNING PROCESS

Introduction

- 1.1 An airport master plan provides recommendations for the future development of an airport, often over a 20-year horizon. The master plan serves as a blueprint that guides the development strategy and direction for an airport and as a ready reference for the airport community and other stakeholders.
- 1.2 As Hong Kong International Airport (HKIA) is an international gateway, its master plan must factor in not only the latest developments in air transport activity and the competitive landscape of the aviation industry, but also all relevant global, regional and local economic developments, including the recent financial crisis and global economic downturn. The strategic importance of the airport, long construction lead time required under a live airport environment and the interlocking effects of new facilities on airport operations combine to make planning critical. Airport Authority Hong Kong (AAHK) meets this challenge with a three-tier planning process, comprising an annual budget; a rolling five-year plan; and a 20-year master plan that is updated every five years. Under the three-tier planning process, and in light of its business strategies and operational requirements, AAHK reviews and explores the requirements for additional infrastructure to fulfil future air traffic demand, including where to locate these new facilities and how to effectively integrate them into the airport's operations.
- 1.3 Development of a master plan usually starts with projection of air traffic demand, a review of the airfield configuration (which mainly comprises the runway and taxiway system), air traffic movements (ATMs, also known as flight movements; each one defined as a single takeoff or landing), and the practical maximum capacity that the configuration can provide. Following the development of a forecast for the ATMs and their distribution over a single day, a review is done on the optimal development and location of the passenger processing terminal¹, passenger concourse² and aircraft parking apron. This impacts the location and development strategies for surface access (road and rail), landside transportation systems, and aviation support facilities and infrastructure (including cargo terminals, aircraft maintenance, catering, etc.).
- 1.4 The planning process recognises and incorporates environmental, economic, operational, construction and other technical aspects, while ensuring overall safety standards and the integrity of airport operations.
- 1.5 HKIA's 20-year master planning process can be summarised as follows:
- Development of a 20-year air traffic projection for HKIA;
 - Stock-taking of current inventory of airport facilities/infrastructure;

¹ A passenger processing terminal is the facility that processes passengers before departure (incorporating functions such as check-in, security screening, immigration clearance, etc.) and after arrival (incorporating functions such as immigration clearance, baggage reclaim, customs inspection and transfer to ground transportation).

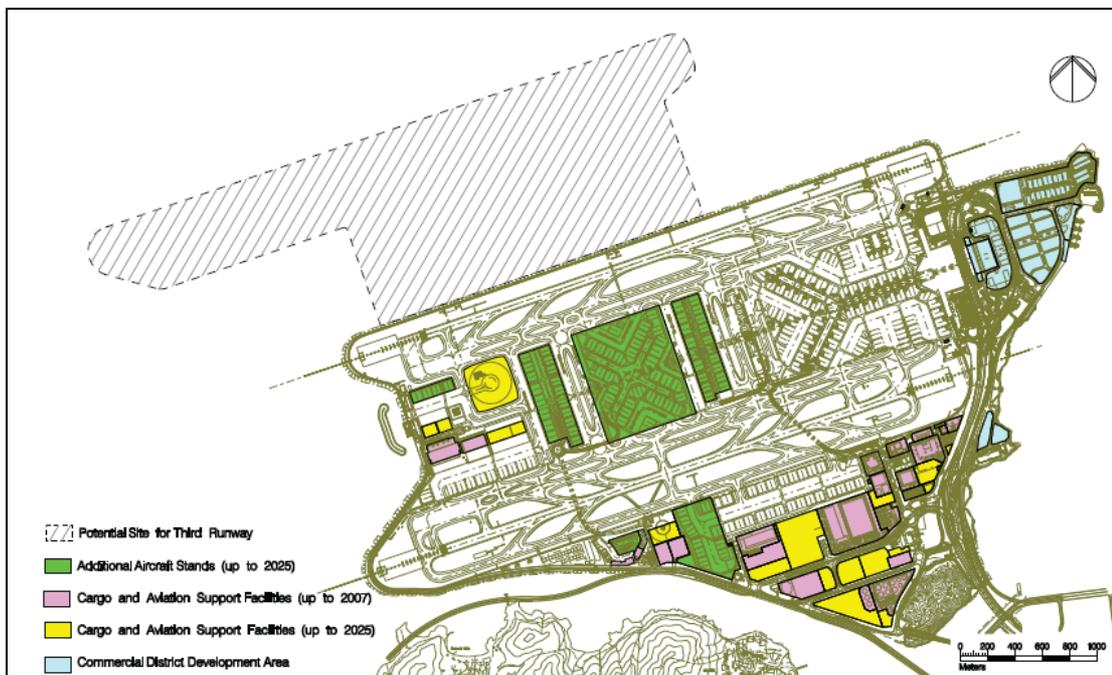
² A passenger concourse is the area where the aircraft boarding gates are located for passengers to embark and disembark the aircraft.

- Development of “Busy Hour Demand Forecasts” for airport facilities/infrastructure;
- Translation into future airport facility/infrastructure requirements;
- Evaluation of supply/capacity shortfalls;
- Development of various airport layout concepts;
- Evaluation of multiple criteria;
- Preliminary engineering and environmental feasibility assessments;
- Recommendations on the preferred airport layout plan; and
- Cost and economic benefit analysis.

Continuation of Master Plan 2025

1.6 The following diagram shows the airport layout plan derived under the HKIA Master Plan 2025 (MP2025) planning process. This indicative concept layout of HKIA has been reviewed under the current planning process.

Figure 1.1 : HKIA Master Plan 2025 – Potential Land Use Plan



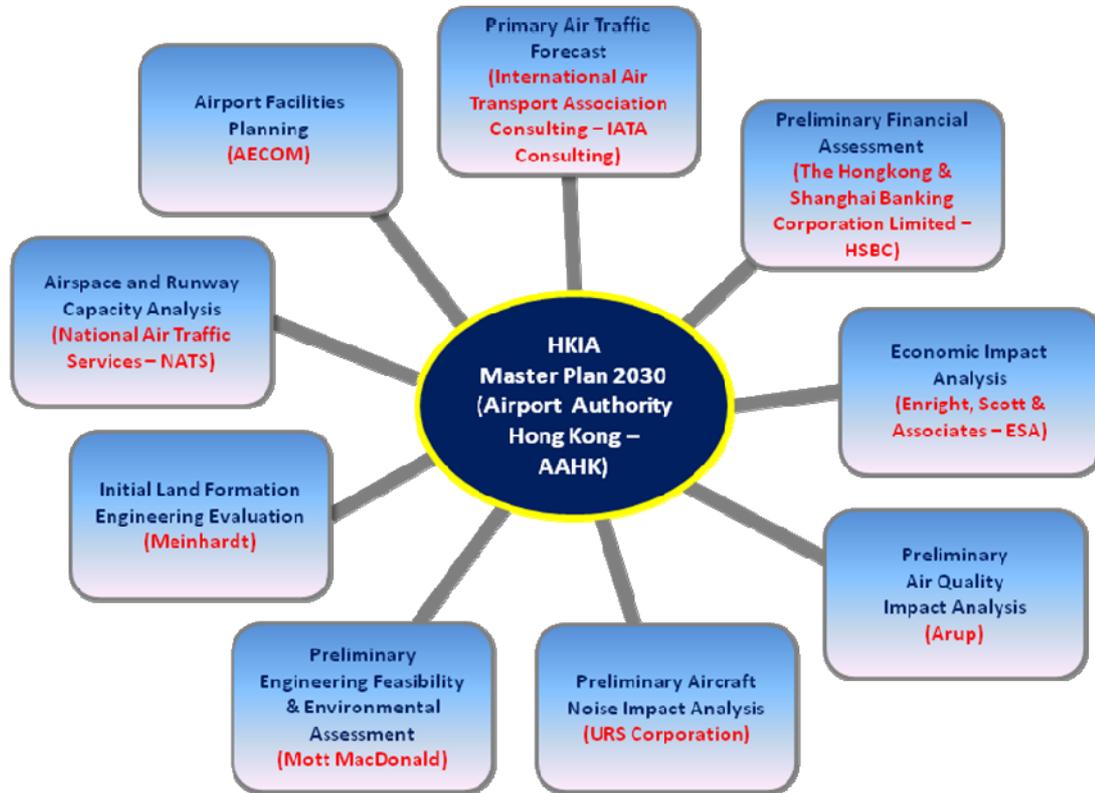
1.7 Released in December 2006, HKIA MP2025 recommended that a thorough examination of the airspace and runway capacity should be undertaken to arrive at a definitive practical maximum air traffic movement level for the airport. In 2007-2008, as the prelude to the HKIA Master Plan 2030 (MP2030), AAHK appointed the United Kingdom’s (UK) National Air Traffic Services (NATS) to examine the practical maximum capacity of HKIA’s existing two-runway system.

Development of MP2030

1.8 Following the completion of NATS’ review, to ensure a transparent and objective planning process, AAHK’s professional and management experts have commissioned

nine independent consultants to research into different strategic aspects of airport development, which have been consolidated into the Master Plan 2030. Brief descriptions of these aspects are set out in Figure 1.2:

Figure 1.2 : Consultants Appointed for the Development of HKIA Master Plan 2030



1.9 **Airport Facilities Planning**

Consultant: AECOM

AECOM (formerly known as Maunsell) is a global provider of professional, technical and management support services to a broad range of sectors: transportation (including airports), facilities, environmental, energy, water and government. With approximately 45,000 employees around the world, AECOM offers a blend of global reach, local knowledge, innovation, and technical excellence in delivering solutions that enhance and sustain the world's built, natural, and social environments. AECOM has been involved in HKIA's previous master plan studies dating back to the New Airport Master Plan carried out in the early 1990s.

Work Scope

AECOM undertook a comprehensive assessment of the existing airport's operational requirements and constraints, in order to achieve an optimal balance between airport operations, aviation support and airport-related development in the planning of facilities capable of meeting future air traffic growth at HKIA. It has also reviewed and

recommended optimal airport layout and land use development plans incorporating the possibility of building a Third Runway along with its associated supporting facilities and infrastructure.

1.10 Primary Air Traffic Forecast

Consultant: IATA Consulting

International Air Transport Association (IATA) is the trade association of the world's international airline industry. IATA Consulting is part of the commercial division of IATA. IATA Consulting serves the entire aviation industry and delivers tailor-made business solutions to airlines, airports, cargo and civil aviation authorities, and air navigation providers.

Work Scope

IATA Consulting prepared air traffic forecasts for HKIA for passengers, cargo and ATMs up to 2030 in order to facilitate the preparation of the HKIA MP2030. The IATA Consulting air traffic forecasts covered three scenarios (High, Base and Low Cases) and took into consideration the financial and economic downturn at the end of 2008. The consultant has also looked at the following key air traffic drivers and their impact on HKIA:

- Economy;
- Air Services Agreements;
- Trade agreements;
- Travel policy;
- Tourism;
- Modal competition;
- Cross boundary infrastructure development;
- Airport strategies; and
- Airline strategies.

1.11 Airspace and Runway Capacity Analysis

Consultant: National Air Traffic Services

National Air Traffic Services (NATS) is a leading and experienced provider of air traffic management services in the UK. It provides air traffic control services to aircraft flying in UK airspace, and over the eastern part of the North Atlantic. In 2009, NATS handled 2.2 million flights carrying around 200 million passengers.

The services provided by NATS are as follows:

- Operate and maintain a nationwide communications, surveillance and navigation network;
- Provide engineering support to all operational units;
- Carry out advanced research and development;
- Develop ground-breaking software for current and new systems; and

- Provide world-class training for air traffic controllers and engineers.

NATS has been involved in the airspace and air traffic management of London's Heathrow Airport. It has also assisted the British Airports Authority (BAA) in the planning for a Third Runway and is currently looking at ways to add capacity based on the existing two-runway system at Heathrow Airport.

Work Scope

NATS' involvement came in two phases. The first phase involved the review of the existing airspace and runway system at HKIA, with the primary objective of identifying a set of technical solutions and recommendations to maximise the capacity of the existing two runways to meet air traffic demand growth. The second phase concerned exploring the option of a Third Runway and the associated gain in capacity from the perspectives of technical feasibility, airspace and air traffic control procedure. Possible alignments of the proposed Third Runway at HKIA were evaluated for taking forward in the HKIA MP2030 development, taking into consideration various factors such as runway capacity, meteorological conditions, terrain constraints and, operational issues such as compliance with International Civil Aviation Organisation (ICAO)'s Manual on Simultaneous Operations on Parallel Runways (SOIR), Instrument Landing System issues, runway mode of operations, air traffic crossover, wider Pearl River Delta (PRD) airspace issues, etc.

1.12 Preliminary Engineering Feasibility & Environmental Assessment

Consultant: Mott MacDonald

Mott MacDonald Hong Kong Limited (formerly known as Mott Connell Limited) is a multi-disciplinary engineering and environmental consultancy firm providing engineering design services. It has been involved in the following engineering design projects at HKIA:

- Passenger Processing Terminal 1 (T1) (opened in July 1998);
- North Satellite Concourse (opened in January 2010);
- SkyPier (opened in January 2010); and
- Hong Kong Business Aviation Centre Hangar No.2 (opened in September 2007).

Work Scope

The consultant provided engineering, environmental impact evaluations, cost and programming input of the various airport expansion options and preferred airport layout plan.

Preliminary engineering design was carried out for various facilities of the optimal airport layout plan provided by AECOM, including preliminary specifications of the Third Runway and its taxiways, aircraft apron, airfield navigational aids and lighting, passenger processing terminal and concourse, landside transportation access system, etc. Other infrastructure requirements such as the supply of aviation fuel, gas and electricity, the treatment of storm water, sewage, and waste generated on site were also identified.

The environmental work stream identified the scope and scale of the potential environmental impact associated with HKIA expansion, allowing further preliminary consideration of key “differentiating” environmental issues and possible mitigation and compensatory measures, and facilitating a qualitative comparison of the available three-runway alignment options. Key environmental considerations were: aircraft noise, air quality, water quality/hydrodynamics and marine ecology, in particular the potential impact on Chinese White Dolphins.

1.13 Initial Land Formation Engineering Evaluation

Consultant: Meinhardt

Meinhardt (Hong Kong) Limited is a multi-disciplinary engineering and environmental consultancy firm providing engineering design services. Meinhardt has been involved in the following projects at HKIA:

- Hong Kong Aircraft Engineering Company Limited Hangar No.2 and No.3A (opened in December 2006 and September 2009 respectively);
- T1 East Hall extension (previous phase opened in March 2004, current phase from April 2010 to mid 2013); and
- T1 enhancement work (from February 2006 to 4th quarter of 2010).

Work Scope

To facilitate the work relating to preliminary engineering feasibility, an initial land formation engineering evaluation was conducted to examine the feasibility of various construction options for land formation over the contaminated mud pits north of the airport island. The consultant also carried out a preliminary assessment of the environmental impact, programme impact and costs associated with the proposed land reclamation options.

1.14 Preliminary Air Quality Impact Analysis

Consultant: Arup

Arup is a leading international business, planning and design consultancy providing building design, economics and planning, infrastructure design, management consulting, and specialist technical services such as air emission modelling. Arup has been involved in aviation development work for more than 50 years, and has worked on a wide range of projects at more than 100 airports throughout the world.

Work Scope

Arup prepared a preliminary air quality review that evaluated the cumulative impact on representative Air Sensitive Receivers (ASRs) along North Lantau and at HKIA from projected future growth in airport operations along with the emission projections

considered in the Environmental Impact Assessment (EIA) reports from future operations of the nearby projects - including the Hong Kong Boundary Crossing Facilities (HKBCF); the Hong Kong Link Road (HKLR) of Hong Kong – Zhuhai – Macao Bridge (HZMB); and Tuen Mun – Chek Lap Kok Link (TMCLKL). The analysis was based on a hypothetical scaling up of HKIA's two-runway operations to the same level as that of the three-runway option. The consultant also compared the cumulative air quality impact for a future year under maximum operating conditions with the current Air Quality Objectives (AQOs) for Hong Kong.

1.15 Preliminary Aircraft Noise Impact Analysis

Consultant: URS Corporation

URS Corporation (URS) is an architectural and engineering design firm, with over 300 offices worldwide. Its airport consulting services group has six key practice areas: Planning, Environmental, Civil Design, Architectural Design, Systems Design and Program/Construction Management. URS has implemented projects at more than 500 airports worldwide, in addition to a wide variety of assignments performed directly for airlines, the US Federal Aviation Administration (FAA) and state aviation departments.

URS' airport and aviation noise practice is considered an industry leader in assessing and addressing the impact of aircraft and airport operations on communities in the airport environs. It has performed numerous studies at airports of all sizes across the US and abroad involving airport noise modelling and analysis, land use compatibility planning, and operational and land use noise mitigation measures. URS undertook the aircraft noise study for the previous EIA update of HKIA, which was published in 1998. Other representative airports where URS has performed environmental or noise studies include:

- Dallas Fort Worth International Airport;
- Phoenix Sky Harbor International Airport;
- San Francisco International Airport;
- Denver International Airport;
- Washington-Dulles International Airport;
- Lambert-St. Louis International Airport;
- Memphis International Airport;
- Austin-Bergstrom International Airport;
- Palm Beach International Airport;
- Orlando International Airport; and
- Aeroporto di Venezia Marco Polo.

Work Scope

This consultant provided a projection of the HKIA Noise Exposure Forecast (NEF) contours for the Third Runway development alternatives based on NATS' airspace and runway capacity evaluation and recommendations. With the projected flight track designs, aircraft operational forecasts, runway utilisation and practical assumptions of evening noise mitigation measures, the FAA Integrated Aircraft Noise Modelling software was used in the projection to generate a forecast of NEF contours for HKIA at design capacity under a three-runway option.

1.16 *Economic Impact Analysis*

Consultant: Enright, Scott & Associates

Enright, Scott & Associates (ESA) is a research and strategy consulting firm based in Hong Kong. They assist corporate, government, and multinational organisations to understand and benefit from changes by combining thought leadership based on rigorous research with hands-on knowledge of the corporate world to provide advice on the forces that influence business and economic development.

Work Scope

An economic impact analysis was undertaken to address the economic impact of expanding HKIA on Hong Kong as a whole. The objectives of this analysis were to:

- Assess the economic impact of the proposed airport expansion from a Hong Kong perspective; and
- Provide a thorough analysis of the capital costs and economic benefits of expanding HKIA under the two-runway and three-runway options.

The analysis also focused on the following key questions:

- What is the current economic contribution of HKIA to the Hong Kong economy?
- What will the economic contribution of HKIA to the Hong Kong economy be in 2030 based on two runways?
- What will the economic contribution of HKIA to the Hong Kong economy be in 2030 with a Third Runway?

1.17 *Preliminary Financial Assessment*

Consultant: The Hongkong and Shanghai Banking Corporation Limited (HSBC)

Established in Hong Kong and Shanghai in 1865, The Hongkong and Shanghai Banking Corporation Limited (HSBC) is the founding member of the HSBC Group – one of the world’s largest banking and financial services organisations – and its flagship in the Asia-Pacific region. It is the largest bank incorporated in the Hong Kong Special Administrative Region (HKSAR) and one of the HKSAR’s three note-issuing banks. HSBC is a wholly owned subsidiary of HSBC Holdings plc, the holding company of the HSBC Group, which has around 8,000 offices in 87 countries and territories and assets of approximately US\$2,418 billion.

HSBC’s infrastructure practice has been consistently ranked as the leading project finance advisor for the Asia Pacific region, and leading bank for capital raising. HSBC has a strong track record of delivering client solutions in Hong Kong, across the region and globally. These include advising on the new Hong Kong airport financial consultancy before the opening of the Hong Kong International Airport, AsiaWorld Expo, Sky City Hotel, Ocean Park, the securitisation of government-owned toll tunnels and bridge in Hong Kong, as well as acquisition financing for BAA Airports in the United Kingdom.

Work Scope

HSBC was commissioned to assess AAHK's financial capability to undertake two development options: the two-runway option and the three-runway option. The work involved was as follows:

- Evaluate the financial model and the assumptions in MP2030 to ensure the validity of the projections;
- Assess the financial feasibility of MP2030 by performing analytical tests and sensitivity analyses;
- Quantify the amount of funding required to undertake the implementation of MP2030;
- Advise AAHK on whether it has the financial resources to complete MP2030 implementation; and
- Consider and analyse the feasibility of different financing options for MP2030 implementation.

Advice from the Airport Community

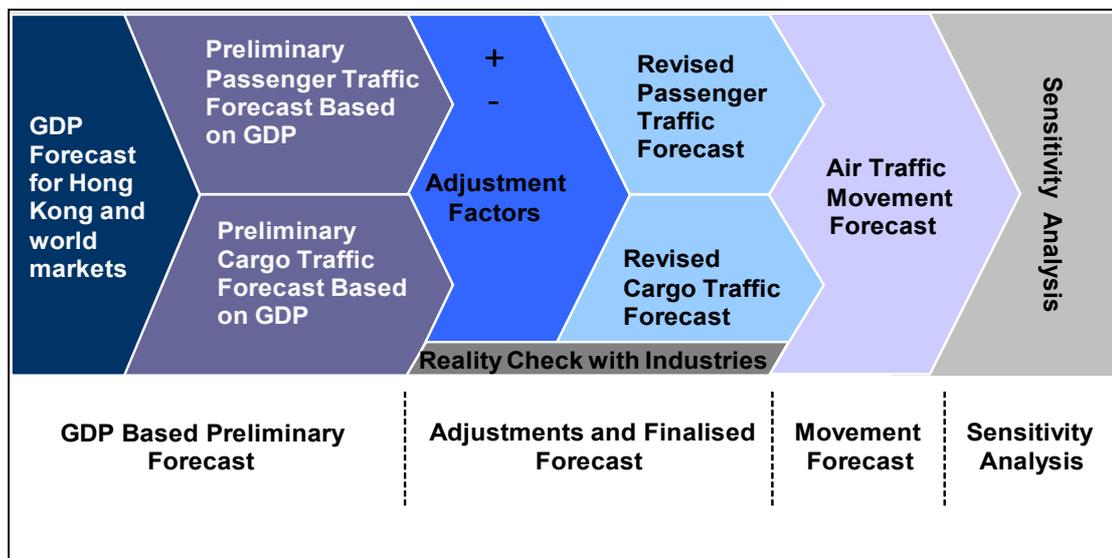
1.18 AAHK has sought advice from the airport community through the Airport Infrastructure Planning and Development Users Working Group (AIPDUWG). AIPDUWG comprises representatives from the Board of Airline Representatives, Airline Operators Committee, Carrier Liaison Group, airlines, Hong Kong Airport Service Providers Association, Civil Aviation Department, Hong Kong Airline Pilots' Association, passenger services handling agents, ramp handling operators, general and express cargo terminal operators, general aviation, maintenance services providers and in-flight catering services providers. Throughout the master planning process, the AIPDUWG held regular meetings to discuss potential operational and technical issues related to HKIA's further development. The Working Group's comments and suggestions are invaluable for the safe and efficient design of future airport facilities.

CHAPTER 2 AIR TRAFFIC DEMAND FORECAST

2.1 The first step of the master planning process is forecasting air traffic demand over a 20-year period. Airport Authority Hong Kong (AAHK) commissioned IATA Consulting to undertake this process, which involves:

- Evaluating the best model to apply for the forecast;
- Compiling the gross domestic product (GDP) forecast;
- Producing preliminary traffic forecasts based on GDP;
- Adjusting traffic forecasts to accommodate the latest market changes;
- Conducting reality checks with aviation-related industries;
- Making primary projections for passenger and cargo traffic and air traffic movements (ATMs, also known as flight movements); and
- Conducting sensitivity analysis to produce a range of estimates for high, low and base cases.

Figure 2.1 : A Structured Air Traffic Demand Forecast Process



2.2 Several forecasting models such as Simple Linear regression, Multiple Linear regression, Log regression and Linear regression based on growth rate, were evaluated to identify the one most suitable for HKIA. While evaluating the models, IATA Consulting examined key factors such as fit with expected evolution of the market, sufficiency of historical data, link between causal variables and traffic, and the accuracy of data and causal variables. Statistical tests such as the coefficient of determination³, Student's T-test⁴

³ The coefficient of determination, R square, describes the proportion of a dependent variable (passenger and cargo) that is explained by an independent variable (such as GDP). It is a good indicator of correlation. It provides a measure of how well future outcomes are likely to be predicted by the model.

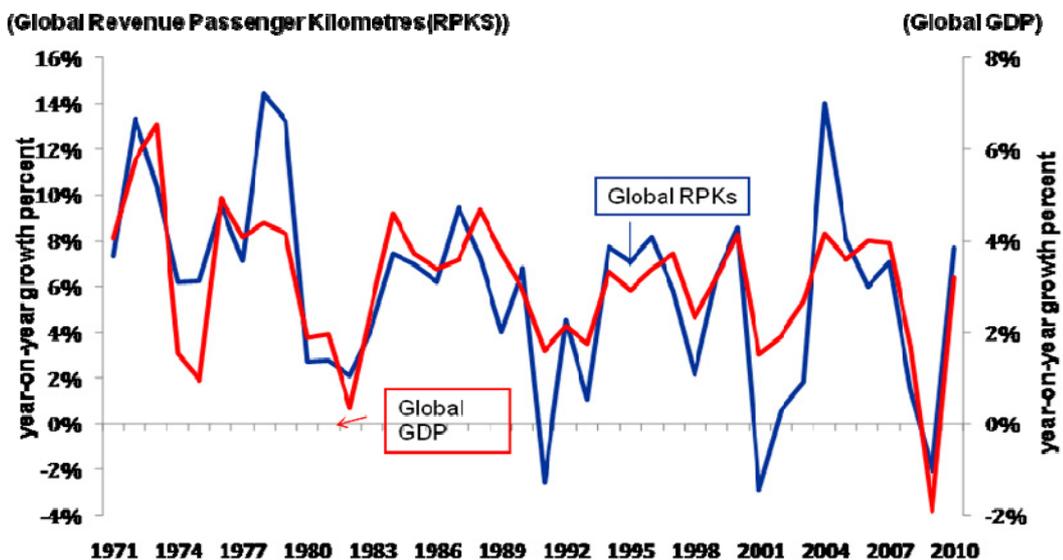
⁴ T statistics: Test and measure how strongly a particular independent variable (such as GDP) explains the variations of the dependent variable (passenger and cargo). They are mainly used in linear regression models (e.g. GDP's correlation to traffic). The higher the T statistics, the greater is the correlation between the independent variable and the dependent variable. A T-value greater than 2.0 can be assumed to be statistically significant.

and F-test⁵ were also conducted. Simple and Multiple Linear regression models gave the best results, after examining the drivers for traffic and applying statistical tests. GDP was found to be the best variable to explain historical traffic evolution (other causal variables were tested and discounted).

GDP Forecast

2.3 The GDP forecast is critical as it is the foundation for the entire traffic demand forecast. Historically, air traffic growth has had a strong correlation to global GDP growth. Figure 2.2 below shows the two trends over the past four decades.

Figure 2.2 : Global Air Traffic versus Economic Growth



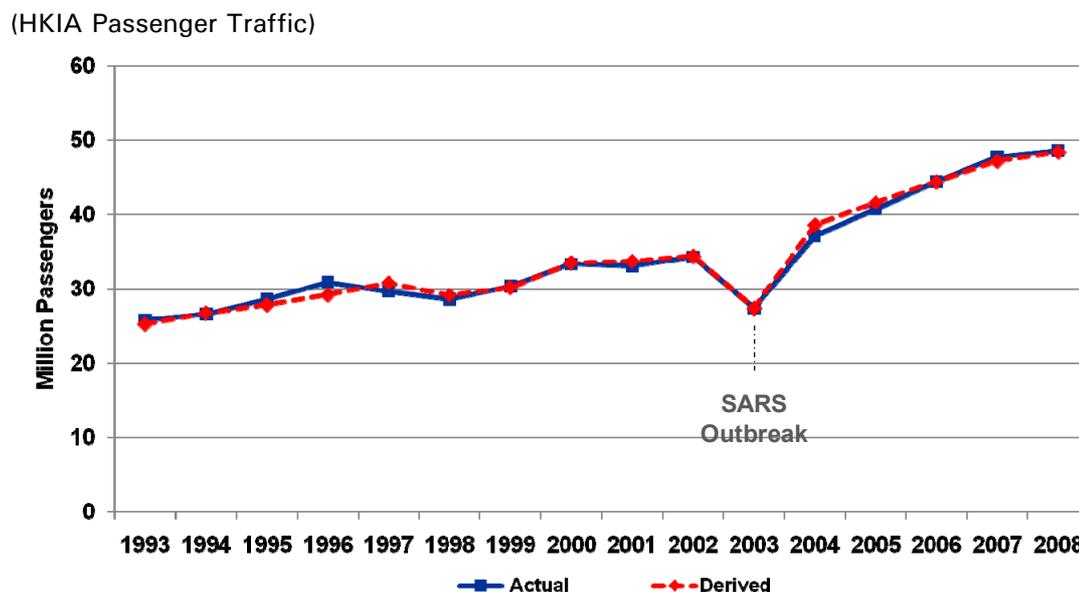
Source: Traffic data from International Civil Aviation Organization (ICAO) and International Air Transport Association (IATA), GDP data from International Monetary Fund (IMF) and Economist Intelligence Unit (EIU)

2.4 Being an international city with an open market and externally-oriented economy, the correlation between air traffic growth and GDP growth for Hong Kong is even stronger. This is evident from the closeness of historical results predicted by the regression formulae⁶ used by IATA Consulting and actual traffic figures (see Figures 2.3 and 2.5).

⁵ F statistics: Similar to T statistics; test and measure how strongly an independent variable is correlated to a dependent variable. They are mainly used in multiple linear regression and consider the whole, instead of just individual variables (e.g. traffic correlation to a set of two different GDP). The higher the F statistics, the greater is the correlation between the two variables. An F-value greater than 4.0 can be assumed to be statistically significant.

⁶Regression is a statistical technique used to explain or predict the behaviour of a dependent variable. Generally, a regression equation takes the form of $Y = a + bx + c$, where Y is the dependent variable to be predicted, X is the independent variable that is being used to predict Y, a is the Y-intercept of the line, and c is a value called the regression residual. The values of a and b are selected such that the square of the regression residuals is minimised.

Figure 2.3 : Comparison between Actual and Derived HKIA Passenger Traffic Based on Hong Kong GDP



Source: AAHK traffic data, IATA Consulting estimates

2.5 HKIA total passenger traffic proved to be closely correlated to HKSAR GDP (measured in real value). Figure 2.4 below details the causal factor (determining element) used for the forecast and the elasticity⁷ of the causal factor. The model used included a hypothetical variable⁸ to factor in the specific effect of the Severe Acute Respiratory Syndrome (SARS) crisis on passenger traffic.

Figure 2.4 : Outcome of the Regression Analyses on HKIA Passenger Total Market

Market	Causal Factor	Regression period	Elasticity ⁷	T-statistic ⁹	R-squared ¹⁰	Market CAGR
HKIA passenger	HK real GDP	1993-2008	1.03	34.9	0.99	4.3%

Source: IATA Consulting’s Methodology

2.6 HKSAR GDP was found to be the sole causal factor for Hong Kong only. Although traffic regression models usually involve several GDPs (local and regional ones) as independent variables, the additional GDP variables were found to be statistically

⁷ Elasticity is the ratio of the percent change in one variable to the percent change in another variable. HKIA passenger traffic’s elasticity to Hong Kong GDP is close to 1, which implies that for every 1% increase in Hong Kong GDP there should be an approximate 1% increase in HKIA passenger traffic.

⁸ A dummy variable is included for SAR’s impact in 2003. In regression analysis, a dummy variable (also known as an indicator variable) is one that takes the values 0 or 1 to indicate the absence or presence of some categorical effect that may be expected to shift the outcome. The addition of dummy variables always increases model fit (coefficient of determination), but reduces the generality of the model.

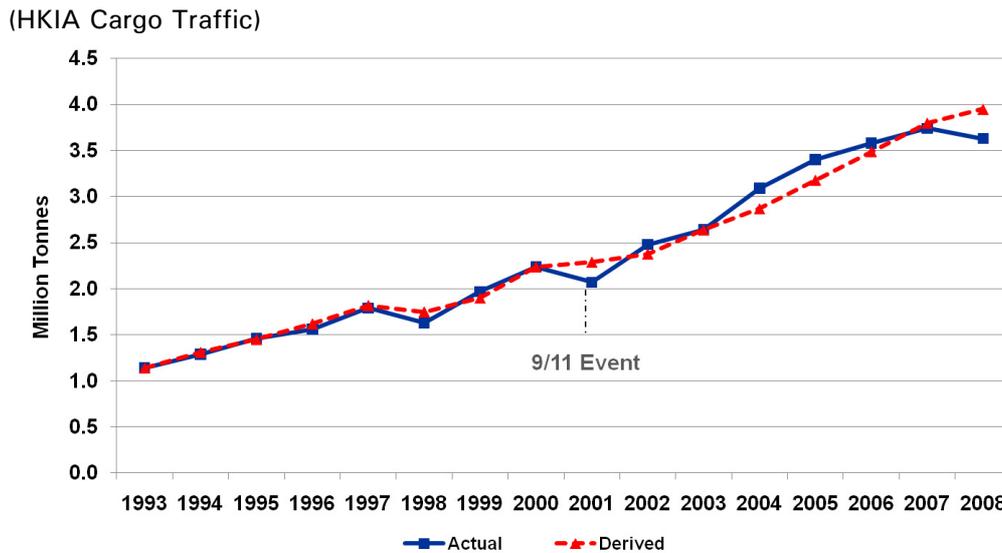
⁹ Refer to Footnote 4.

¹⁰ Refer to Footnote 3.

insignificant, implying that they could not be used to explain any part of the traffic evolution in Hong Kong.

- 2.7 HKIA is in this unique situation because:
- The Hong Kong economy is closely tied to international systems;
 - About 75% of HKIA traffic is regional (to/from the Mainland and Asia); and
 - HKSAR and Asia GDP follow similar patterns of evolution.

Figure 2.5 : Comparison between Actual and Derived HKIA Cargo Traffic Based on Hong Kong GDP and Global GDP



Source: AAHK traffic data, IATA Consulting estimates

- 2.8 For HKIA, total cargo traffic proved to be closely correlated to HKSAR and world GDP (measured in real value). Figure 2.6 below details the causal factor used for the HKIA cargo forecast and the corresponding elasticity. A hypothetical variable was introduced in the cargo model to factor in the specific effect of the event of 9/11 on traffic.

Figure 2.6 : Outcome of the Regression Analyses on HKIA Cargo Total Market

Market	Causal Factor	Elasticity 1993-2008	F ¹¹	R-squared	Market CAGR 1993-2008
HKIA cargo	HK real GDP World real GDP	1.9*	181	0.98	8%

Note: * measured against Real HK GDP
Source: IATA Consulting's Methodology

- 2.9 The economy is the main driver for passenger and cargo traffic development. The following sections describe how analysts project the global economy and the economies of the various regions of interest to HKIA: HKSAR, Pearl River Delta (PRD), Mainland and

¹¹ Refer to Footnote 5.

Yangtze River Delta (YRD). Development of these key economies is forecast along past trends, implying in particular a greater role for PRD within the Greater Pearl River Delta (GPRD) and for YRD within the Mainland.

The Global Economy

- 2.10** World GDP grew at an annual rate of 3.1% during the decade prior to the economic downturn of 2001. From 2001 to 2008, world GDP recovered and exceeded the previous decade's growth rate, reaching US\$61,221 billion at an average annual growth rate of 3.9%. Fuelled by countries such as China and India, world trade volume steadily increased at an average growth rate of 5.8% per year during the same period¹².
- 2.11** In 2008, world GDP slowed to 3.3%, and World Bank projections for 2009 estimated it to have contracted by 2.9%. During this period, weak demand from developed nations for manufactured goods severely weakened world trade volume, which contracted by 11.1% in 2009.
- 2.12** A global economic recovery is underway, buoyed by the strong performance and stabilisation of Asia's economies. It has also been driven by a rebound in manufacturing, the stabilisation of retail sales and commodity prices, and a gradual improvement in financial conditions. However, the economies of developed nations are still relatively weak, suggesting that the road to a full recovery may still have bumps ahead. World GDP is expected to reach US\$71,497 billion in 2014, growing at an average annual rate of 3.6%¹³, and then remaining relatively stable for the rest of the decade. In the long run, **world GDP is anticipated to grow at a Compound Annual Growth Rate (CAGR) of 4.0%**¹⁴.

The Mainland Economy

- 2.13** The Mainland has had double digit GDP growth rate in the past decades. In 2004, the Mainland became the third-largest country in the world in terms of GDP. In 2008, Mainland GDP topped US\$4.4 trillion, and the period of 2004-2008 showed an average annual growth rate of 10.2%, with GDP per capita reaching US\$3,150 in 2008¹⁵. Following the global trend, the Mainland economy began to slow down in the fourth quarter of 2008. Although the Mainland's long-term GDP growth rate is expected to be a modest 5.5% in 2030, this is still higher than the anticipated world GDP growth rate of 4.0%¹⁶. Foreign direct investment (FDI) is expected to remain high over the medium term, fuelled by the disparity between production costs in the Mainland and those of western countries. As the Mainland moves up the value chain, its import level is expected to increase and reach a balance with exports by 2020. By 2030, its GDP per capita is forecast to reach approximately US\$14,000¹⁷.

¹² IMF World Economic Outlook Database, April 2010

¹³ IMF World Economic Outlook Database, April 2010

¹⁴ EIU (July 2009), Global Insight (July 2009)

¹⁵ China Statistical Yearbooks 2009

¹⁶ Global Insight (July 2009)

¹⁷ World Bank, IATA Consulting estimates based on Global Insight

The Pearl River Delta Economy

- 2.14** The PRD economic zone is the Mainland's leading economic zone covering nine cities/municipalities – namely Guangzhou, Shenzhen, Foshan, Zhuhai, Jiangmen, Zhongshan, Dongguan, Huizhou, and Zhaoqing. In 2009, PRD was home to 42,870 enterprises, of which 42,481 were small and medium enterprises (SMEs), with a total footprint of 42,000 square kilometres and a work force of close to 12.9 million. In the same year, the Mainland census recorded a total PRD population of over 47 million. The PRD region is considered one of the most diverse regions in the Mainland, influenced by a large number of foreign firms and a growing capitalistic environment. It covers only 0.4% of the country's land area, yet the region contributed 9.9% of its GDP and 18.3% of its FDI in 2008¹⁸.
- 2.15** Fuelled mainly by Hong Kong investments that relocated their manufacturing operations to the PRD region, attracted by the cheap labour, the region formerly dominated by farmland has seen its economy swell.
- 2.16** As one of the Mainland's most diverse manufacturing regions, the PRD region is also a major export base for foreign investors from the HKSAR. With the growing manufacturing sector in the region, PRD infrastructure has developed quickly to support the thriving demand for trade. In 2008, the PRD region handled a total value of US\$656 billion in import and export trade representing close to 30% of the Mainland's total trade.
- 2.17** Increasing competition between the Mainland's manufacturing regions has led to PRD seeking new sources of economic growth. Developing better connectivity between the Guangdong cities and Hong Kong will enable both partner regions to leverage their combined vast and dynamic resources to attract more investment. Political and economic agreements such as the Hong Kong-Guangdong Co-operation Agreement of April 2010 will further facilitate this.

Figure 2.7 : PRD Economy as a Percentage of the Mainland Economy – 1990 to 2007

PRD	1990	1995	2000	2005	2007
Permanent Population	2.1%	2.7%	3.4%	3.5%	3.6%
GDP	5%	7%	8%	10%	10%
GDP per Capita (number of folds greater relative to Mainland GDP per Capita)	2.61	2.51	2.58	2.86	2.89
Foreign Direct Investment	35%	21%	26%	19%	20%
Total Value of Imports	37%	33%	33%	28%	27%
Total Value of Exports	36%	35%	34%	29%	29%

Note: PRD includes Guangzhou, Shenzhen, Foshan, Zhuhai, Jiangmen, Zhongshan, Dongguan, Huizhou and Zhaoqing.

Source: China Statistical Yearbook

¹⁸ Guangdong Statistical Yearbook 2009, China Statistical Yearbook 2009

- 2.18** The PRD region is restructuring to promote high technology and modernisation, and is aiming to move upstream in the value chain by building research and development capabilities especially in the pharmaceutical industry sector.
- 2.19** The PRD region is developing its service industries to expand its position as an international centre, with Shenzhen expected to become the region's financial centre. Its financial industry's contribution to total GDP is expected to be over 15% by 2020.
- 2.20** There is also increasing competition amongst the various PRD cities to modernise and attract demand. In addition to the established options of Shenzhen and Guangzhou, Qingyuan and Jieyang, which are just outside the PRD are emerging as competitive alternatives for corporations investing further westward in the Mainland. Industries in Qingyuan include electronic information, equipment manufacturing, and metal processing and those in Jieyang include power production and supply, plastic products, textiles, and metallurgy. Foshan and Dongguan are also emerging centres. The growing domestic demand and better linkage between PRD and the rest of the Mainland should balance the risk of developing overcapacity in the region over the long term.
- 2.21** As the Mainland economy grows, the PRD's GDP is forecast to increase at CAGR of 7.1% from 2008-2030¹⁹. By 2030, its GDP is expected to reach US\$1.8 trillion, and foreign direct investment (FDI) will remain high. The growth in PRD import and export value is expected to slow down slightly as the region's economic focus shifts from manufacturing to services, which occurs naturally as markets become more mature and sophisticated.

Figure 2.8 : Estimated GDP and Population Growth Rates for PRD Region (in CAGR)

	2001-2005	2006-2010	2011-2015	2016-2020	2021-2025	2026-2030
GDP	8.5%	8.8%	8.5%	7.4%	6.6%	5.8%
Population	1.2%	1.7%	2.0%	1.5%	1.2%	1.2%

Source: World Bank, Experian, estimates based on Global Insight

The Yangtze River Delta Economy

- 2.22** The YRD is the most populous area in the Mainland; and its economic zone includes 16 cities: Shanghai, Hangzhou, Ningbo, Jiaxing, Huzhou, Shaoxing, Zhoushan, Taizhou, Nanjing, Wuxi, Changzhou, Suzhou, Nantong, Yangzhou, Zhenjiang, and Taizhou. The YRD region covers an area of 110,000 square kilometres and had a population of 93.9 million in 2007. The GDP of the region reached US\$686 billion, accounting for approximately 18.1% of Mainland GDP. GDP per capita in the YRD region exceeds US\$6,900 and is among the highest in the country.
- 2.23** While the PRD region is the centre for manufacture and assembly of light consumer goods, the YRD region focuses predominantly on heavy industrial equipment such as

¹⁹ Experian, IATA estimates based on Global Insight

machinery, chemicals, and other upstream industries. Shanghai has developed its economy around the financial, logistics, real estate, and automotive sectors. Suzhou is a strong manufacturing base for foreign companies, and Nanjing is a hub for the automotive, electronics, education and natural resource sectors. In 2007, the total industrial output of the YRD was valued at US\$1,440 billion, accounting for 24.3% of Mainland output.

- 2.24** Since the 1990s, FDI in the YRD region has increased very rapidly. Shanghai, for example, received US\$7.9 billion in FDI in 2007, 71 times higher than in 1990. Fuelled by its geographic advantage as the hub for water transportation, a number of ports on the coastline, market potential and a strong cluster of higher education institutions, YRD continues to be one of the top FDI destinations in the Mainland.
- 2.25** The YRD region also serves as a major logistics centre in the Mainland. In addition, its well developed aviation infrastructure – the region handled 16.4% of the nation's total cargo in 2007 - allows the YRD to be the one of the Mainland's most important distribution hubs. Export is one of the YRD's major economic drivers, and the region generated US\$451 billion in exports, roughly 36.9% of the Mainland's total, almost 72 times greater than that achieved in 1990.
- 2.26** Going forward, YRD industries are likely to continue to focus on their current sectors. While most current development is concentrated in the major cities of the YRD, namely Shanghai, Nanjing, Hangzhou, and Suzhou, significant future FDI inflows can be expected in the rest of the YRD.
- 2.27** Export and import trade will remain the top YRD economic driver. Current expansion of major YRD ports, especially in Shanghai, will strengthen the YRD shipping industry. However, rapid growth will lead to saturation in port infrastructure in the future.
- 2.28** Shanghai's focus on the financial sector is anticipated to grow steadily in the coming years, fuelled by the Mainland's growing domestic demand. The State Council states that Shanghai will be developed into a global financial and shipping centre by 2020. Despite the slowdown caused by the financial crisis, foreign interest remains strong and Shanghai is expected to achieve the status of "Wall Street of East Asia".
- 2.29** While concerns do exist about competition between the YRD and PRD, their divergent industry and market focus areas will in fact limit competition between the two. The YRD specialises mainly in raw materials, heavy industrial goods and other upstream industries, with Shanghai and Jiangsu accounting for more than 70% of the national output for micro-computers, and Jiangsu and Zhejiang accounting for 69% of Mainland's chemical fibre in 2007. PRD on the other hand specialises in consumer goods; specifically electronics and IT products on the east bank of the PRD and household appliances on the west bank.

Figure 2.9 : Estimated GDP and Population Growth Rates for the YRD Region (in CAGR)

	2001-2005	2006-2010	2011-2015	2016-2020	2021-2025	2026-2030
GDP	11.3%	9.2%	8.8%	7.2%	6.3%	5.5%
Population	0.8%	0.8%	0.8%	1.3%	1.2%	1.2%

Note: YRD includes Shanghai, Nanjing, Suzhou, Wuxi, Changzhou, Yangzhou, Zhenjiang, Nantong, Taizhou, Hangzhou, Ningbo, Huzhou, Jiaxing, Shaoxing, Zhoushan and Taizhou

Source: World Bank, Experian, estimates based on Global Insight

The Rest of Mainland Economy

2.30 The rest of the Mainland, excluding the PRD and YRD, accounts for roughly 85.8% of its population and 71% of its GDP.

2.31 *Bohai*

The Bohai Bay rim economic zone is made up of Beijing (municipality), Tianjin (municipality), Hebei (province), Shandong (province), and Liaoning (province), with a total area of roughly 170,000 square kilometres and a total population of over 215 million. The Bohai Bay rim is one of the major economic zones of Mainland. Its GDP of US\$4,404 billion accounted for close to a quarter of the Mainland's GDP in 2008. Bohai economic zone is vastly diverse and includes agricultural and marine processing, heavy industries, modern technology including information technology services, and financial services.

2.32 While the secondary sector represents 51% of its GDP, most of Bohai Bay's GDP comes from heavy industries and large enterprises. Bohai's tertiary sector represents 41% of its GDP and approximately 9% of the Mainland's GDP and this proportion is likely to grow as the region develops.

2.33 With a total population of 16.3 million, Beijing is the heart of the Bohai region. Beijing's service sector accounted for 72.1% of the city's GDP in 2007. Beijing's three biggest economic sectors include wholesale and retail trade, information technology services, and financial services. Of the three, the financial services sector showed the fastest growth in 2007 at 22.3%.

2.34 Bohai is expected to continue to focus on high-tech electronics. Beijing hopes to build its reputation as the Mainland's Silicon Valley. Reinforcing its ambitions to become a high-tech zone, Beijing has the largest number of high level education and scientific research institutions in the Mainland - roughly 430 institutions employing 93,625 scientists and engineers. With a number of major technological multi-national corporations (MNCs) such as NEC and Sun Microsystems setting up large facilities in Beijing, FDI increased by 18.7% per annum between 2003 to 2007 to a little under US\$5.07 billion.

2.35 Tianjin is expanding its financial services to become the region's financial centre to better support Bohai's expansion, Shandong is emphasising software/application

development, network communications and telecommunications, and Hebei and Liaoning remain focused on the agricultural and natural resource industries.

Figure 2.10 : Estimated GDP and Population Growth Rates for the Bohai Region (in CAGR)

	2001-2005	2006-2010	2011-2015	2016-2020	2021-2025	2026-2030
GDP	10.3%	9.3%	9.1%	7.5%	6.6%	5.8%
Population	0.6%	0.6%	0.6%	0.6%	0.4%	0.4%

Note: Bohai Rim includes two municipalities: Beijing and Tianjin, and three provinces: Hebei, Shandong and Liaoning

Source: World Bank, Experian, estimates based on Global Insight

2.36 Central and Western Provinces of the Mainland

The Central and Western provinces of the Mainland have historically received lower levels of investment. In order to bridge the gap between the eastern coastal cities and the western cities, the Go West campaign was launched in 1999, backed up with encouragement and incentives from the Central government.

2.37 While a significant amount of Government funding has been allocated to the rest of the Mainland, this is not expected to rapidly develop it into a region of similar economic strength as the PRD and YRD within the forecast horizon. There will be no noteworthy increase in foreign companies relocating to the rest of the Mainland that may result in a reallocation of FDI from the coastal cities. The gap between the rest of the Mainland and the coastal cities will gradually reduce, but will persist for the next few decades. As the second-tier regions of the Mainland develop, PRD and YRD will play a key role as logistics, services and financial hubs for these regions.

Figure 2.11 : Estimated GDP and Population Growth Rates for the Rest of the Mainland (in CAGR)

	2001-2005	2006-2010	2011-2015	2016-2020	2021-2025	2026-2030
GDP	8.4%	7.0%	9.4%	7.5%	6.6%	5.8%
Population	0.5%	0.6%	0.6%	0.1%	-0.1%	-0.4%

Note: Rest of the Mainland includes all regions but PRD, YRD, and Bohai

Source: World Bank, Experian, estimates based on Global Insight

The Hong Kong Economy

2.38 HKSAR, geographically located at the centre of East Asia's developing countries, is recognised for its open government and well-developed infrastructure. Hong Kong's

international network and free trade policies have allowed the city to establish itself as a business centre in Asia.

- 2.39** Although not immune to external shocks, Hong Kong's economy has demonstrated its resilience. HKSAR faced the Asian financial crisis in 1997 as a result of which 1998 unemployment rates increased over 5% and retail sales declined 17%, and it was further impacted by the 2001 global slowdown. In 2003, the economy was affected by the Severe Acute Respiratory Syndrome (SARS) epidemic. On average, Hong Kong's economic output growth in 2003 decreased 1.2%, representing an approximate US\$1.9 billion loss in spending for goods and services. More recently, the economic recession in 2008 caused Hong Kong's GDP to shrink. Against the background of this turbulent decade, Hong Kong's economy is now recovering strongly.
- 2.40** During the '60s and '70s, the Hong Kong economy was predominantly driven by manufacturing. In the following decades, Hong Kong moved away from its traditional roots, investing heavily in its service sectors. As the Mainland's infrastructure and openness to foreign companies developed, many manufacturers relocated their facilities to the Mainland. The share of Hong Kong's GDP from manufacturing has decreased from 30% in the '70s to less than 3% in 2008. By relocating the majority of its labour intensive manufacturing to the Mainland, and diverting investment to its financial and retail sectors, Hong Kong has become one of Asia's busiest service hubs and financial marketplaces. In 1991, Hong Kong's tertiary GDP accounted for nearly 72% of the total GDP, and by 2008, it accounted for approximately 91% of its GDP.
- 2.41** Hong Kong's foreign trade sector has greatly benefited from its close involvement in the economic development of the Mainland over the past decades. Hong Kong's liberal trade policies have made it the Mainland's third largest trading partner, after the United States and Japan. The link with the Mainland's economy has grown steadily with the Mainland's share of HKSAR trade increasing from 39.0% in 2000 to 48.0% in 2008. The world's 13th largest trading economy, Hong Kong handled over US\$749 billion in merchandise trade in 2008 compared to US\$164 billion in 1990. Hong Kong has been the Mainland's most important logistics centre since 2005. Furthermore, Hong Kong is the site of the third-largest container sea port and the largest international freight airport in the world.
- 2.42** Contributing significantly to Hong Kong's economy, tourism generated over 3% of Hong Kong GDP in 2008. The World Tourism Organisation ranked Hong Kong 12th globally in terms of international traffic. Once dominated by Japanese and Taiwanese visitors, over half of the inbound arrivals in Hong Kong now come from the Mainland. From 1981 to 2008, the number of inbound visitors from the Mainland grew about 12-fold from 2.5 million to 29.5 million. During this period, tourist demand fell only once - due to the SARS outbreak in 2003, travel demand fell by 6.5%.

Figure 2.12 : Hong Kong Economic Drivers as a Percentage of GPRD – 1995 to 2007

Economic driver	1995	2000	2001	2002	2003	2004	2005	2006	2007
Population	15.8%	13.4%	13.2%	13.1%	13.0%	13.0%	13.0%	12.9%	12.7%
GDP	72%	61%	58%	54%	49%	46%	43%	40%	37%
GDP per Capita (folds)	15.4	10.4	9.3	8.1	6.7	5.9	5.3	4.7	4.2
Import and Export Value	78%	69%	67%	63%	59%	57%	56%	55%	55%

Note: Greater Pearl River Delta (GPRD) includes HKSAR, Macao SAR, and nine (9) cities/municipalities of the Guangdong province of the Mainland.

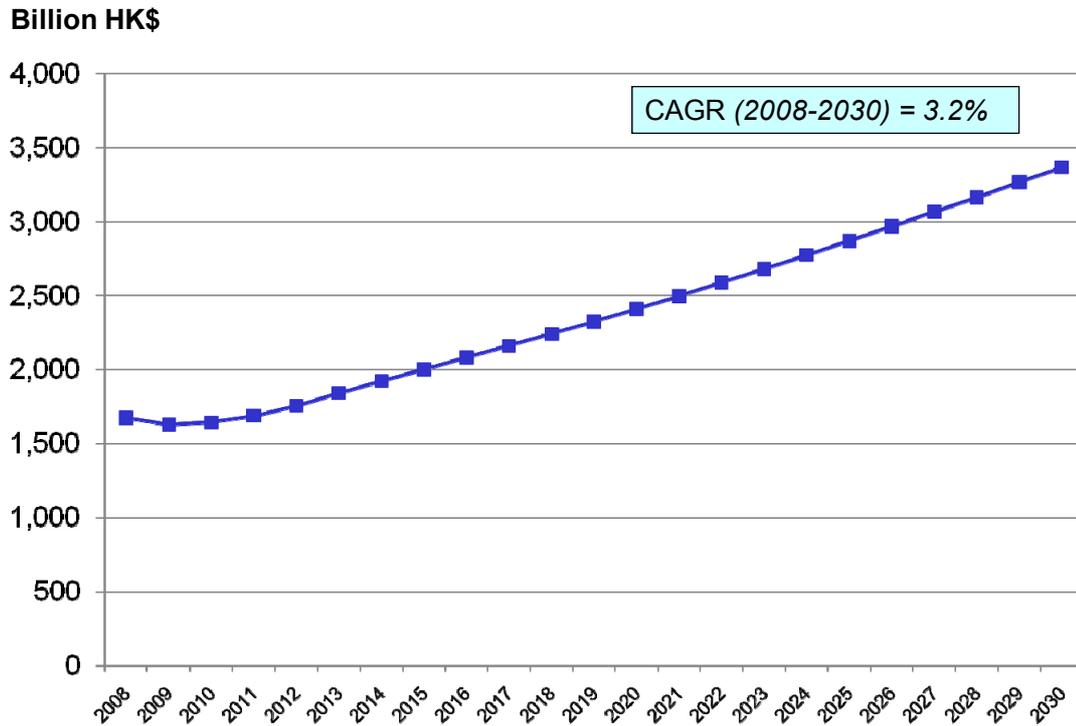
Source: The Mainland, Hong Kong, Macao Statistical Yearbook

- 2.43** Hong Kong has seen its GDP increase by almost 4.0% per annum from 2004-2009, after recovering from the effect of the global economic slowdown and SARS epidemic in 2001-2003. Hong Kong's link with the Mainland economy has also strengthened significantly, with the Mainland's share of HKSAR trade increasing from 39.0% in 2000 to 48.7% in 2008²⁰.
- 2.44** Hong Kong has proven resilient to economic challenges. Over the past decades Hong Kong has always been among the first in the region to recover from a crisis and capture new opportunities for growth. **Between 2008 and 2030, Hong Kong's GDP is forecast to continue growing at a CAGR of 3.2%**²¹. The infrastructure projects connecting Hong Kong with the Mainland should strengthen HKIA's position as a leading international and regional aviation centre as well as keep it as the preferred gateway to the Mainland. Hong Kong's economic outlook over the coming decades appears promising (see Figure 2.13).

²⁰ China Statistical Yearbooks 2002 and 2009

²¹ EIU (July 2009), Global Insight (July 2009)

Figure 2.13 : Hong Kong’s GDP Growth, 2008-2030



Source: Census and Statistics Department (real GDP of 2008 and 2009), 5-year forecast from EIU and long term forecast from Global Insight, July 2009 versions

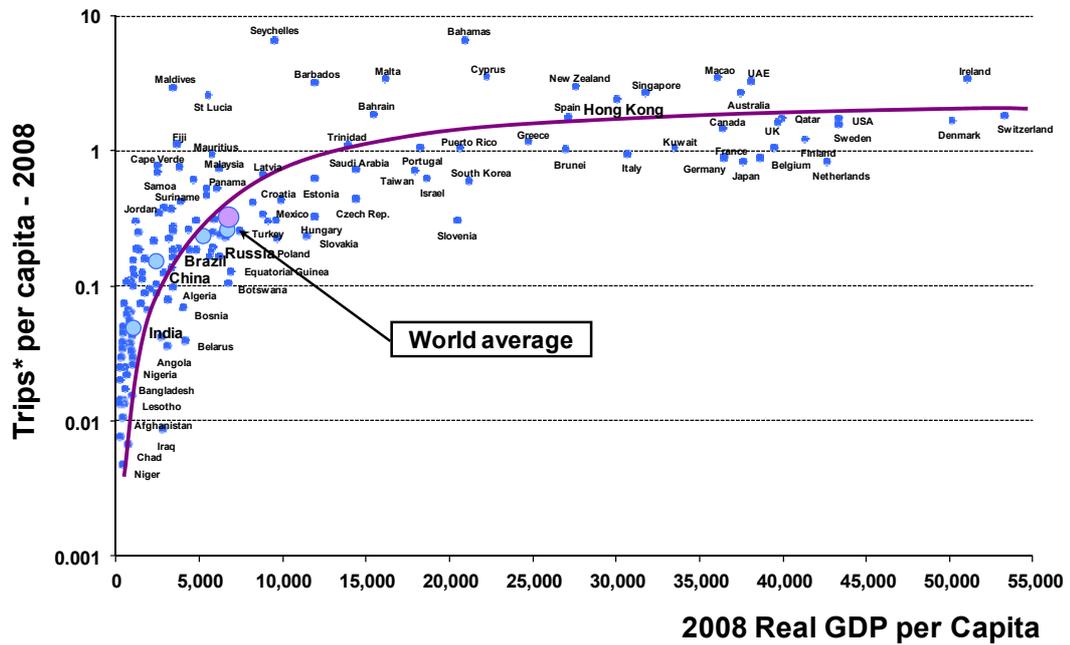
Details on GDP assumptions used are in Appendix 1.

Aviation Market Outlook: Mainland and the Global Scene

2.45 By 2030 IATA Consulting forecasts estimated air traffic to and from the Mainland to reach nearly 2.1 billion trips and cargo traffic to reach 44 million tonnes. This projection is supported by several observations. On the passenger side, the World Tourism Organisation forecasts that the Mainland will become the world’s fourth-largest tourist source market and the largest domestic tourist market by 2015. Mainland’s GDP per capita will reach approximately US\$14,000 in 2030²², and as the economy grows the desire and ability of the Mainland Chinese to travel both domestically and internationally will grow rapidly. The travel propensity of the Mainland Chinese is currently below the world average and is expected to increase hugely (see Figure 2.14).

²² World Bank, IATA estimates based on Global Insight

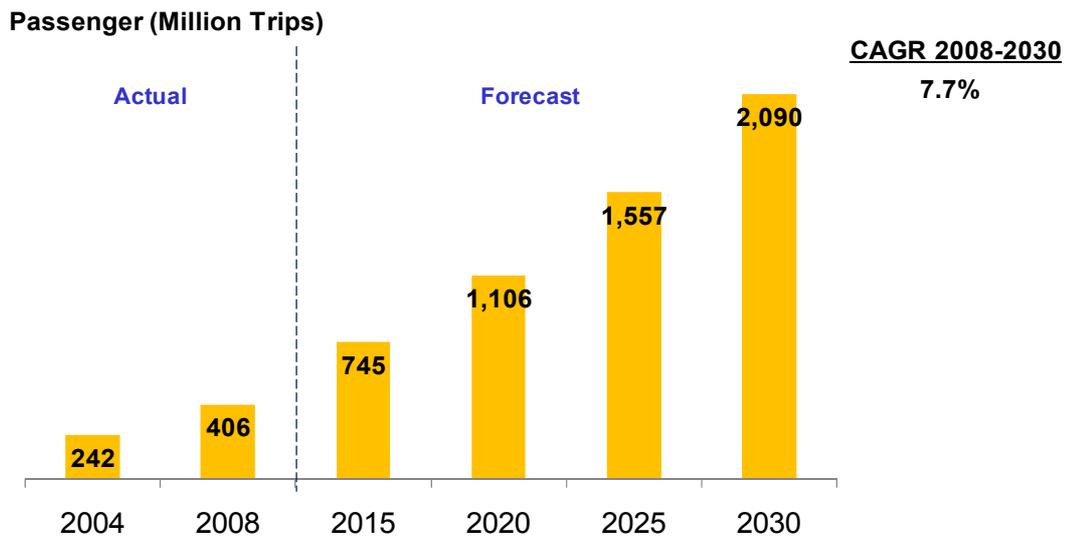
Figure 2.14 : Propensity to Travel in Relation to Real GDP per Capita



Note: GDP in 2005 US\$
 *passengers originating from a particular country
 Source: IATA PaxIS, Global Insight, Airbus

2.46 The Mainland is the global manufacturing capital, and its cargo must be delivered to its overseas markets around the world. Rising FDI, improving living standards, more liberal trade policies and a growing cargo and logistics sector support a robust cargo growth projection. Over the past decade, cargo traffic at Mainland airports has increased by a CAGR of over 10% each year, reaching 9.5 million tonnes in 2009. The Mainland’s substantial trade volume and growing economy will be key factors in its cargo growth.

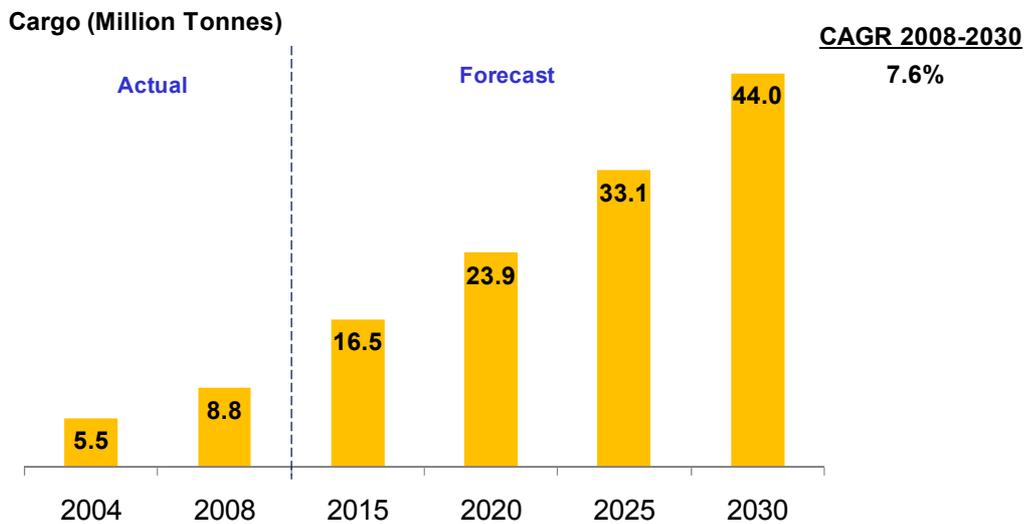
Figure 2.15 : Mainland Passenger Traffic Forecast



Note: Mainland includes PRD and excludes Hong Kong and Macao

Source: Civil Aviation Administration of China (CAAC), AAHK for actual figures; IATA Consulting estimates

Figure 2.16 : Mainland Cargo Traffic Forecast

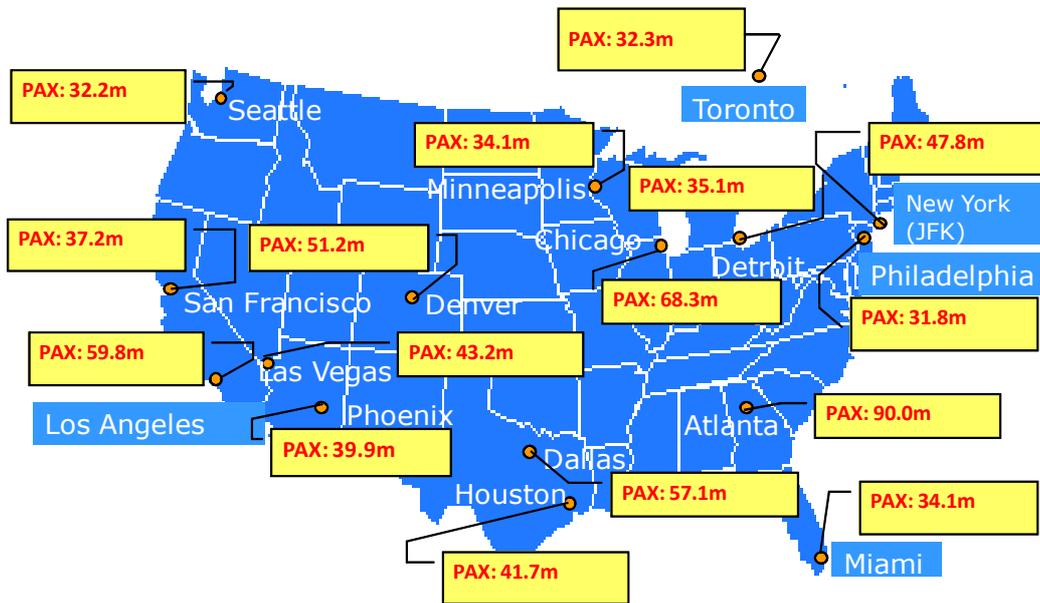


Note: Mainland includes PRD and excludes Hong Kong and Macao

Source: CAAC, AAHK for actual figures; IATA Consulting estimates

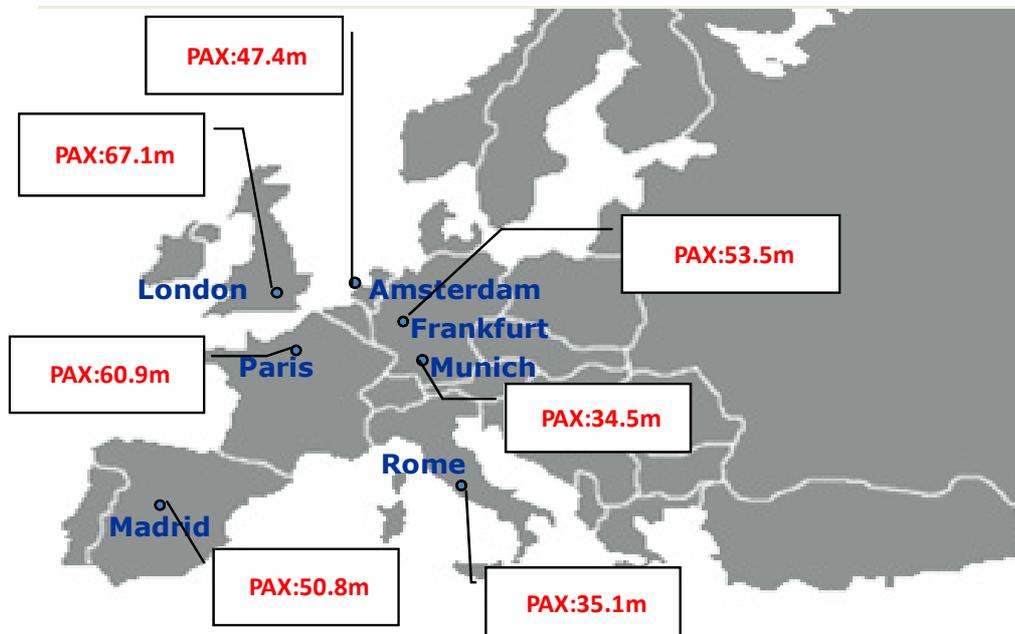
2.47 The Mainland passenger traffic forecast can be referenced to recent passenger traffic levels for highly developed aviation markets. North America and Europe typically operate in the neighbourhood of 1.6 billion and 1.5 billion passengers per year respectively. This is similar to the Mainland’s projections for 2025, but these regions are only about one-third and a half of Mainland’s population respectively (see Figures 2.17 and 2.18).

Figure 2.17 : Major Hub Airports in North America Handled 1.6 Billion Passenger Trips in 2008



Note: US population 2008 = 311.7 million (UN),
 Canada population 2008 = 33.3 million (World Bank)
 Source: ACI's World Airport Traffic Report 2008 and 2009

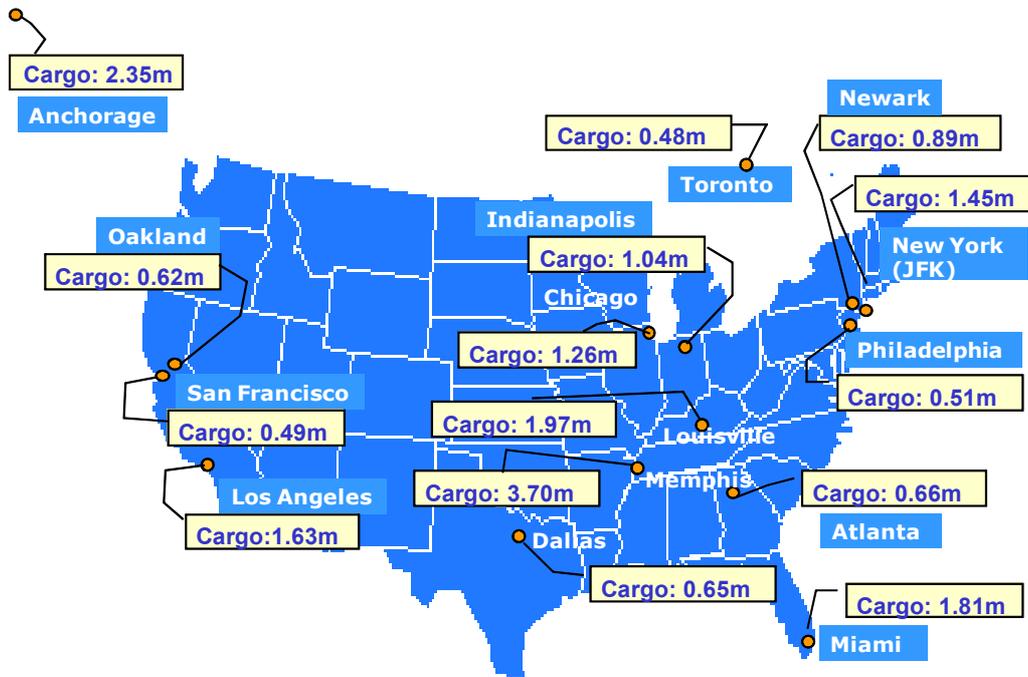
Figure 2.18 : Major Hub Airports in Europe Handled 1.5 Billion Passenger Trips in 2008



Note: Europe population 2008 = 731.6 million; W Europe = 187.8 million (UN)
 Source: ACI's World Airport Traffic Report 2008 and 2009

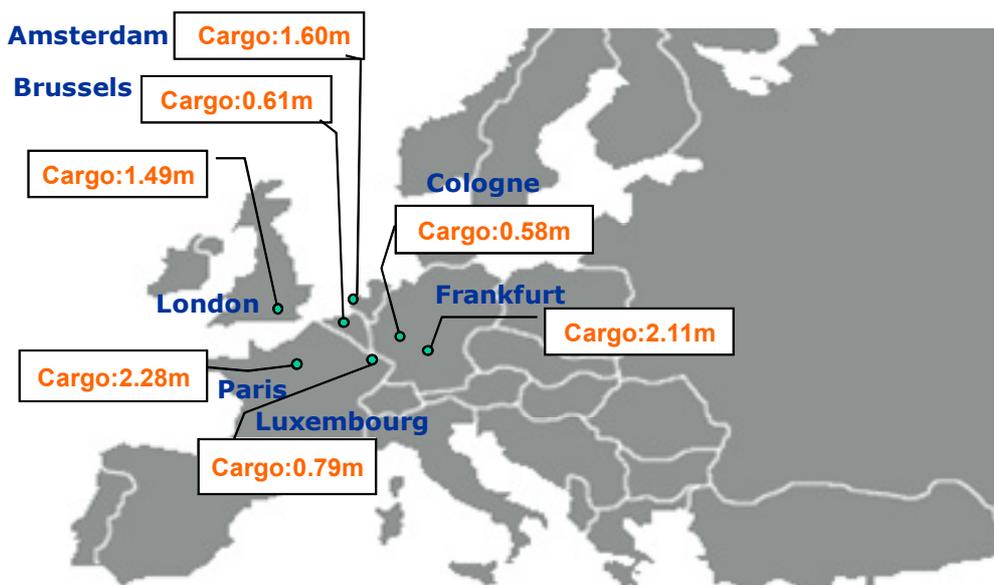
2.48 Referencing cargo growth in the Mainland in the same manner as above, North America and Europe, both smaller and more mature markets, had 29 million tonnes and 18 million tonnes of cargo respectively in 2008 (see Figures 2.19 and 2.20).

Figure 2.19 : Major Hub Airports in North America Handled 29 Million Tonnes of Cargo in 2008



Source: ACI's World Airport Traffic Report 2008 and 2009

Figure 2.20 : Major Hub Airports in Europe Handled 18 Million Tonnes of Cargo in 2008



Source: ACI's World Airport Traffic Report 2008 and 2009

Aviation Market Outlook: Greater Pearl River Delta

2.49 The PRD²³, HKIA's catchment area (see Figure 2.21), is one of the Mainland's most diverse and fastest growing regions. Being one of the Mainland's most affluent areas, it is not just the country's centre of manufacturing but also a major export base for investors from Hong Kong. PRD infrastructure is therefore growing robustly to support the thriving demand for trade. In 2008, the PRD region alone handled a total value of US\$656 billion in import and export trade, representing close to 30% of the Mainland's total.

Figure 2.21 : Pearl River Delta Location



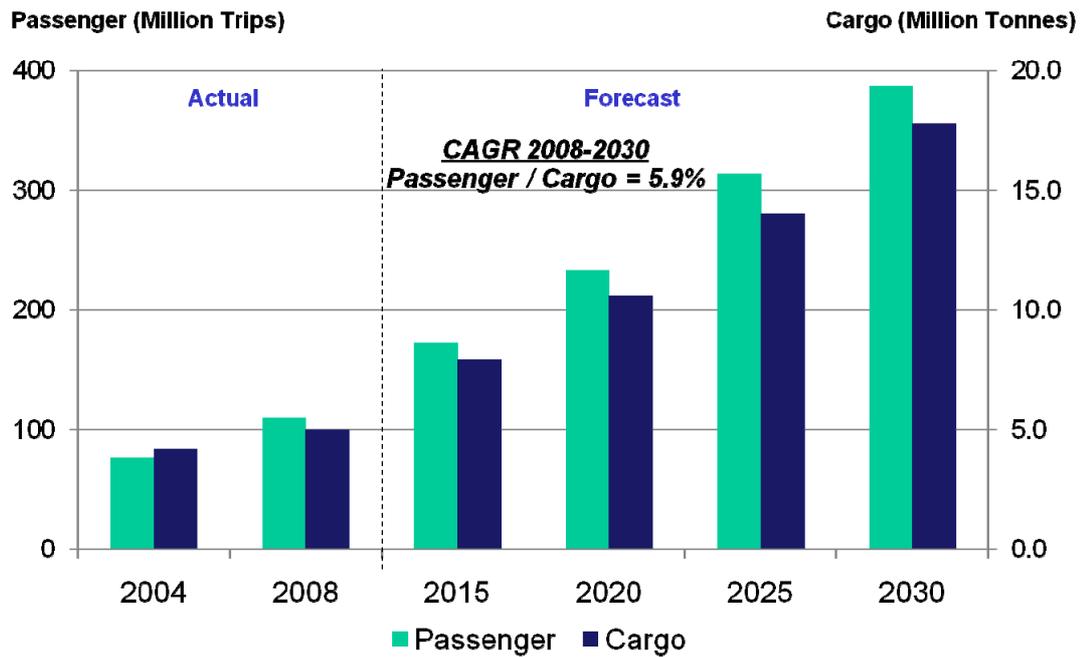
2.50 The electronics, IT, automotive, petrochemical technology, energy, medical and household appliance industries are the primary focus for the PRD in the National's 11th Five-Year Plan. The region has since been rapidly restructuring and upgrading its facilities and infrastructure in keeping with this focus.

2.51 Assuming continuous growth in trade and the overall economy, IATA Consulting estimates that the aviation market in the GPRD²⁴ in 2030 will grow to 387 million passenger trips and 18 million tonnes of cargo (see Figure 2.22).

²³ The PRD comprises Dongguan, Foshan, Guangzhou, Huizhou, Jiangmen, Shenzhen, Zhaoqing, Zhongshan and Zhuhai.

²⁴ The GPRD comprises PRD plus Hong Kong and Macao.

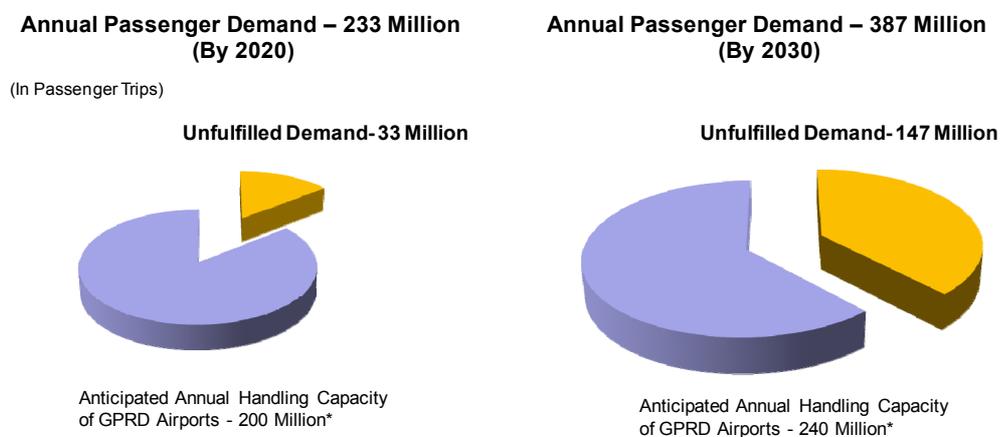
Figure 2.22 : GPRD Passenger and Cargo Traffic Forecast



Note: GPRD includes Hong Kong, Guangzhou, Shenzhen, Macao and Zhuhai airports
Source: Civil Aviation Administration of China (CAAC), AAHK for actual figures; IATA Consulting forecast

2.52 Within the GPRD, there are five airports, namely, HKIA, Guangzhou Baiyun International Airport, Shenzhen International Airport, Macao International Airport and Zhuhai Airport. Having taken into account the anticipated increase in the handling capacity of the five airports in the next twenty years, IATA Consulting forecasts that there will still be a significant unfulfilled demand for air services both in the medium term up to 2020 and in the long term up to 2030 (see Figure 2.23).

Figure 2.23 : GPRD Airports Capacity and Forecast Passenger Demand (2020 and 2030)



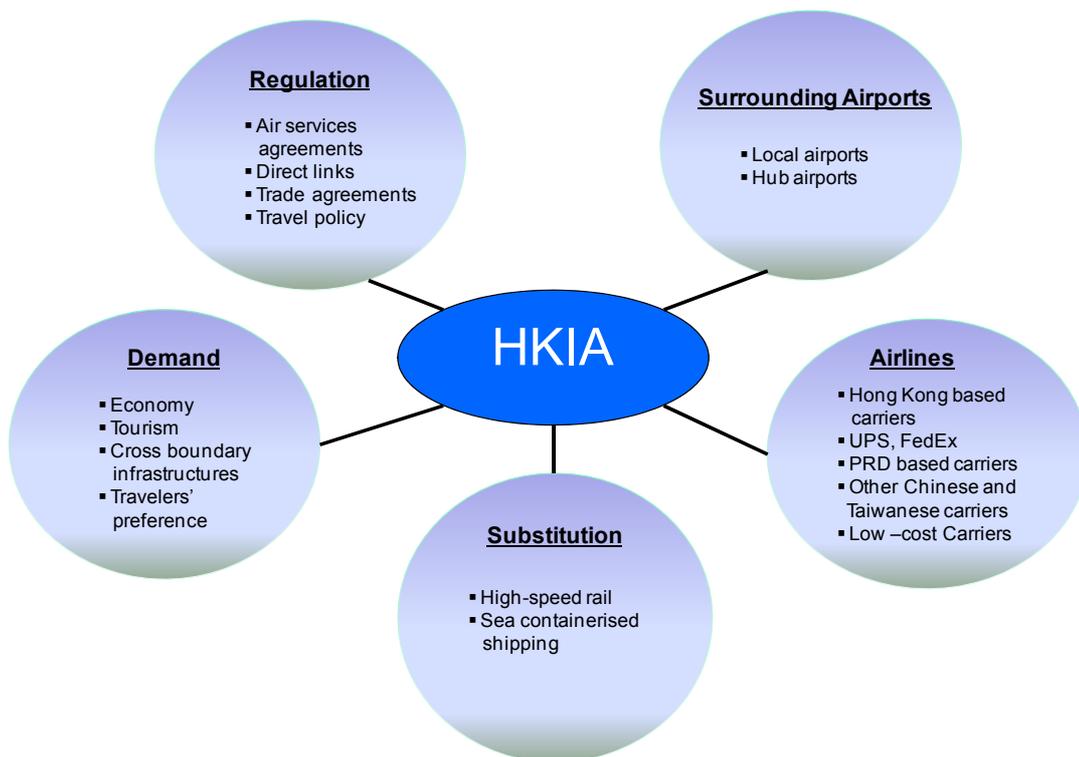
Note: *For HKIA, the capacity assumed is 60 million based on completion of the committed Midfield Phase 1 Development
Source: CAAC, IATA Consulting analysis and estimates

2.53 The London and New York areas provide a useful reference for reviewing the growth potential of airports in the GPRD. In 2008, London’s five airports (Heathrow, Gatwick, Stansted, Luton and London City) served a total of nearly 137 million passengers, and New York’s three airports (JFK, Newark and LaGuardia) served approximately 106 million passengers. Each area has a population of around 8 million. In contrast the five airports in the GPRD, whose combined catchment has a population of approximately 48 million, served a combined total of only 110 million passengers in 2008. Extending the same ratio of population to passengers as New York and London to the GPRD suggests that GPRD airports should aim to serve 350 to 450 million passengers.

Potential Factors Impacting HKIA’s Future Growth

2.54 During the forecasting process, IATA Consulting considered various factors that may impact the airport environment (see Figure 2.24).

Figure 2.24 : Market Dynamics Surrounding HKIA



2.55 Factors that change gradually and continuously are catered for in the regression analysis. Other abrupt changes in the airport market, such as cross-strait direct flights and development of cross-boundary infrastructure are separately assessed to evaluate whether there is any incremental impact on the regression based forecast. The following sections will discuss the various factors affecting HKIA’s traffic demand, as well as IATA Consulting’s views on whether certain factors require incremental traffic adjustments to the regression based forecast.

Regulation: Air Services Agreements

2.56 Air Services Agreements (ASAs) provide the regulatory umbrella under which the aviation industry operates and develops. Recent years have witnessed a continuous liberalisation of traffic rights, not only between HKSAR and its counterparts but also between the Mainland and other major world economies. Further deregulation is expected to take place in the short, medium and long term enabling existing markets to grow and new markets to emerge. Direct links between the Mainland and other major world economies constitute an unprecedented factor that will need to be assessed separately from the regression traffic model.

2.57 Hong Kong

The following paragraphs analyse the recent ASAs' history in HKSAR. It shows how the Hong Kong government implemented a continuous aviation liberalisation process based on growing the number of ASAs, and progressively liberalising the existing ones. Given that Hong Kong has the authority to sign ASAs with other countries, this trend as well as the introduction of fifth freedom rights²⁵ will further strengthen Hong Kong's accessibility and competitive positioning as an origin/destination airport and hub within Asia and the region.

2.58 Hong Kong has signed ASAs over the past few years with markets such as Maldives, Laos and Fiji, reaching a total of 61 ASAs. Although ASAs with most of Hong Kong's key markets have already been concluded several years ago, additional agreements with smaller countries as well as more liberalised agreements with existing air services partners are expected. The recent renegotiation of the ASA with Japan is a good illustration of the deregulatory trend in place. Flights between Japan and Hong Kong have in the past been restricted in capacity from all major gateway cities such as Nagoya, Osaka, Fukuoka, Sapporo, Sendai and Okinawa. With the exception of Tokyo, all restrictions were revoked in 2008 allowing unlimited capacity between these cities and Hong Kong by airlines of both sides.

2.59 Hong Kong has concluded ASAs with unlimited third/fourth freedom capacity with 20 aviation partners. Fifth freedom rights are often exchanged in order to further facilitate airlines' operations. There is room for further expansion and development with respect to third, fourth and fifth freedoms.

²⁵ Fifth freedom right refers to the right or privilege, in respect of scheduled international air services, granted by one state to another state to put down and to take on, in the territory of the first state, traffic coming from or destined to a third state.

2.60 The Mainland and Hong Kong

Between the Mainland and Hong Kong, third and fourth freedom rights are available as follows:

- Restrictions on passenger capacity and carriers to 3 airports in the Mainland (Beijing, Shanghai (Pudong) and Shanghai (Hongqiao)).
- No restriction on 61 passenger routes.
- No restriction on 63 cargo routes.

2.61 IATA Consulting anticipates the implementation of more liberal rights between the Mainland and Hong Kong. This enhancement is essential to stimulate additional demand between the Mainland and the SAR.

2.62 The Mainland

The Mainland has adopted a progressive approach in liberalising its air traffic rights. In 1987, 40 ASAs were in place between the Mainland and its counterparts. Since then, the Mainland has liberalised its aviation framework and, to date, has concluded about 96 ASAs with its aviation partners. This trend is expected to continue, resulting in additional routes and services to and from the Mainland airports and stimulating traffic growth at these airports. One of the most symbolic developments is the implementation of Direct Links between the Mainland and Taiwan. Despite the intensifying airport competition triggered by this liberalisation, HKIA, as a gateway to PRD and a hub to the Mainland, remains uniquely positioned to benefit from the growing Mainland market.

2.63 The U.S.-China ASA is one of the most emblematic developments of recent years. The two nations reached an agreement to allow for a significant expansion of passenger and cargo air services as set out below:

- The agreement allows U.S. carriers to operate to the Mainland gateway cities of Beijing, Shanghai and Guangzhou over 2008-2012, with an increase in air services from 7 daily flights in 2004 to 46 daily flights in 2012.
- The agreement entails an increase in the number of U.S. passenger carriers that may serve the Mainland market; from 6 in 2007 to 9 in 2011.
- Additionally, it allows unlimited U.S. cargo flights to any point in the Mainland and permits an unlimited number of U.S. cargo carriers to serve the market as of 2011. The Central Government has authorised the establishment of foreign cargo hubs in the Mainland (FedEx in Hangzhou and Guangzhou, UPS in Shanghai and Shenzhen and DHL in Shanghai) granting beyond rights to the associated carriers.
- Both countries agreed to launch initial Open Skies Agreement (OSA) negotiations in 2010.

2.64 As part of the aviation deregulation process, further expansion towards some Asian countries is widely expected. A few months after Mainland and the Association of Southeast Asian Nations (ASEAN) member states²⁶ concluded the China-ASEAN Free

²⁶ The member states of ASEAN are Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam.

Trade Area (CAFTA) in 2007, a Framework Agreement on China-ASEAN Comprehensive Economic Cooperation was signed. This Agreement encompassed an air transport agreement aimed at creating a fully liberalised air services regime between the ASEAN states and Mainland. The ASEAN member states and Mainland agreed to actively expand the ASAs and connectivity at a bilateral, regional or sub-regional level, to facilitate the circulation of passengers and goods and increase the trade in the region. ASEAN countries aim to implement full deregulation of international and domestic flights by 2015.

2.65 However, at this point, the implementation of passenger OSAs (such as Mainland China-U.S. or Mainland China-European Union) is not expected to be concluded soon. Mainland carriers are not prepared to compete on major long haul routes yet. Nevertheless, the initial aviation liberalisation agreement and its associated measures described above will have a beneficial impact on the Mainland's air traffic infrastructure and are expected to help support the sustainable development of the Mainland economy.

2.66 Under the 11th Five-Year Plan, domestic routes were to be fully opened up for all Chinese airlines by end-2010, allowing any Chinese airline to fly any domestic route any time and at any frequency, without having to request approval.

2.67 IATA Consulting's Evaluation

After assessment of the overall impact of ASA development on HKIA traffic, IATA Consulting has concluded that this factor will continue to develop gradually and continuously following historical trends. Therefore its impact is catered for in the regression based forecasting model and no special adjustment is needed.

Regulation: Cross-strait Direct Flights

2.68 Direct links between the Mainland and Taiwan constitute the most radical evolution in ASAs. The following paragraphs outline the current situation of the direct links and their likely evolution.

2.69 Prior to the implementation of cross-strait direct flights in July 2008, HKIA served as the dominant hub providing access to the Mainland for Taiwanese passenger and cargo traffic. From 1997 to 2007, HKIA passenger traffic to and from Taiwan increased at a CAGR of 4.5%, while air cargo increased by an average of 7.7% per year.

2.70 The introduction of direct links in July 2008 began with 36 weekly charter passenger flights, which subsequently increased to 108 weekly passenger flights and 15 weekly cargo flights in December 2008. As of 31 August 2009, this had increased to 270 weekly scheduled passenger flights and 28 weekly cargo flights. In May 2010, it was agreed to add a further 100 non-stop scheduled weekly passenger flights and 20 weekly cargo flights.

2.71 Simultaneously, the Taiwanese visa policy allowing Mainlanders to visit has been considerably relaxed, allowing up to 3,000 daily visitors from the Mainland. IATA Consulting estimated that cross-strait flights carried about 3.5 million passengers and

54,000 tonnes of cargo in 2009, among which about 2 million were new passengers as a result of the relaxed visa policy.

- 2.72** In the short and medium term, IATA Consulting assumes a continuous enhancement of the ASAs maintaining the principles of reciprocity and even number of flights on either side. However, growth would be slow as Taiwanese airlines cannot increase capacity as fast as Chinese airlines. Over the long term, it is believed that unlimited capacity arrangements will be granted.
- 2.73** While cross-strait direct flights have negatively impacted the traffic between Hong Kong and Taiwan in the short to medium term, the relaxation of the immigration policy for Mainlanders to visit Taiwan and increased cross-strait activities are likely to stimulate new demand. Generally speaking, the relaxation of the policy for Mainlanders to visit Taiwan and increased cross-strait activities stimulating overall GDP growth in Taiwan will stimulate growth in cross-strait passengers. Based on publicly available information, IATA Consulting expects the current Mainland visitor quota to increase progressively and reach 10,000 per day in the medium term. In the long term, IATA Consulting believes that the visa policy will be further relaxed so as not to constrain demand and to make Taiwan as attractive as Beijing for Mainland visitors. Beijing currently receives about 12 million Mainland visitors a year.
- 2.74** On the economic front, it is expected that direct links and closer ties between Taiwan and the Mainland, including the signing of the Economic Cooperation Framework Agreement (ECFA), will stimulate the Taiwanese economy. In particular, tourism, retail and trade, construction and logistics are likely to be the primary beneficiaries under this policy. Considering the elasticity of traffic to GDP, the policy is estimated to increase the number of Taiwanese visitors to Mainland China by up to 10%.
- 2.75** Hong Kong/Taiwan has for many years been the busiest air route out of HKIA with about 50 flights per day at present. Before cross-strait direct flights commenced in July 2008, passenger traffic segments potentially impacted by direct flights constituted about 16% (i.e. 7.7 million) of our total throughput in 2007, which decreased to 10% (i.e. 4.9 million) in 2010. Cargo traffic was reduced from 17% (i.e. 0.6 million tonnes) of our throughput in 2007 to 13% (i.e. 0.5 million tonnes) in 2010. However, this short-term negative impact has been partly mitigated by the relaxation of the policy for Mainlanders to visit Taiwan and the new demand for air travel stimulated by increased cross-strait economic activities. In 2010, overall passenger and cargo traffic between Hong Kong and Taiwan grew 4% and 14% respectively, over 2009. Looking ahead, increasing tourism and trade activities across the strait is expected to stimulate further growth in the Hong Kong/Taiwan passenger and cargo market.

2.76 IATA Consulting's Evaluation

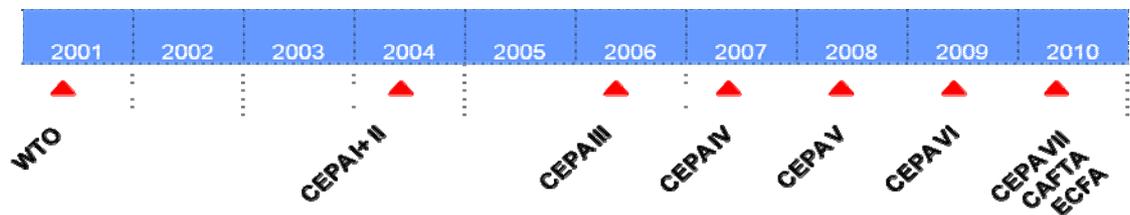
After assessment of the impact that cross-strait direct flights have on HKIA traffic, IATA Consulting has concluded that this factor will have a negative incremental impact on HKIA's regression based passenger traffic forecast of around 1.3 million from the regression based forecast in 2030. On the cargo side, this factor will have a negative incremental impact on HKIA's regression based cargo traffic forecast of around 0.7 million from the regression based forecast in 2030.

Regulation: Trade Agreements

2.77 Trade agreements will continue to play a growing role, fuelling both import and export to the Mainland as well as supporting the Mainland economy. Hong Kong will benefit from this stimulus as a result of the Closer Economic Partnership Agreement (CEPA) which allows wide and increasing accessibility to the Mainland market. As a hub to the Mainland and a gateway to PRD, Hong Kong will also take advantage of the growing exports and imports of the Mainland.

2.78 Figure 2.25 below summarises some of the most significant liberalisation measures of Mainland China that directly influence the Hong Kong economy and illustrates the Mainland's progressive approach towards trade liberalisation.

Figure 2.25 : Trade Agreements of the Mainland



2.79 WTO

The Mainland became a member of the World Trade Organisation (WTO) in December 2001, and has undergone progressive liberalisation and restructuring to provide open market access.

2.80 The next rounds of negotiation will further reduce tariffs and liberalise trade conditions, resulting in an improved trade environment for Mainland exports and imports. Similarly, the entrance of new WTO members (Russia, Vietnam, and Ukraine) will further boost trade²⁷.

2.81 Some logistics activities (handling, freight forwarding, express mail) were liberalised after 2001, allowing foreign players to operate fully-owned logistic companies in the Mainland.

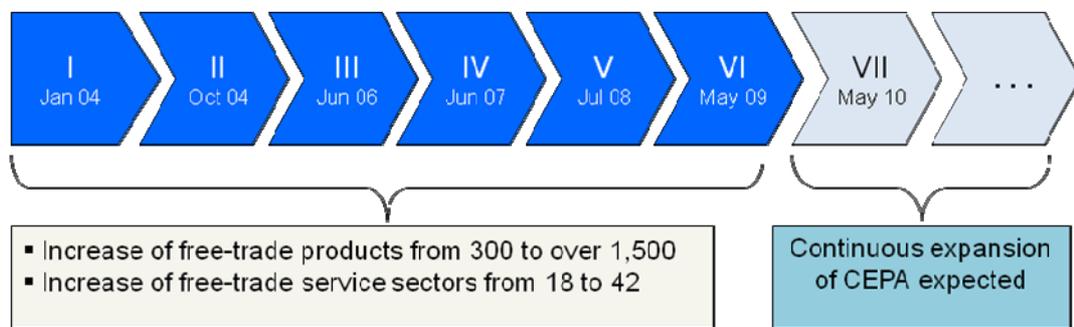
²⁷ "WTO Successfully concludes negotiations on China's entry", World Trade Organization (WTO) 2001 Press Releases (Press/243) dated 17 September 2001

2.82 CEPA

CEPA is the first bilateral Free Trade Agreement (FTA) between the Mainland and Hong Kong, aimed at liberalising the trade of products, services and investment. Since the signing of CEPA in 2004, HKSAR companies have been able to export products into the Mainland free of duty. Since then, several revisions have been implemented to better support the business needs of domestic and foreign enterprises (see Figure 2.26).

2.83 On tourism, CEPA Supplement VI authorised Mainland travel agents organising group tours to Taiwan for Mainland residents to plan a stop in Hong Kong in transit²⁸.

Figure 2.26 : CEPA Road Map



2.84 In general, CEPA has progressively opened up the Mainland market for an increasing number of Hong Kong firms. It is strongly expected that free trade agreements between HKSAR and the Mainland will be further enhanced allowing the Hong Kong economy to take greater advantage of the Mainland’s growth. CEPA VII was signed in May 2010 and took effect from 1 January 2011.

2.85 CAFTA

The establishment of China-ASEAN Free Trade Area (CAFTA) in January 2010 has further driven the Mainland’s economic growth. CAFTA is expected to become the world’s third largest free trade area. Under CAFTA no tariff will be levied on 90% of products traded between the Mainland and ASEAN countries²⁹.

2.86 In addition, ASEAN member states and the Mainland have agreed to actively expand the ASAs and OSAs in the region. This is expected to strengthen the sustainable growth of air transport in and out of the Mainland and will in particular provide greater opportunities for air cargo traffic demand.

²⁸ Mainland and Hong Kong Closer Economic Partnership Arrangement (CEPA) Legal Text from the Trade and Industry Department, the Government of the HKSAR

²⁹ “China to invest more in ASEAN under the CAFTA”, China Business News dated 8 January 2010, Hong Kong Trade Development Council (HKTDC) Market Intelligence

2.87 In conclusion, the trade agreements described above are expected to provide stimulus to sustain economic growth of the Mainland.

2.88 ECFA

The Economic Cooperation Framework Agreement (ECFA) is a trade agreement signed in June 2010 between the Mainland and Taiwan that aims to reduce tariffs and commercial barriers between the two markets. The agreement covers 539 Taiwanese products and 267 Mainland Chinese goods. The Mainland will also open its markets to Taiwan in 11 service sectors including banking, securities, insurance, hospitals and accounting, while Taiwan will offer wider access in seven areas, including banking and movies. The agreement also aims to boost investment between the two sides.

2.89 Further discussions will focus on cutting down on and removing restrictive measures gradually, enlarging the service sectors covered, and enhancing cross-strait cooperation.

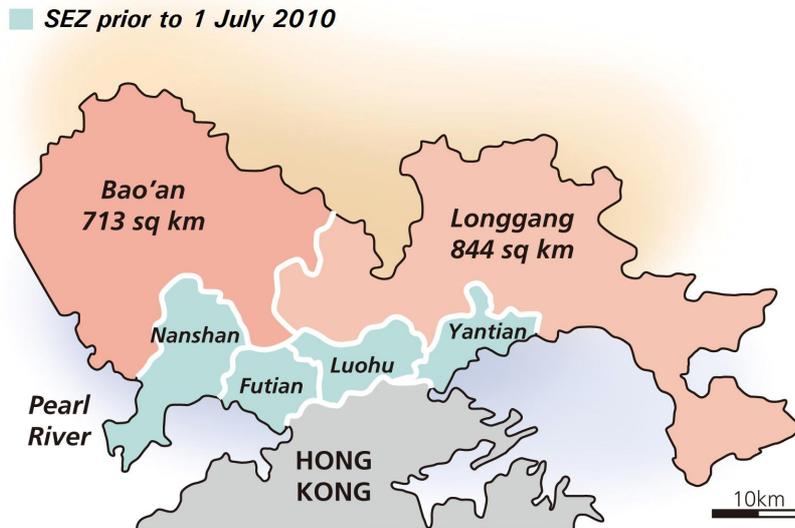
2.90 Shenzhen Special Economic Zone (SEZ) expansion

In the '80s, the Mainland government established several Special Economic Zones (Xiamen, Shantou, Zhuhai, Hainan and Shenzhen) that offered a more relaxed economic regime. These SEZs were given special tax incentives to attract foreign investment, as well as greater independence on international trade activities.

2.91 On 1 July 2010, Bao'an and Longgang districts entered the Shenzhen SEZ, increasing its area five-fold from 396 square kilometres to 1,948 square kilometres (see Figure 2.27). One of the aims of the extension is to further develop the two cities of Shenzhen and Hong Kong into global centres for the finance, trade, logistics, innovation and culture industries.³⁰

³⁰ "Shenzhen SEZ aims to be 5 times bigger", China Daily dated 22 May 2009

Figure 2.27 : Former and Recently Extended Perimeter of the Shenzhen Special Economic Zone



2.92 IATA Consulting's Evaluation

After assessment of the impact on HKIA traffic of trade agreements governing the region, IATA Consulting has concluded that this factor will continue to develop gradually and continuously following historical trends. Therefore its impact is catered for in the regression based forecasting model and no special adjustment is needed.

Regulation: Travel policy

2.93 This section identifies the recent and future changes in the travel policy, which may have a sizeable impact on air traffic. Further liberalisation is to happen, extending the past trends.

2.94 Hong Kong

The Hong Kong travel policy is already very liberal. Travellers from over 170 countries can visit Hong Kong visa free for periods from 7 days to 180 days. No significant change is expected on this front³¹.

2.95 Mainland

Mainland has progressively liberalised its travel policy to facilitate outbound tourism. It is expected that steps will continue to be taken to reduce travel restrictions for Mainlanders. These measures will boost tourism in HKSAR and increase the number of travellers potentially connecting through HKIA.

³¹ Immigration Department, the Government of the HKSAR

2.96 Approved Destination Status

During recent years, Mainland developed the “Approved Destination Status” (ADS)³² for specific overseas destinations. As of early 2009, 127 countries had been given the ADS compared to just 15 in 2000³³. A further expansion of the list of countries is expected. However, its impact on outbound tourism volumes from Mainland China will be minimal as the approved destinations already cover the majority of potential tourist destinations. In late 2009, the major omission from the ADS list was Taiwan.

2.97 Individual Visit Scheme

Introduced in 2003, the “Individual Visit Scheme” (IVS) allows Mainlanders to travel to Hong Kong and Macao on an individual basis. Prior to IVS, Mainlanders were required to travel with business visas or in group tours.

2.98 The IVS currently covers 49 municipalities and 270 million inhabitants³⁴ in Mainland. Since its introduction, the IVS has resulted in a massive surge in outbound tourism to Hong Kong from 6.8 million in 2002 to 16.9 million in 2008 (see Figure 2.28)³⁵. In 2008, the number of travellers entering Hong Kong under the IVS was 8.9 million, representing 52.7% of the total³⁶. It is anticipated that the IVS will continue to drive visitor numbers to Hong Kong.

2.99 Only 6.2% of the population eligible for the IVS has so far travelled to Hong Kong. This share is likely to grow as the Mainland economy further flourishes.

2.100 Despite the large number of inhabitants covered, the IVS scheme currently includes only 20% of the entire Mainland population. The scheme is being expanded progressively to cover new municipalities stimulating travel to Hong Kong. Only 0.7% of non-IVS eligible Mainlanders travelled to Hong Kong – in contrast to 6.2% of the eligible ones.

³² The Tourism Industry Association of Canada

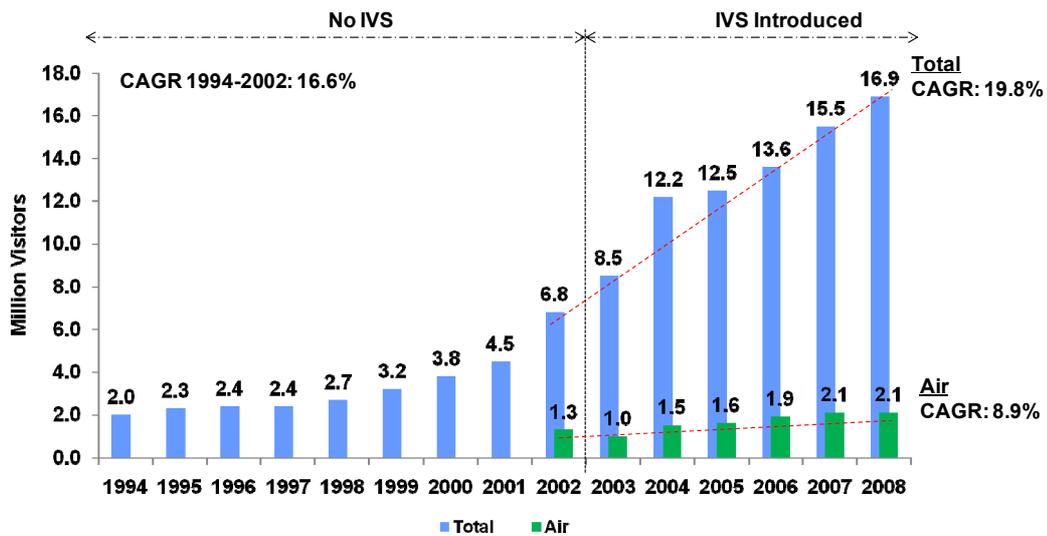
³³ Hong Kong China Hawaii Chamber of Commerce

³⁴ Visitor Information – Individual Visit Scheme, Tourism Commission, Commerce and Economic Development Bureau, the Government of the HKSAR

³⁵ Research Statistics, PartnerNet, Hong Kong Tourism Board (HKTB)

³⁶ “Annual Economic report: Hong Kong 2008” by Consulate General of Switzerland in Hong Kong, 20 March 2009

Figure 2.28 : Number of Mainland Visitors to Hong Kong – 1994 to 2008



Note: Includes same day and overnight visitors
 Source: Government of HKSAR, Hong Kong Tourism Board

2.101 Although a significant proportion of the Mainlanders making use of the IVS are from Guangdong, air traffic also strongly benefited from the IVS with the number of visitors arriving by air growing by almost 9% per annum since its implementation.

2.102 Multiple-entry Visa for Shenzhen hukou-residents

In April 2009, a multiple-entry visa policy for 2.2 million Shenzhen permanent residents was introduced in Hong Kong. This was another step in the relaxation of immigration policies for the Mainland, which will further drive the economic growth of Hong Kong and facilitate the use of HKIA by PRD residents³⁷.

2.103 It is expected that the programme is being considered for extension to 6.5 million non-household registered residents of Shenzhen in 2012. IATA Consulting anticipates a further increase in PRD inhabitants visiting Hong Kong in the near and mid-term.

2.104 IATA Consulting’s Evaluation

After assessment of the impact of travel policy developments on HKIA traffic, IATA Consulting has concluded that this factor will continue to develop gradually and continuously following historical trends. Therefore its impact is catered for in the regression based forecasting model and no special adjustment is needed.

Demand Consideration: Tourism development

2.105 Apart from economic and regulation related aspects, there are other factors affecting potential demand which HKIA can tap into. These factors are examined by IATA Consulting in the following paragraphs.

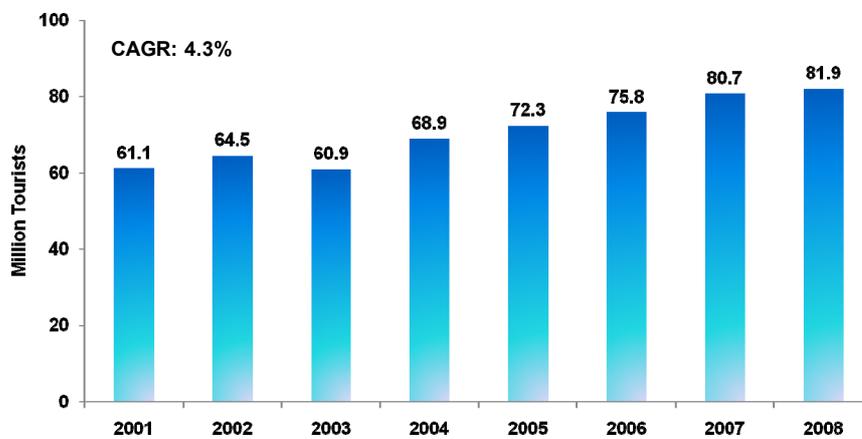
³⁷ Annual Report 2008-2009, Immigration Department of HKSAR

2.106 Tourism to and from HKSAR and the Mainland has been a major driver of growth in international air traffic. Hong Kong is strengthening its attractiveness with new projects for the decade 2010-2020. Relaxation of travel policy, economic growth and liberalisation of air services agreements will further drive the buoyant increase of inbound and outbound tourists to and from the Mainland.

2.107 Tourism to and from HKSAR

Outgoing tourism has grown 4.3% per annum from 2001 to 2008, almost in line with national GDP and Hong Kong can therefore be considered a mature market (see Figure 2.29).

Figure 2.29 : Evolution of Outbound Tourism in Hong Kong – 2001 to 2008³⁸

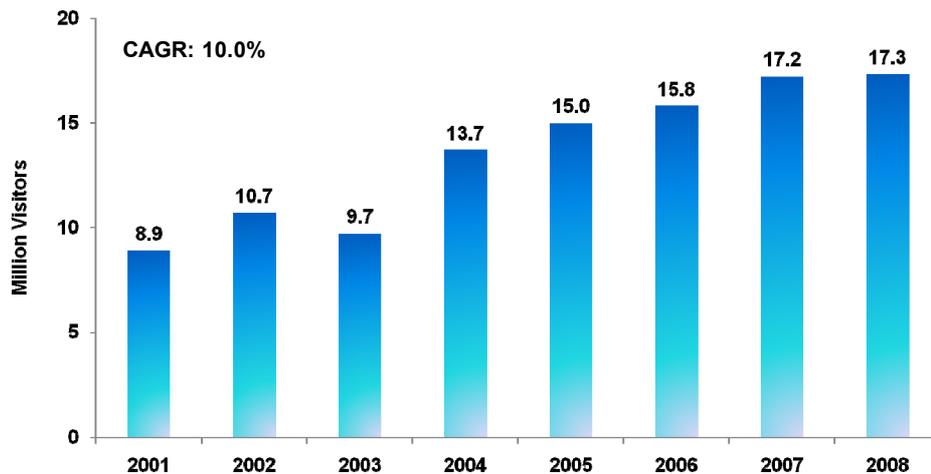


Note: The outbound tourists refer to the sameday and overnight tourists
Source: Hong Kong Tourism Board

2.108 Hong Kong’s incoming tourism market is affected by several highly dynamic factors and made up of two distinct segments: foreign tourists and Mainland tourists. Visitors to Hong Kong increased by 10% annually between 2001 and 2008 (see Figure 2.30).

³⁸ Research Statistics, PartnerNet, Hong Kong Tourism Board (HKTB)

Figure 2.30 : Evolution of Inbound Tourism in Hong Kong – 2001 to 2008³⁹



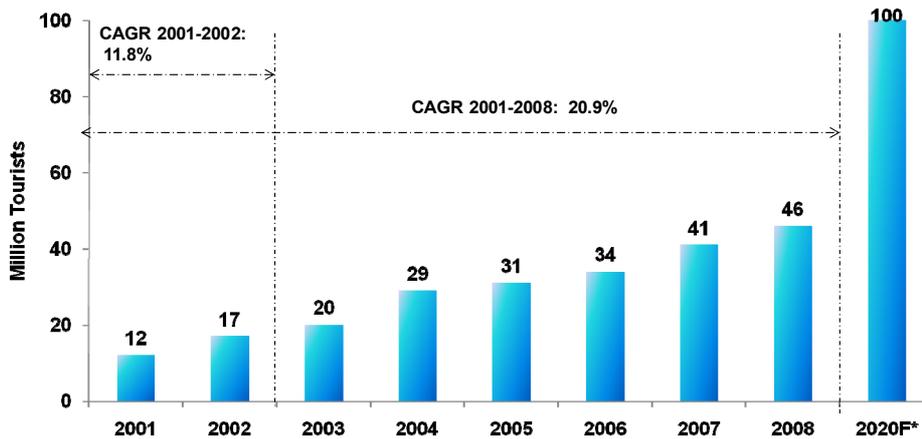
Note: The inbound tourists refer to the overnight tourists only
 Source: Hong Kong Tourism Board

2.109 Tourism to and from the Mainland

Since the beginning of the 21st century, the Mainland has experienced rapid and steady growth in its tourism industry. With regard to outbound tourism from the Mainland, the importance of Hong Kong as a destination has already been highlighted.

2.110 The total number of outbound tourists from the Mainland has increased from 12 million in 2001 to 46 million in 2008, recording an almost 21% annual increase (see Figure 2.31).

Figure 2.31 : Evolution of Outbound Tourism in the Mainland^{40, 41, 42} – 2001 to 2008



Note: The outbound tourists refer to overnight tourists only
 *WTO forecast
 Source: CNTA

³⁹ Research Statistics, PartnerNet, Hong Kong Tourism Board (HKTB)

⁴⁰ "CHINA'S OUTBOUND TOURISM: AN OVERVIEW" by Prof. Zhang Guangrui, Director, Tourism Research Centre, Academy of Social Sciences, WTM-ChinaContact Conference 2006

⁴¹ Tourism Statistics, National Tourism Administration of People's Republic of China

⁴² "Tourism 2020 Vision", Volume 3 East Asia & Pacific, by World Tourism Organization (UNWTO)

2.111 According to the World Tourism Organisation, the Mainland is likely to become the world's fourth largest source of outbound tourists by 2020 reaching over 100 million travellers per year. This increase is supported by several key factors including:

- Economic growth and increasing disposable income of Mainlanders;
- Relaxation of travel policy (ADS and IVS policy, simplification of the visa application process, alleviation of restrictions on foreign currencies);
- Increase in leisure time (paid holiday policy and change in the statutory holiday system);
- Change in consumption habits; and
- Improved international relationships.

2.112 Holiday System

The implementation of a new holiday system from 2008, elaborated below, will stimulate the outbound tourism from the Mainland in the coming years:

- The Central Government has recently modified the holiday system including a rearrangement of statutory holidays and the introduction of a paid holiday system.
- The previous system was based on two fixed holiday weeks in May and October. In 2007, the May Golden Week holiday was replaced by 5 flexible paid holidays and the number of statutory holidays was increased by 1 day to 11^{43,44}.
- As of January 2008, all employees of government agencies, enterprises and public-service institutions are entitled to take paid holidays after serving the same employer for one year. Employees who have worked less than 10 years are eligible for 5 paid days off a year; those who have worked for 10 to 19 years are eligible for 10 days and those who have worked for 20 years and above have 15 days. National holidays and weekends are not counted as paid holidays⁴⁵.

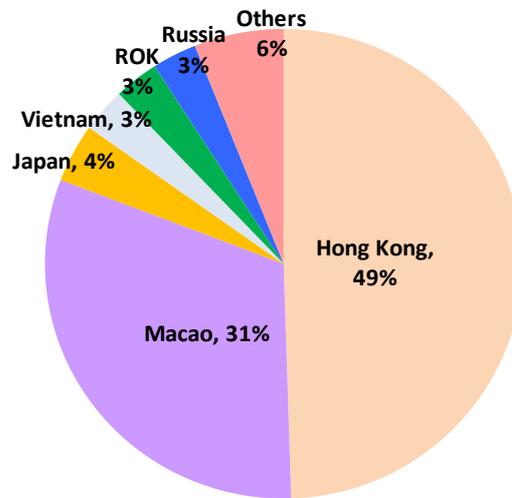
2.113 HKSAR ranked as the most preferred tourist destination for the Mainland Chinese in 2005. (see Figure 2.32).

⁴³ "China makes its holiday plans", EMT Worldwide, 21 January 2008

⁴⁴ "New holiday system set for first test", China Daily, 26 March 2008

⁴⁵ "China makes its holiday plans", EMT Worldwide, 21 January 2008

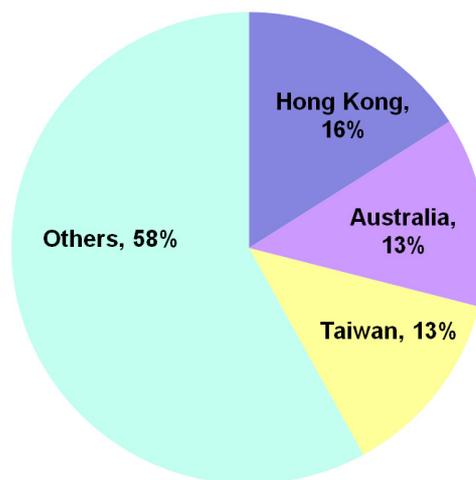
Figure 2.32 : Breakdown of Mainland Outbound Tourists by Destinations – 2005



Source: Tianjin University of Finance and Economics

2.114 As the Mainland’s economy develops, the propensity to travel will rise and a growing number of Mainland tourists are expected to fly abroad. A large number of them will select Hong Kong, replacing more ‘experienced’ travellers who will go further to South East Asia, Australia or other long-haul destinations. It should be noted that despite the interest of Mainlanders in Taiwan, Hong Kong remains their preferred destination for international travel (see Figure 2.33).

Figure 2.33 : Preferred International Destinations by Mainland Tourists⁴⁶ – 2008



Source: Visa and PATA, Asia Pacific Travel Intentions Survey 2009

⁴⁶ Visa and Pacific Asia Travel Association (PATA), Asia Pacific Travel Survey 2009

2.115 The inbound tourism market into the Mainland is also growing rapidly. The total number of inbound tourists grew from 91.7 million in 2003 to 131.9 million in 2007. In 2008, inbound tourism decreased to 130 million due to visa restrictions and the global financial crisis⁴⁷.

2.116 Inbound tourism is expected to keep growing as the Mainland modernises its tourism and hospitality infrastructure.

2.117 *IATA Consulting's Evaluation*

After assessment of the impact of the development of tourism on HKIA traffic, IATA Consulting has concluded that this factor will continue to develop gradually and continuously following historical trends. Therefore its impact is catered for in the regression based forecasting model and no special adjustment is needed.

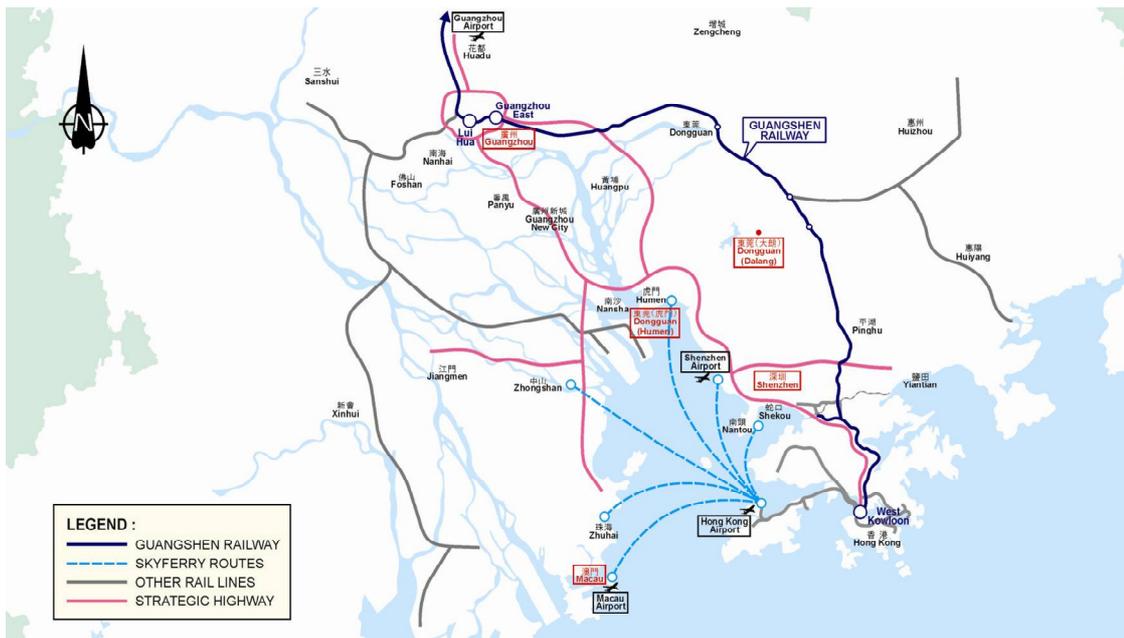
Demand Consideration: Cross-Boundary Infrastructure Development

2.118 A number of infrastructure improvement projects around the GPRD have been either approved or are under study. Several of these projects will improve the accessibility of GPRD airports, which is expected to strengthen their role. These infrastructure developments represent unprecedented factors whose specific impact on traffic was assessed by IATA Consulting. The most sizeable projects about to be implemented are:

- Tuen Mun-Chek Lap Kok Link (TMCLKL) and Tuen Mun Western Bypass (TMWB)
- Hong Kong-Zhuhai-Macao Bridge (HZMB)
- Guangzhou-Shenzhen-Hong Kong Express Rail Link (XRL)

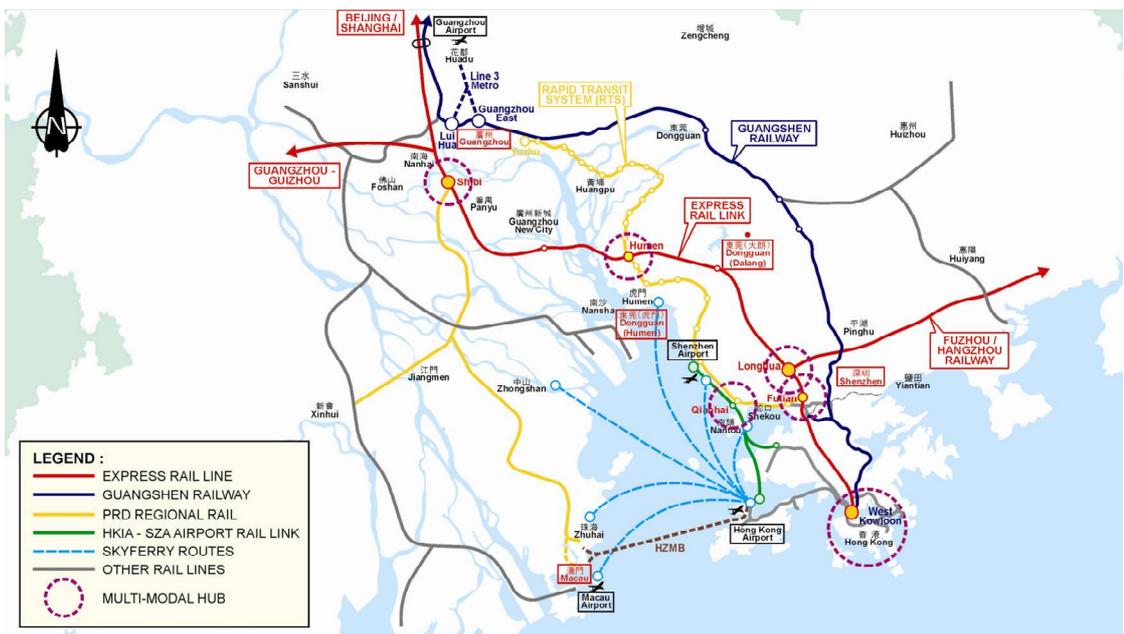
⁴⁷ China Travel Guide, Chinatour.com International Inc.

Figure 2.34 : Current Surface Transport in the GPRD



Source: AAHK, IATA Consulting and MVA

Figure 2.35 : Potential Future Surface Transport in the GPRD



Source: AAHK, IATA Consulting and MVA

2.119 TMCLKL and TMWB

With all major cross boundary roads from the PRD completed by 2016, the Tuen Mun Road, Ting Kau Bridge and Lantau link will be operating beyond capacity. The completion of the TMCLKL and TMWB is slated to synchronise with that of the HZMB, and will allow the growing ground traffic to access the airport. These projects will save 15-20 minutes in travel time between HKIA and the north-western New Territories, western

Shenzhen, and eastern PRD, providing much greater accessibility and increased competitiveness to the logistics industry, one of the four pillar industries of Hong Kong. The new infrastructure, however, will not have much impact on the distribution pattern of GPRD passengers and cargo traffic among the GPRD airports.

2.120 IATA Consulting’s Evaluation

After assessment of the impact of the TMCLKL and TMWB development on HKIA traffic, IATA Consulting has concluded that the improved access to the airport is already assumed in the demand forecast (by not constraining demand due to access issues). Therefore no special adjustment to the regression based model is needed.

2.121 HZMB

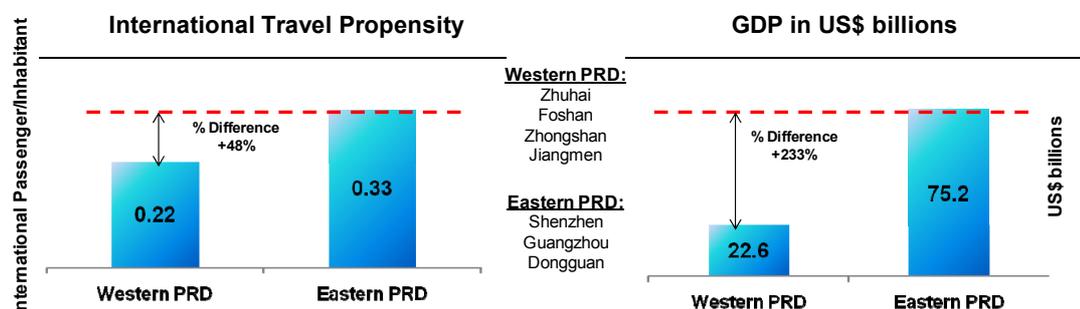
The HZMB, planned to be opened in 2016, will provide another transportation mode in addition to the Macao/Zhuhai ferry to Hong Kong. After evaluation, IATA Consulting has concluded that the bridge is likely to have a positive impact on the HKSAR and western PRD economy and therefore will boost the propensity to travel in the GPRD. However, the accessibility benefits will be limited to a small number of markets.

2.122 Impact on the economy

Several economic studies have analysed the role that connectivity played in the development of the western PRD. Some of these studies describe the operational area of HKSAR-based investors as a 3-hour circle around Hong Kong. With the current road transportation time of about 4-5 hours between Hong Kong and Macao, few HKSAR-based investors have moved across the Delta to develop their business.

2.123 Between 1980 and 2000, Dongguan and Shenzhen, benefiting from the massive investment led by HKSAR investors, have developed three times faster than Zhuhai and Zhongshan in the western PRD area.

Figure 2.36 : Comparison of the Eastern and Western Banks of the PRD in terms of International Travel Propensity and GDP – 2008



Source: China Bureau Statistics and MVA/IATA Consulting analysis

2.124 The bridge linking Hong Kong and Zhuhai is likely to stimulate flows of capital and expertise across the Delta. Overall, it will contribute to the further development of the GPRD economy, increasing the economic development and wealth of the western municipalities of Macao, Zhuhai, Zhongshan and Jiangmen.

2.125 On the one hand, the bridge is poised to boost the economy of the western bank of the Delta. On the other hand, given that the GPRD is an interlinked system and increased focus on the western areas will have an impact on other areas of GPRD, and hence the potential additional impact on the economy of the region.

2.126 It is assumed that the GDP forecasts used for PRD and HKSAR have already included the long-term impact of the bridge on the economy. Therefore, the likely industrial development of the western GPRD is already factored in the model.

2.127 Impact on connectivity within the GPRD

The bridge between Zhuhai/Macao and Hong Kong will change transportation use and habits around the GPRD. However, detailed analyses show that only HKIA and Macao airport will experience no change in their accessibility.

2.128 From Hong Kong

HKSAR passengers will see the best access time to Macao International Airport (MFM) cut by about 40 minutes from 150 minutes to 110 minutes. However, HKIA remains much closer with a 40-minute travel time between Hong Kong Island and the airport. Although there are no records of the number of HKSAR passengers flying via Macao airport, it is estimated that the number of passengers who are price sensitive and willing to travel to MFM for lower fares is currently very small. The extent of this potential diversion of traffic is expected to remain limited as low-cost services will be further developed in HKIA.

2.129 If MFM implements a more aggressive orientation towards low-cost carriers, the airport could be preferred in the future by HKSAR-related price sensitive travellers. However, as the time value of these travellers is low, a 40-minute reduction in the access time to Macao airport is unlikely to make a sizeable difference to the number of HKSAR passengers electing to use it.

2.130 From Macao

Macao passengers will see the best access time to HKIA reduced by about 30 minutes from 90 minutes to 60 minutes. Some Macao travellers may choose HKIA instead of MFM as access time is reduced. However, Macao airport remains the closest airport for Macao travellers with a 30-minute access time from downtown Macao. In addition to the decrease in access time, the bridge will probably increase the connection frequency between Macao and HKIA. However, with one sailing every hour, the Hong Kong-Macao ferry already offers a high level of service. Even with increased coach frequencies, the theoretical access time to HKIA airport would remain higher than the access time to Macao airport.

2.131 From Zhuhai

Travellers to and from Zhuhai will also benefit from a 30-minute reduction in access time to HKIA. As with Macao, access time to HKIA will go down from 90 to 60 minutes.

2.132 The bridge does not reduce the access time from any other locations of GPRD to any of the GPRD airports. In particular:

- HZMB does not improve the 2-hour ferry access time to Shenzhen from Macao and Zhuhai;
- HZMB does not improve the access time to any PRD airports from Jiangmen, Zhongshan and Foshan municipalities.

2.133 IATA Consulting's Evaluation

IATA Consulting has assumed that the impact of the development of HZMB on HKIA traffic has already been factored into the GDP forecasts for PRD and HKSAR. Since the forecasting model is GDP based, no special adjustment to the regression based model is needed.

2.134 However, the real economic impact of HZMB is still uncertain, as the toll and interfacing with the local areas are not yet confirmed. IATA Consulting believes it is prudent to test the sensitivities on the impact of HZMB assuming that it stimulates flows of capital and expertise across the Delta enabling the western PRD to catch up with the eastern PRD. A potential upside of around 1.5 million passengers in 2030 on top of the regression based model forecast could be added based on the following assumptions:

- HKIA market share in the western cities of the GPRD will follow the same trend as HKIA market share in GPRD international Origin and Destination (OD) traffic;
- International average travel propensity of the western bank cities will catch up with the eastern bank cities in 25 years (from 2016 to 2041);
- International OD demand from the western PRD cities will follow the international traffic forecast established for GPRD airports (excluding HKIA); and
- The additional traffic to HKIA is international and follows the distribution of international passengers at HKIA.

2.135 Similarly, a potential upside of around 0.8 million cargo tonnes in 2030 on top of the regression based model could be added based on the following assumptions:

- Industrial activity in the western PRD area would develop faster, partially closing the gap with eastern PRD and generating additional economic growth;
- The contribution of western PRD to GPRD air cargo traffic would double. (As the computer and communication industry accounts for about half of global air cargo traffic, it is assumed that 12% is a reasonable estimate for the current contribution of the western PRD cities to GPRD air cargo traffic.);
- GPRD international OD cargo traffic will achieve its forecast of 10.5 million tonnes in 2030, of which HKIA represents 61%; and
- Without the bridge and with no change in the distribution of the manufacturing activities around GPRD, western GPRD would account for 1.2 million tonnes in 2030. Factoring in the upside assumptions based on incremental development of

western GPRD due to the bridge would increase the total by another 1.2 million tonnes in 2030.

Demand Consideration: Passenger travelling preferences

2.136 Travellers prefer direct flight services. On a given route with competing direct and indirect services, direct services tend to capture 70% to 85% of the market despite the premium on price. However, direct air services are conditioned by traffic volume and unit revenue. The share of direct services usually increases as the economy flourishes.

2.137 In 2008, about 63% of the international market to and from the Mainland flew on direct services. This proportion was very high in comparison with more mature aviation markets such as Europe (56%), North America (53%) and Australasia (51%). The concentration of demand for international travel in the key areas of Beijing, YRD and PRD explains the gap. Over the forecast period, it is estimated that the proportion of direct traffic in the Mainland will remain stable as the result of opposite forces:

- As the Mainland further develops, other provinces will generate a higher share of demand for international travel, resulting in an increase in indirect traffic to these provinces.
- As the Mainland further develops, some indirect markets will become big enough to be serviced with direct flights. Additionally, the implementation of direct air links across the strait will also contribute to an increase in direct flights.

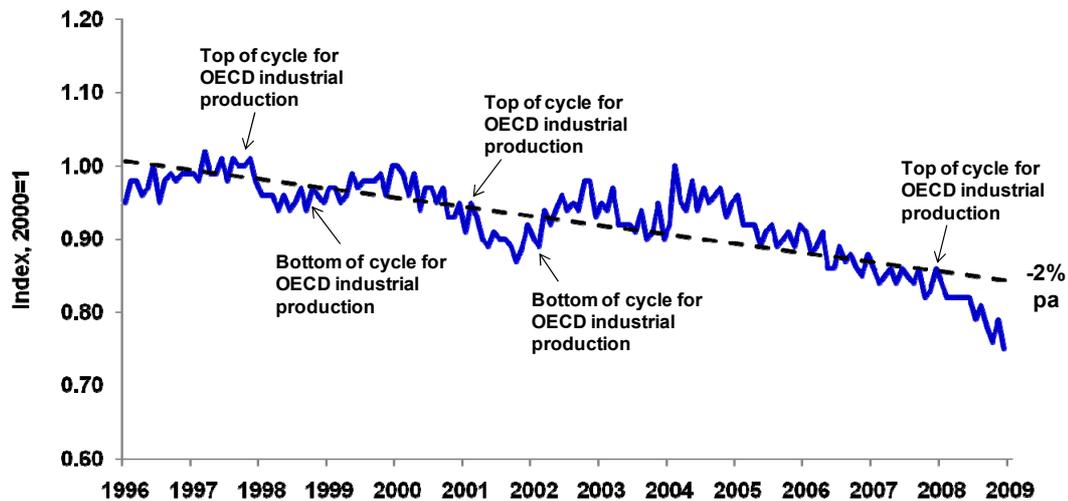
2.138 *IATA Consulting's Evaluation*

After assessment, IATA Consulting has concluded that the impact of developing passenger travelling preferences on HKIA traffic will continue to develop gradually and continuously following historical trends. Therefore its impact is catered for in the regression based forecasting model and no special adjustment is needed.

Substitution Factor: Modal competition: Air – Sea competition

2.139 For the past decade, air freight has been the preferred mode of transport within the shipment industry because of the rapid growth in manufacture of technological products (high value items) and time sensitive shipping.

Figure 2.37 : Air Freight as a Ratio to World Trade – 1996 to 2009



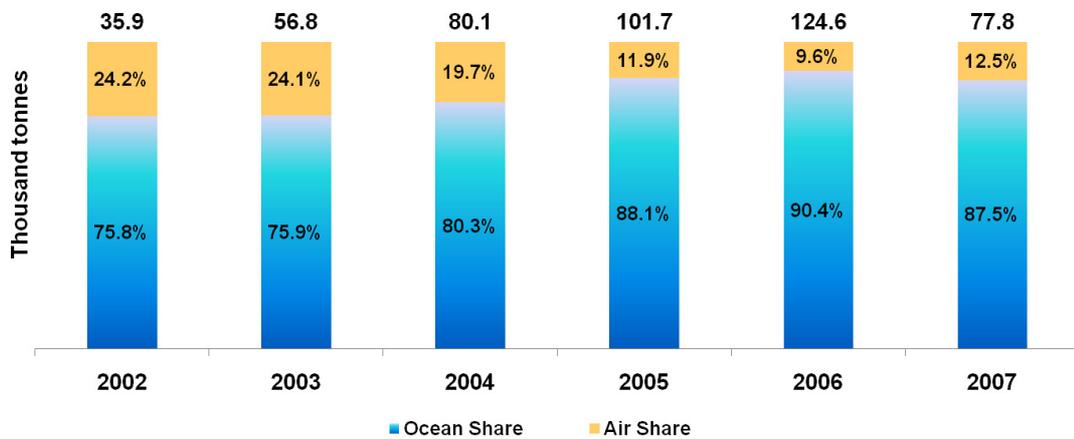
Source: IATA

2.140 For the past 15 years, the correlation between air cargo demand and world trade has been declining steadily (see Figure 2.37). There are two primary reasons for this decline⁴⁸:

- Increased competition with containerised shipping due to technology advances, increased speed, improved reliability and lower costs of sea transportation.
- Variations in product life cycle:
 - As products mature and demand is stable or declining, unit values decline as well and inventory carrying cost decreases. This results in a shift from air to sea transportation in order to keep costs down.
 - As a new generation replaces ageing products, product unit value is high resulting in high inventory carrying cost necessitating speedy/reliable transportation. In these scenarios, air shipment is preferred.
 - As new generations of products become lighter and lighter, growth of the air shipping market slows. Video monitors and projectors are examples of commodities with declining unit values.

⁴⁸ "End of an era? Why the 'super spike' in fuel prices may signal the end of 'super growth' in air freight" Report by MergeGlobal Value Creation Initiative, August 2008

Figure 2.38 : Air Freight Share Trend of Video Projectors/Monitors Commodity: Asia to United States – 2002 to 2007



Source: MergeGlobal

2.141 As a result of these trends, world air freight as measured in tonnes-km grew on average 2 percentage points below world trade growth between 1997 and 2008.

2.142 IATA Consulting’s Evaluation

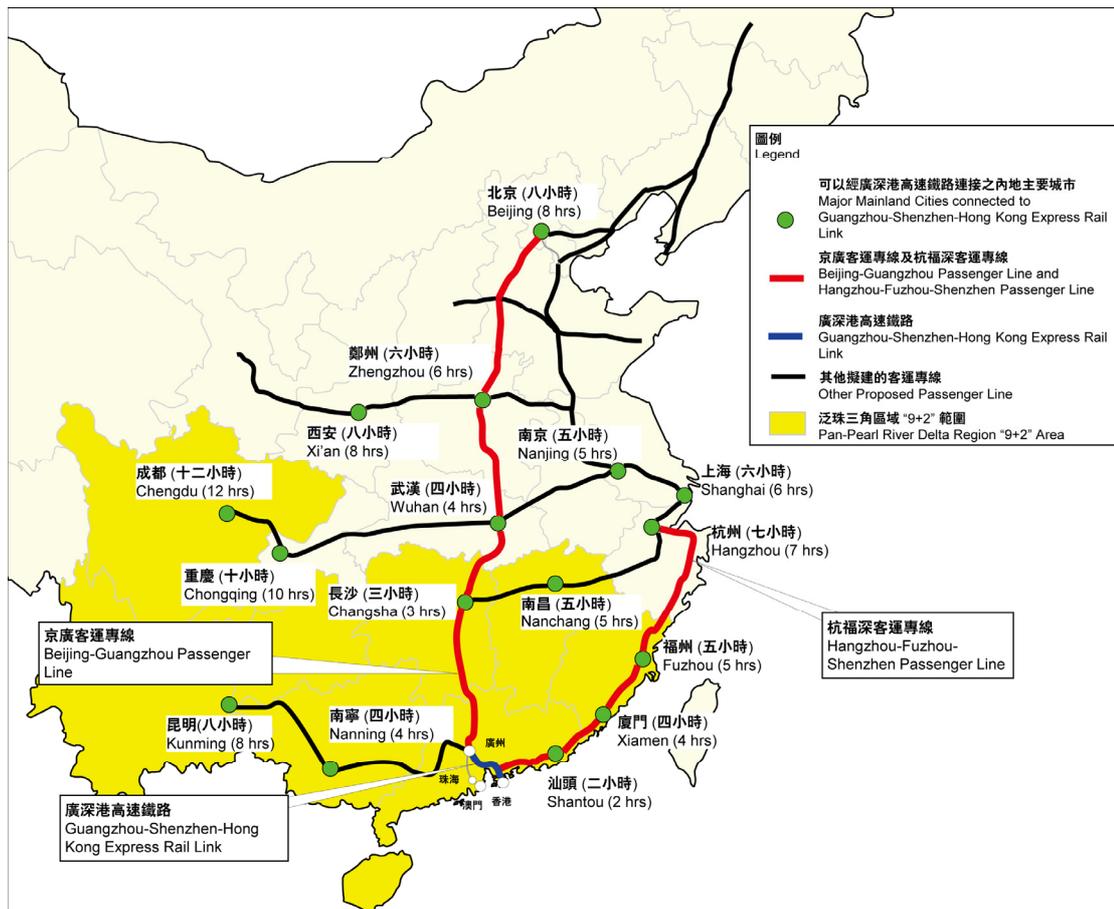
After assessment of the impact of air-sea competition on HKIA traffic, IATA Consulting has concluded that the shift from air to sea will continue at the same pace in the future. Even if it continues at the same pace, air shipping still provides one major advantage, namely speed of delivery. Based on Airbus’ research, general air cargo is delivered roughly a week faster than containerised sea shipment on the North Pacific, and close to a week and a half quicker than bulk sea shipment. Hence the speed of air cargo is still its core advantage and will remain essential for manufacturers and businesses. Therefore its impact is catered for in the regression based forecasting model and no special adjustment is needed.

Substitution Factor: High-speed Rail Development

2.143 By 2016, the Guangzhou-Shenzhen-Hong Kong Express Rail Link (XRL), a 26-kilometre railway, will connect Guangzhou, Shenzhen and Hong Kong and interconnect with the Mainland’s High Speed Train (HST) network.

2.144 The XRL will dramatically improve rail service quality and is expected to raise train transportation to a competitive level to air, although travel times will remain more advantageous for air. Therefore, a possible diversion from air to rail transportation modes has been evaluated.

Figure 2.39 : The Railway Infrastructure Development Map of the Mainland



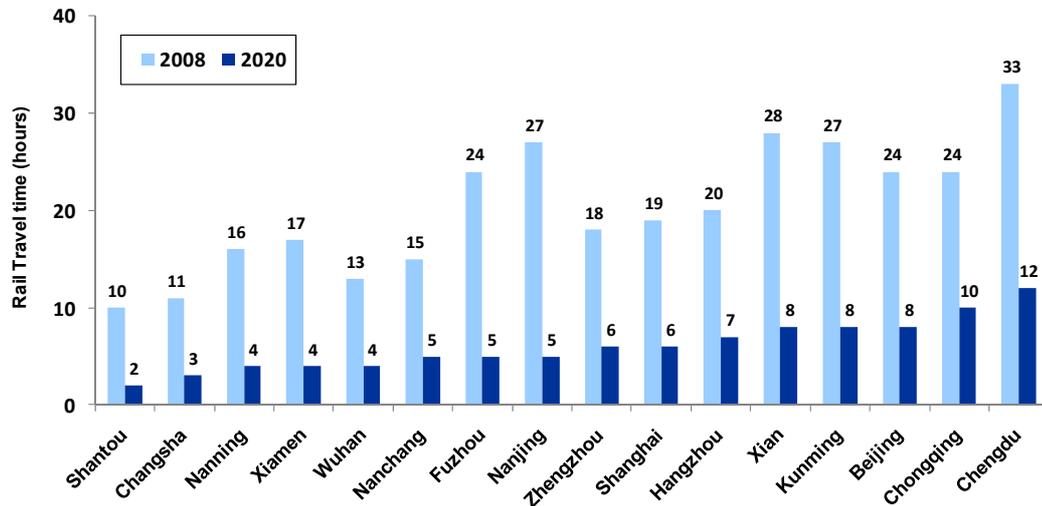
Source: Transport and Housing Bureau

2.145 As part of a trillion-US\$ infrastructure investment plan, the Mainland has embarked upon a large railway infrastructure development project connecting its main cities with high-speed trains capable of speeds of up to 300-350km/h. The Mainland's railway network expansion plan includes the construction of 13,000 km of high speed rail lines by 2012; and 16,000 km by 2020. The main corridors are from Guangzhou to Beijing, Shanghai to Kunming, Beijing to Shanghai, Xuzhou to Lanzhou and Shenzhen to Hangzhou.

2.146 West Kowloon Terminus (WKT) in Hong Kong will be connected to the Mainland's high speed train system through the XRL. Linking its main cities (Beijing to Guangzhou, Shanghai to Kunming, Shanghai to Shenzhen), the high-speed train is expected to cut rail travel time by a factor of two to five. Trips from HKSAR to Shantou will be reduced to 2 hours, Changsha to 3 hours, and to Nanning, Xiamen and Wuhan to 4 hours (see Figure 2.40). In addition, Nanchang, Fuzhou and Nanjing will be reachable within 5 hours. Trips to Zhengzhou, Shanghai and Hangzhou are expected to take within 7 hours from Hong Kong by high-speed train. Trips to Xian, Kunming and Beijing are expected to take around 8 hours. Trips to Chongqing and Chengdu are expected to exceed 8 hours.

2.147 Depending on demand, the Mainland’s Chinese HSTs will be made of 8 cars (600 seats) or 16 cars (1200 seats). This configuration is very similar to the European model where single trains usually offer 350-550 seats and double trains, 700-1100 seats.

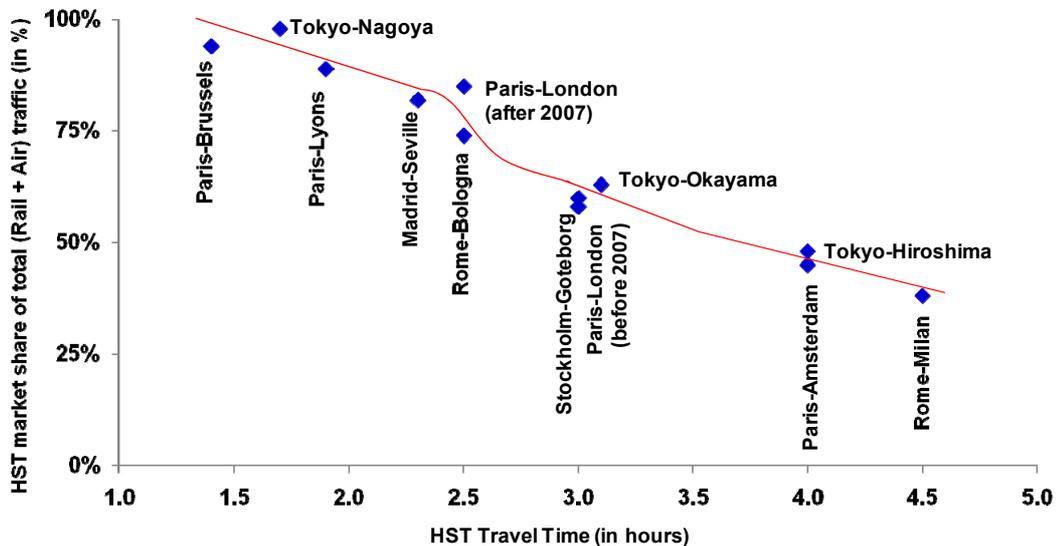
Figure 2.40 : Evolution of the Shortest Rail Travel Times from Hong Kong between 2008 and 2020



Source: Transport and Housing Bureau, IATA Consulting estimates

2.148 Since high-speed rail is a relatively new phenomenon in the Mainland, it is helpful to analyse the European and Japanese experiences, two markets with a long history of high-speed train operations, to understand how this development may impact the aviation market. In Europe and Japan, high-speed rail transportation tends to dominate when rail travel time does not exceed 3.5 hours. A 3.5-hour train trip corresponds to 1,000 km. For shorter distances, HST benefits from approximately a 1.5 hour advantage over air travel: rail stations are typically closer to the town than airports; air travel requires longer processing time for departure and arrival. So far, there have been no studies investigating the train capture rates for journeys beyond 4.5 hours (which corresponds to about 1,300 km).

Figure 2.41 : Current Correlation between Rail Travel Time and Rail Market Share on OD traffic; European and Japanese routes – 2008



Source: Railway Operators, UIC

2.149 Recent surveys confirm the empirical observation, revealing that travel time is the most influential element when choosing high-speed trains as the mode of transport⁴⁹. Money saving does not appear to be a key decision criterion when it comes to choosing between air and rail.

2.150 New demand is generally induced further to the launch of HST services, benefiting both rail and air. Induction rates are quite variable and range from 8% to over 100%. Examples taken from European and Japanese environments suggest that +10% is a conservative assumption for the level of new demand that could be generated:

• France:	
○ Overall HST network	+ 10%
○ Paris-Lyon (2hr HST)	+ 25%
○ Paris-Marseilles (3hr HST)	+ 45%
• Japan:	
○ Shinkansen	+ 8%-150%
• Spain:	
○ Madrid-Seville (2hr30 HST)	+ 15%

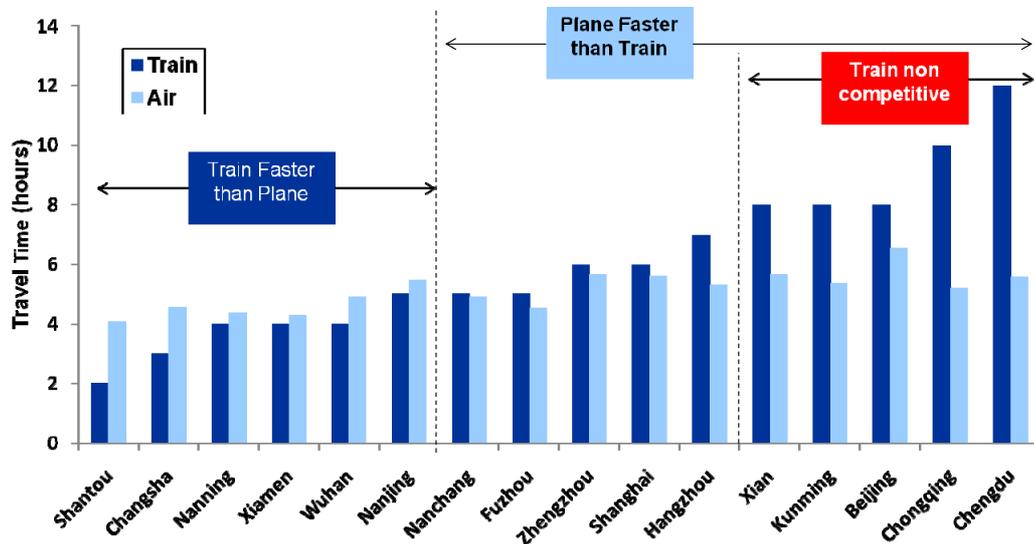
2.151 Additionally, rail and air transportation modes can combine into air-rail intermodal services. Major hubs like Frankfurt airport, Paris-Charles de Gaulle or Amsterdam-Schiphol all benefit from rail intermodality that significantly enlarges their catchment area and diverts long-haul and medium-haul air passengers from competing hubs. The

⁴⁹ A study of the development and issues concerning high speed rail (HSR), Yong Sang Lee Korea Railroad Research Institute and Transport Studies Unit, University of Oxford; Working paper N° 1020; January 2007; page 10 table 13

convenient connection of these airports to the HST network seems to be a key requirement to do this effectively.

2.152 With the development of the XRL connecting Hong Kong to the Mainland’s high-speed rail network, and further expansion of the high speed rail network within the Mainland (see Figure 2.39), high-speed rail could potentially affect the competitiveness of air travel between Hong Kong and short-haul Mainland destinations like Shantou, Changsha, Nanning, Xiamen, Wuhan, Nanjing, Nanchang and Fuzhou (see Figure 2.42). However, all these regional Mainland routes combined contributed only about 3% of HKIA’s passenger throughput in 2010. Therefore, any negative impact from the XRL is unlikely to be significant. On the other hand, trains provide convenient and frequent link-up to second-tier and third-tier locations outside major cities, thus potentially enlarging the catchment area for Hong Kong.

Figure 2.42 : Projected High-Speed Rail Travel Time versus Air Travel Time from Hong Kong in 2020



Note: Air travel time includes an additional three-hour dwell and access time on top of the flight duration

Source: IATA Consulting estimates, Transport and Housing Bureau

2.153 IATA Consulting’s Evaluation

After assessment of the development of XRL on HKIA traffic, IATA Consulting has concluded that the net impact on HKIA would be negligible. Although flights to short haul markets in the Mainland may be negatively impacted, the experience in Europe and Japan has shown that the introduction of high speed rail can increase people’s willingness to travel and in the medium to long term, increase the overall market size for both rail and air transportation markets, thereby compensating (or in most cases, over-compensating) for any air traffic loss on specific routes. Therefore no special adjustment to the regression based model is needed.

Surrounding Airports

- 2.154** The provision of air services to a community can be viewed from two very different dimensions. On the one hand, it serves to satisfy the demand for travel and for the transportation of cargo. In addition, the economic activities it generates facilitate the development of the entire economy, bringing substantial economic benefits beyond just the aviation sector. The relationship between HKIA and its surrounding airports must be viewed from both these dimensions.
- 2.155** Purely from the transportation point of view, the existence of airports with sufficient capacity and good connectivity nearby would offer both travellers and shippers more choices and thus greater convenience. However, if such traffic were processed through neighbouring airports instead of HKIA, all the economic activities associated with such traffic would take place outside Hong Kong as well. Hong Kong, as a whole, would suffer substantial economic loss as reflected in lesser revenue for our airport operation (and thus lower return on our investment); the loss of potential business and jobs in the aviation-related industry (for example, airlines, airport support services, etc.); and the loss of economic value to the community that could otherwise be created through the aviation industry and its employees. Hence, the following analysis from IATA Consulting of the surrounding airports should be viewed from these two dimensions.

Airport Development in the GPRD Region

- 2.156** In 2008, the five airports in the GPRD region together handled 110 million passenger trips and 5 million tonnes of cargo. HKIA alone handled 44% of these passengers and 72% of the cargo. If only international airport traffic among the five airports is counted, HKIA alone handled around 80% of international passengers (excluding Hong Kong-Mainland) and around 90% of international cargo throughput.

Figure 2.43 : GPRD Airports Total Traffic in 2008

Airport Traffic in 2008	Passenger (Million trips)	Cargo (Million tonnes)
Hong Kong International Airport	48.6*	3.63
Guangzhou Baiyun Airport	33.4	0.69
Shenzhen Bao'an International Airport	21.4	0.60
Macao International Airport	5.1	0.10
Zhuhai Airport	1.1	0.01
Total	109.6	5.02

Note: *Transit passenger counted twice

Source: CAAC, AAHK, airport websites

- 2.157** Guangdong's exposure to Hong Kong's international market and foreign enterprises over the decades has resulted in a more mature economy than that of the rest of the Mainland. As the Mainland's economy continues to develop rapidly, the rest of the Mainland is expected to narrow the gap with Guangdong. Nevertheless, the GPRD region's total traffic (including Hong Kong and Macao) will approach 390 million passenger trips and 18 million tonnes of cargo in 2030. In light of this anticipated

growth in demand, airports in Guangzhou and Shenzhen have embarked upon major facility expansion plans.

2.158 Guangzhou Baiyun International Airport

The new Guangzhou Baiyun International Airport at Huadu commenced operations in 2004. Construction of two new concourses for its Terminal 1 has just been completed, raising annual handling capacity to 45 million passengers. Terminal 2 is expected to be operational in 2013, bringing annual capacity to 75 million passengers. Runway capacity is also expected to increase significantly, with a third runway expected by 2013, a fourth by 2020⁵⁰ and ultimately a fifth. By 2030, Guangzhou Baiyun International Airport is expected to have an annual capacity of approximately 90 million passengers.

On the cargo side, FedEx opened its largest hub outside the United States at Guangzhou Baiyun International Airport in February 2009. The hub, which focuses on intra-Asia traffic, initially has 30 parking positions but will expand to 50. The airport is also expected to pursue a strategy to better serve its catchment area and has begun implementing plans to open a second off-airport cargo station in Zhuhai. By 2015, cargo capacity will exceed 2 million tonnes.

2.159 Shenzhen Bao'an International Airport

Shenzhen Bao'an International Airport started operations in 1991. It now operates over 3,800 scheduled passenger flights per week to 77 destinations (including 11 international points)⁵¹, more than 3 times the weekly frequency it offered 10 years ago. To meet fast-growing demand, a second runway will open in 2011 and a third terminal in 2015, bringing annual capacity to 45 million passengers. The airport's current plan is to achieve an annual capacity of 60 million passengers by 2035.

It is also expected that Shenzhen Bao'an International Airport will capitalise on the local government's emphasis on cargo and logistics to develop into a major air cargo hub. This is consistent with the National's 11th Five-Year Plan, which sets aggressive goals for Shenzhen to bolster its logistics sector, including port and airport-related activities. UPS recently relocated its intra-Asia air hub operations from the Philippines to Shenzhen, and operations commenced in May 2010.

2.160 Macao International Airport

Macao International Airport commenced operations in November 1995. Macao International Airport is a fully functional 24-hour airport. Phase one of the airport is equipped with a full range of passenger and cargo facilities designed to handle 6 million passengers and 165,000 tonnes of freight a year.

⁵⁰ Source: 印发广州空港经济发展规划纲要的通知, 广州市人民政府办公厅秘书处 2010年8月2日印发

⁵¹ Data based on OAG 6/12/2010 and 11/12/2000 weeks

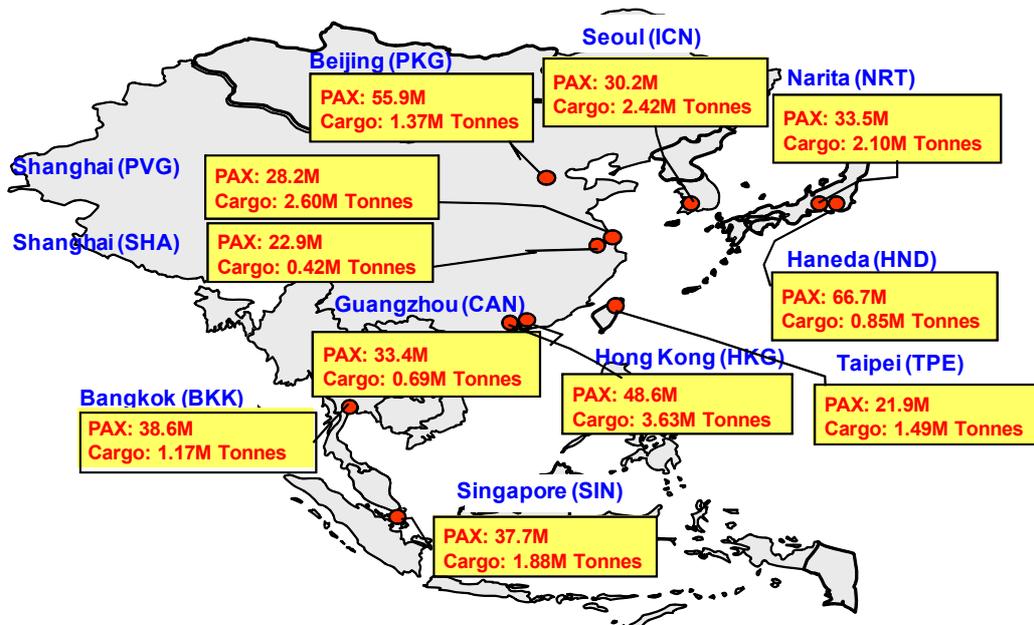
2.161 Zhuhai Airport

Zhuhai Airport started commercial operations in 1995 and was taken over in 2006 by a management company that is jointly owned by AAHK and Assets Supervision and Administration Commission of Zhuhai Municipal People’s Government under a 20-year agreement. Zhuhai Airport offers domestic flights to major Mainland cities and is used predominantly by the Mainland’s networks and low-cost carriers. Based on the rapid economic development recorded in 2007 and 2008, the airport aims to address the growing demand from the PRD, targeting 2 million passengers and 50,000 tonnes of cargo in 2011.

Airport Development in Asia

2.162 In 2008, Asia had 11 major hubs handling around half a billion passenger trips and close to 20 million tonnes of cargo.

Figure 2.44 : Major Airports in Asia



Note: Asia 2008 traffic used ACI APAC total minus Australasia
 Source: ACI’s World Airport Traffic Report 2008 and 2009

2.163 All the major airports in Asia have plans to expand in response to expected growth in demand over the next decade.

2.164 *Shanghai Pudong International Airport* is the world’s 41st-busiest airport for total passenger throughput and third for total cargo throughput. In 2008, it increased its annual capacity from 20 million to 60 million passengers, and 4.2 million tonnes of cargo. It is now planning to add a new terminal and two more runways (from three runways to five) by 2015, further increasing its capacity to 80 million passengers.

2.165 *Beijing Capital International Airport (BCIA)* is the world's eighth-busiest airport for total passenger throughput and eighteenth for total cargo throughput. It officially opened in March 1958 under the administrative control of the Civil Aviation Administration of China (CAAC). Passenger Terminal 1, covering an area of 60,000 square metres and its auxiliary facilities, including parking apron and car parks, were officially put into service in January 1980. It was designed to serve 60 flights daily and 1,500 passengers at peak hours.

With the continuous growth in both number of international airlines flying to Beijing and the density of flights, the airport was enlarged again in 1999. Terminal 2, covering an area of 336,000 square metres and equipped with state-of-the-art facilities, officially went into operation in November 1999. Terminal 2 is able to handle 26.5 million passengers every year.

Terminal 3 became fully operational in 2008. Upon its opening, it was the largest airport terminal-building complex built in a single phase, with a total floor area of 986,000 square metres. It features a main passenger terminal and two satellite concourses. It increased BCIA's total capacity by 50 million passengers per year to approximately 82 million.

In order to accommodate future demand, a second airport is expected to be built in the southern part of Beijing.

2.166 *Incheon International Airport* is the world's 39th-busiest airport for total passenger throughput and fourth for total cargo throughput. The Korean Ministry of Land, Transport, and Maritime Affairs stated that the government would invest US\$3.13 billion by 2015 to develop Seoul into Asia's transportation hub to attract more business. Upon completion of its expansion plans, Incheon International Airport will be capable of handling 62 million passengers and 5.8 million tonnes of cargo a year, up from the current 44 million passengers and 4.5 million tonnes of cargo. It ultimately plans to increase its handling capacity to as much as 100 million passengers and 7 million tonnes of cargo per annum. The airport's aspiration is to continue reinforcing its position as a hub for Asia and Mainland China for traffic to/from North America.

2.167 *Narita and Haneda Airports* in Japan are the two primary airports serving the greater Tokyo area. Narita is the world's 31st-busiest airport for total passenger throughput and eighth for total cargo throughput; and Haneda is the world's 4th-busiest airport for total passenger throughput. Haneda handles almost all domestic flights to and from Tokyo while Narita handles almost all international flights. In recent years, however, international services from Haneda have expanded significantly with the addition of "scheduled charter" flights to Seoul, Shanghai and Hong Kong. The Japanese government plans to expand Haneda's international role in the future with more regional flights and off-peak charter services in light of Narita's congestion and expansion issues.

Haneda's third terminal for international flights and a Fourth Runway were completed in October 2010. An international air cargo facility will also be constructed nearby. The addition of this new runway is expected to increase Haneda's operational capacity from

285,000 movements to 407,000 movements per year. Haneda is expected to be able to handle 90 million passengers after its expansion in 2010.

2.168 *Singapore Changi Airport* is the world's 19th-busiest airport for total passenger throughput and tenth for total cargo throughput. The airport has just increased its capacity to 68.7 million passengers and 3.2 million tonnes of cargo with the opening of Terminal 3. With the planning of Terminal 4 under discussion, airport capacity is projected to increase by an additional 20 million passengers in 2015. It is anticipated that the airport will pursue its aviation hub strategy for both legacy and low-cost carriers. With the expansion, Singapore Changi is expected to improve its capability to serve ASEAN⁵² transfer/transit traffic.

2.169 *Taipei Taoyuan Airport* is the world's 58th-busiest airport for total passenger throughput and fifteenth for total cargo throughput. In 2008, Taipei Taoyuan Airport handled 21.9 million passengers. The expected surge in traffic from the Mainland will very likely saturate the capacities of most Taiwanese airports, including Taoyuan, and Taiwan is reportedly working on the revision of its airport plan.

On the cargo front, the airport aims to create an Airport City and become a global logistics hub in East Asia. Approximately 1,250 hectares of land will be allocated to develop logistics and office activities, including an extension of the current Free Trade Zone. Direct cargo links will make it easier for Taipei to develop as a regional hub and even a long-haul hub between Asia and the United States. If required, the construction of a third runway is envisaged in the long term.

2.170 *Bangkok Suvarnabhumi Airport* is the world's 18th-busiest airport for total passenger throughput and twentieth for total cargo throughput. It was officially opened for most domestic and all international commercial flights in September 2006. The airport has two parallel runways and two parallel taxiways to accommodate simultaneous departures and arrivals. It has a total of 120 parking bays, five of which are capable of accommodating the Airbus A380 aircraft. With a capacity of 76 aircraft movements per hour, both international and domestic flights share the airport terminal but are assigned to different parts of the concourse. In the initial phase of construction, it will be capable of handling 45 million passengers and 3 million tonnes of cargo per year. Ultimately, it aspires to be the primary gateway to Thailand and to serve 100 million passengers and over 6 million tonnes of cargo annually.

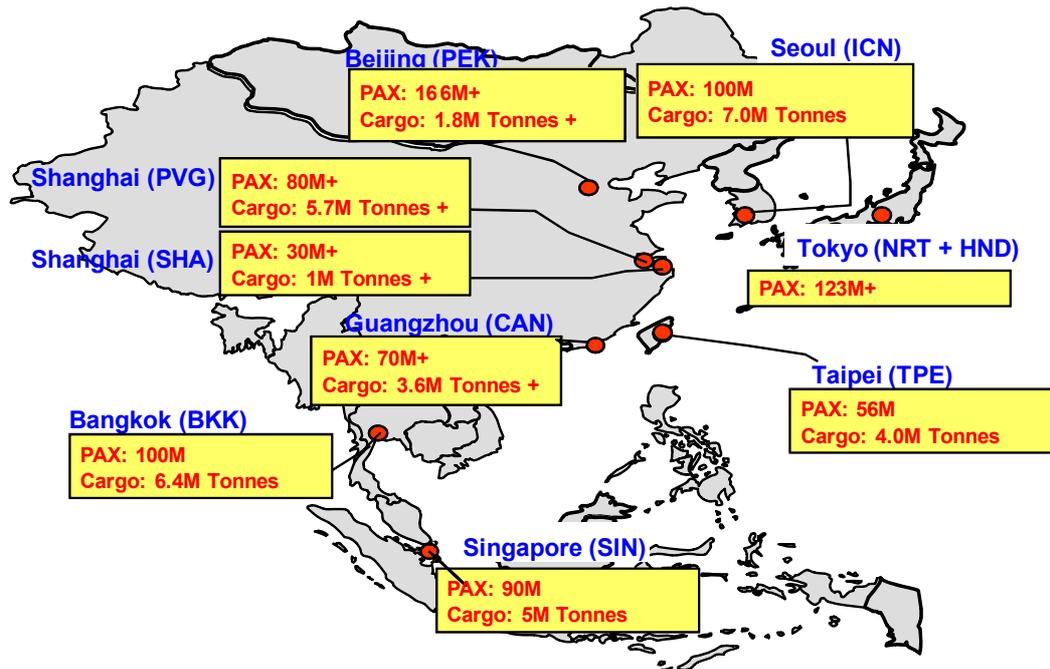
2.171 In summary, all the key hubs in Asia have aspirations, plans or projects underway to grow to service their countries and catchment areas, and pose challenges to HKIA. Competition faced by HKIA in this regard is two-fold:

- Threats to HKIA's share of indirect international traffic flow into/out of the Mainland; and
- Threats to HKIA's share of long-haul connecting traffic between the U.S./Europe and South Asia/Australasia.

⁵² The Association of Southeast Asian Nations (ASEAN) comprises 10 countries located in South East Asia, namely Indonesia, Malaysia, the Philippines, Singapore and Thailand, Brunei, Burma (Myanmar), Cambodia, Laos and Vietnam.

2.172 In 2008, around 40% of passenger traffic into/out of the Mainland was indirect, and HKIA was the dominant hub airport handling this indirect traffic flow⁵³. Its geographical location makes HKIA a very attractive gateway between North America and South East Asia, ranking among the top three connecting hubs along with Taipei and Narita. However, Bangkok and Dubai are taking the leading roles as connecting hubs between Europe and South East Asia. Similarly Singapore and Dubai are taking the leading roles as connecting hubs between Europe and Australasia⁵⁴. Figure 2.45 shows the potential Asia airport landscape (excluding HKIA) in the long term.

Figure 2.45 : Potential Asia Airport Landscape



Tokyo: Forecast for 2017

Guangzhou: Forecast for 2020

Taipei: Forecast for 2030

Beijing: Cargo forecast for 2015

Passenger forecast for 2020, including second airport

Shanghai (PVG + SHA): Forecast for long term (遠期)

Bangkok, Seoul: Ultimate design capacity

Singapore: IATA

Source: Literature research

2.173 IATA Consulting's Evaluation

After assessment of the impact of airport competition on HKIA traffic, IATA Consulting has concluded that the intensifying competition among airports has already started to develop in the past decade and the trend will continue in the future. Therefore its impact is generally factored into the regression based forecasting model. The one exception, in IATA Consulting's view, is transshipment cargo where the development of Shanghai

⁵³ IATA AirportIS 2007m IATA adjustments

⁵⁴ IATA PaxIS

Pudong and Taipei in particular will step up in the future and adversely impact HKIA's competitiveness in this area. The estimated negative impact from intensification of competition on the transshipment market to HKIA's regression based forecast for 2030 is around 0.3 million tonnes.

Airline Development Strategies

2.174 Airline and airport strategies are often interrelated. Relevant developments are also incorporated into other sections of the report. However, due to commercial sensitivities, detailed findings regarding airline development strategies cannot be revealed.

2.175 IATA Consulting's Evaluation

IATA Consulting considered all possible changes in the strategies of the airlines serving HKIA and its competitors and no disruptive change is anticipated apart from areas already discussed in the previous sections. Therefore no special adjustment is needed to the regression based forecast.

HKIA Unconstrained Air Traffic Demand Forecast up to 2030

2.176 After developing the GDP regression based forecasting model and fully assessing the various aspects of HKIA's market environment, IATA Consulting has concluded that the regression based projections (base case) should be amended with the following adjustments (see Figure 2.46).

Figure 2.46 : Adjustment Factors to Regression Based Passenger and Cargo Traffic Forecast

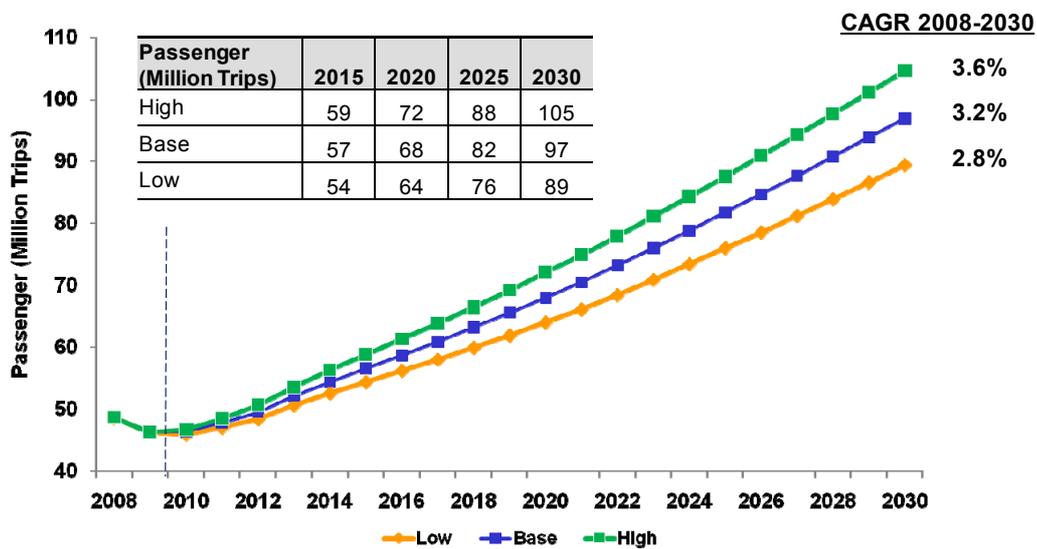
Passenger (Incremental Impact to Regression Based Forecast in 2030)	Cargo (Incremental Impact to Regression Based Forecast in 2030)
Direct Links (Negative 1.3 Million)	Direct Links (Negative 0.7 Million Tonnes)
N/A	Intensification of competition on the Transshipment market (Negative 0.3 Million Tonnes)
N/A	Relocation of UPS and FedEx hubs to PRD from the Philippines (Negative 0.2 Million Tonnes)

Source: IATA Consulting's Methodology

2.177 In addition, although the preliminary conclusion is to not include any incremental impact caused by XRL and HZMB, in the regression based forecast, IATA Consulting is of the view that they will potentially have a positive effect on HKIA. This needs to be further explored as the pricing and economic impact of these projects is further studied/confirmed.

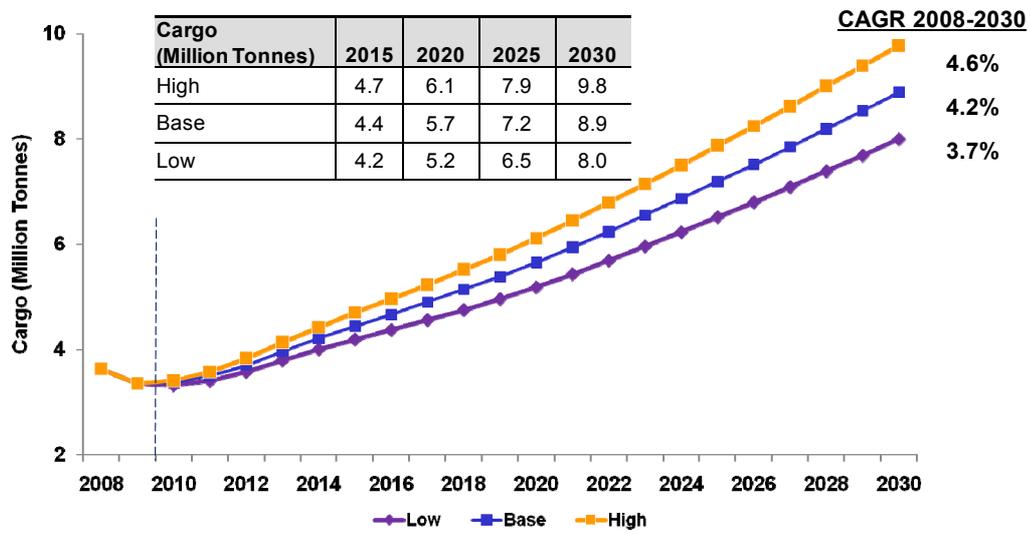
- 2.178 To derive the high and low range of HKIA traffic demand up to 2030, IATA Consulting has applied the 95% Prediction Interval. Prediction Intervals provide a measure of the accuracy of the model. The 95% Prediction (P95) Interval is the interval within which future traffic is expected to fall with a 95% probability given the historical figures (traffic and GDP). The P95 interval is usually considered the most appropriate indicator of traffic sensitivity by airport investors.
- 2.179 Based on the GDP regression model, and the consideration of potential incremental adjustments to HKIA air traffic demand as described in previous sections, IATA Consulting estimates that **air traffic demand for HKIA will fall within the range of 89-105 million passengers and 8-9.8 million tonnes of cargo by 2030** with 95% prediction interval, with respective CAGRs of 2.8%-3.6% and 3.7%-4.6% between 2008 and 2030 (see Figures 2.47 and 2.48).

Figure 2.47 : HKIA Passenger Traffic Projection (Up to 2030)



Source: IATA Consulting estimates; AAHK statistics for actual figures

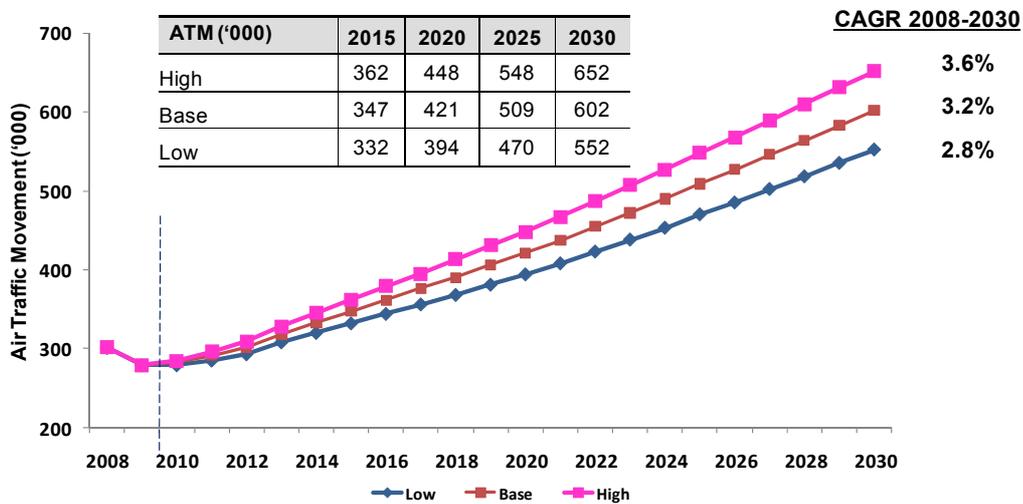
Figure 2.48 : HKIA Cargo Traffic Projection (Up to 2030)



Source: IATA Consulting estimates; AAHK statistics for actual figures

2.180 Based on historical passenger and cargo payload, future aircraft trends and airline fleet plans, IATA Consulting has estimated that **air traffic movements will reach 552,000-652,000 by 2030**, with a CAGR of 2.8%-3.6% (see Figure 2.49).

Figure 2.49 : HKIA Air Traffic Movement Projection (Up to 2030)



Source: IATA Consulting estimates; AAHK statistics for actual figures

Reality Checks

2.181 **Reality checks** with industry sources were carried out by comparing the IATA Consulting forecast with various other long-term forecasts produced by the relevant entities.

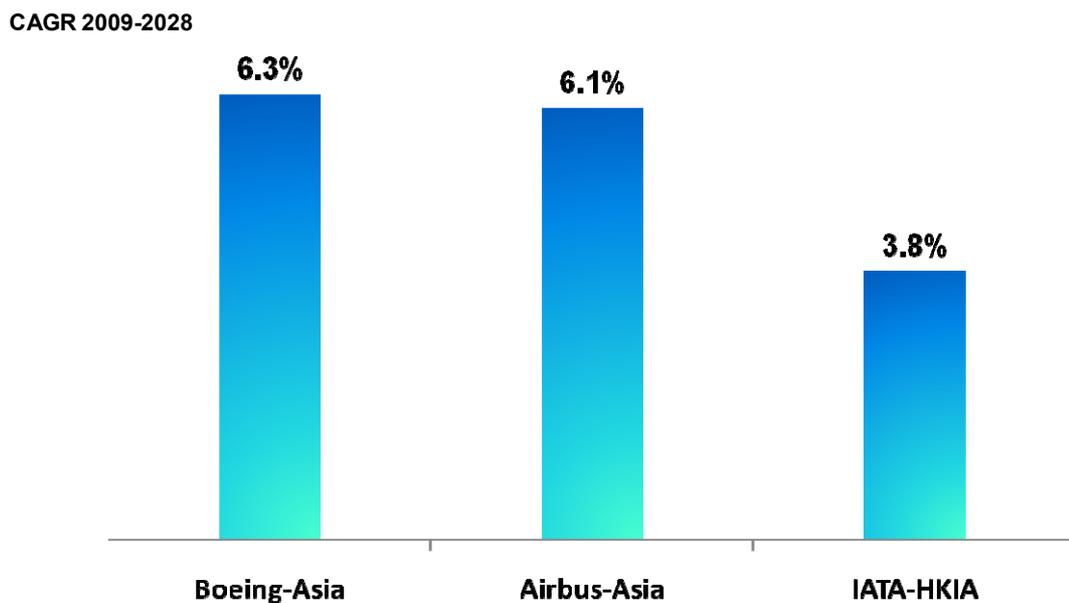
Figure 2.50 : Traffic Forecasts from Boeing and Airbus

CAGR 2009-2028	Boeing	Airbus
Asia Pacific Region		
Passenger	6.3%	6.1%
Cargo	6.0%	6.3%
China		
Passenger	7.6%	7.3%
Cargo	6.6%	7.8%
World		
Passenger	4.7%	4.5%
Cargo	5.2%	5.0%

Source: Boeing and Airbus

Passenger Forecast

Figure 2.51 : Comparison of Boeing, Airbus and IATA Consulting Passenger Forecasts – 2009 to 2028

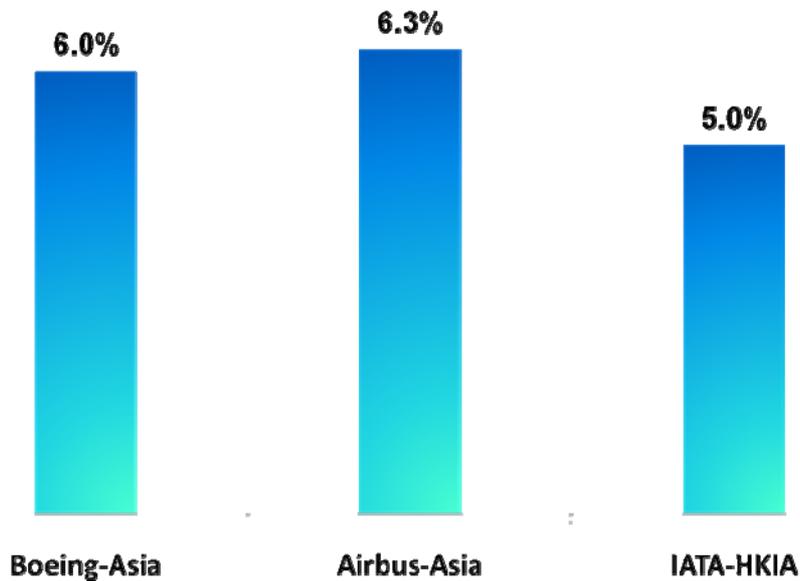


Source: Boeing, Airbus and IATA analyses and estimates

2.182 Boeing and Airbus do not forecast traffic for Hong Kong individually. Among the available forecasts, it has been concluded that the forecast for Asia is the most relevant one to use, for the following reasons:

- About 74% of HKIA passenger traffic relates to Asia; and
- Hong Kong’s economy has proven to be very much tied to the Asian economy at large with almost parallel GDPs.

- 2.183** For the forecast period, Boeing forecasts an annual growth rate of 6.3%, the highest amongst the three forecasts; Airbus forecast a growth rate of 6.1%. Both forecasts include the impact of the global financial crisis and take into account the low 2009 base.
- 2.184** Both Boeing's and Airbus' forecasts are driven by an increase in intra-Asia demand provided by the growing long haul Low Cost Carrier (LCC) market and the opening of the Mainland, India/Middle East and developing Southeast Asia tourism markets. The lifting of restrictions on cross-strait flights between Taiwan and the Mainland further supports Boeing's and Airbus' forecast.
- 2.185** The demand between the North American region and Asia is expected to follow historical growth trends at a slightly slower rate than that projected by Boeing and Airbus due to market maturity. Passenger traffic will benefit from the opening of Chinese markets and increasing travel demand to/from Southeast Asia.
- 2.186** The European market will follow similar trends to those of North America. Fuelled by the Mainland's liberalisation and increasing travel interest from Southeast Asia to Europe as described by Boeing and Airbus, growth is expected to be higher than that of the North American region. The development of the aviation market of Southern and Eastern Europe will further amplify travel demand growth into Europe.
- 2.187** IATA Consulting forecasts that HKIA will follow a lower growth rate than Boeing and Airbus. The main reasons are as follows:
- Similar to Boeing and Airbus' forecasts, HKIA's future traffic will be driven by the developing markets of Mainland, Southeast Asia and India. However, Hong Kong's travel market is relatively mature compared to the rest of Asia, and therefore overall growth will likely be lower than the developing countries of Asia. Recent years have witnessed fast growing travel demand to/from Southeast East Asia and Mainland. This has been factored into HKIA's traffic model, and will probably continue at a slower pace than that projected by Airbus and Boeing.
 - HKIA will benefit from the growth of Mainland either as a gateway to the GPRD region or as a hub. However given competition from fast growing airports, HKIA will only capitalise on a part of Mainland's growth.
 - Given that the Hong Kong market is relatively mature, induction of new traffic to North America and Europe as forecast by Boeing and Airbus for the Asia rim is unlikely as most Hong Kong travellers have already been introduced to these markets. Growth in traffic to/from the North America and European region is expected to remain relatively stable in the future.
- 2.188** Taking into consideration all of the above factors, the IATA Consulting's passenger growth forecast is more conservative than that of Boeing and Airbus.

Cargo forecast**Figure 2.52 : Comparison of Boeing, Airbus and IATA Consulting Cargo Forecasts - 2009 to 2028****CAGR 2009-2028**

Source: Boeing, Airbus and IATA Consulting analyses and estimates

2.189 For the forecast period, Boeing forecasts an annual growth rate of 6.0%, very close to Airbus' forecast of 6.3%. Both Boeing's and Airbus' forecasts are driven by an increase in trade demand in India and Mainland. Free trade areas and trade agreements between India, Mainland, and South East Asia are drivers for the increase in cargo demand.

2.190 The IATA Consulting forecast is expected to follow a slightly lower growth rate than that predicted by Boeing and Airbus for the following reasons:

- Similar to Boeing and Airbus, HKIA's future traffic will be driven by the developing markets of the Mainland and India (grouped under "Others"). That said, only a portion of this trade benefit will trickle down to Hong Kong through partnership agreements such as CEPA and Guangdong-Hong Kong Co-operation Agreement, resulting in a slightly slower growth rate; and
- Given that cargo traffic in the North American and European regions is focused on the opening of the markets of the Mainland, developing nations of Asia, and the Middle East, increasing competition from the Mainland's airports and increasing air service agreements will slow HKIA's growth.

Relying on Neighbouring Airports is Not an Option

2.191 Some advocates have argued that greater co-operation with PRD airports (most notably Shenzhen International Airport) could possibly remove the need for HKIA to expand its capacity. AAHK, however, does not believe that it is a viable proposition, for the following reasons:

- a) air services to and from an airport are regulated by individual jurisdiction and governed internationally through a network of bilateral air services agreements. Therefore, flight movements that HKIA cannot accommodate due to capacity constraints cannot be funnelled to other airports purely based on demand or at our wishes;
- b) it would not be in the interest of most passengers who would likely find using or transferring through another airport highly inconvenient; and
- c) most importantly, relying on other airports to meet HKIA's demand would inhibit the growth of the airport and thus adversely affect Hong Kong's overall competitiveness as a world city.

2.192 Indeed Hong Kong airlines will not be able to provide additional services through another airport in the PRD to Mainland cities or foreign destinations. Although Mainland airlines which operate from a PRD airport may provide an alternative for travellers to the rest of the Mainland or a foreign destination, travellers are likely to find it highly inconvenient to transfer at that PRD airport.

2.193 It should be noted that the Hong Kong-Shenzhen Western Express Line (WEL), which is currently under feasibility study by the Government, may provide an efficient mode of transport to allow seamless passenger flight connections between the two airports, and to make it even more convenient for the GPRD's travelling public to fly via HKIA internationally or Shenzhen airport domestically. The project is subject to further studies, including alignment options, patronage forecasts, the functionality of the railways, its technical standards, operational and service requirements, etc. If and when the WEL is constructed, the benefit it brings would equally apply to both Options.

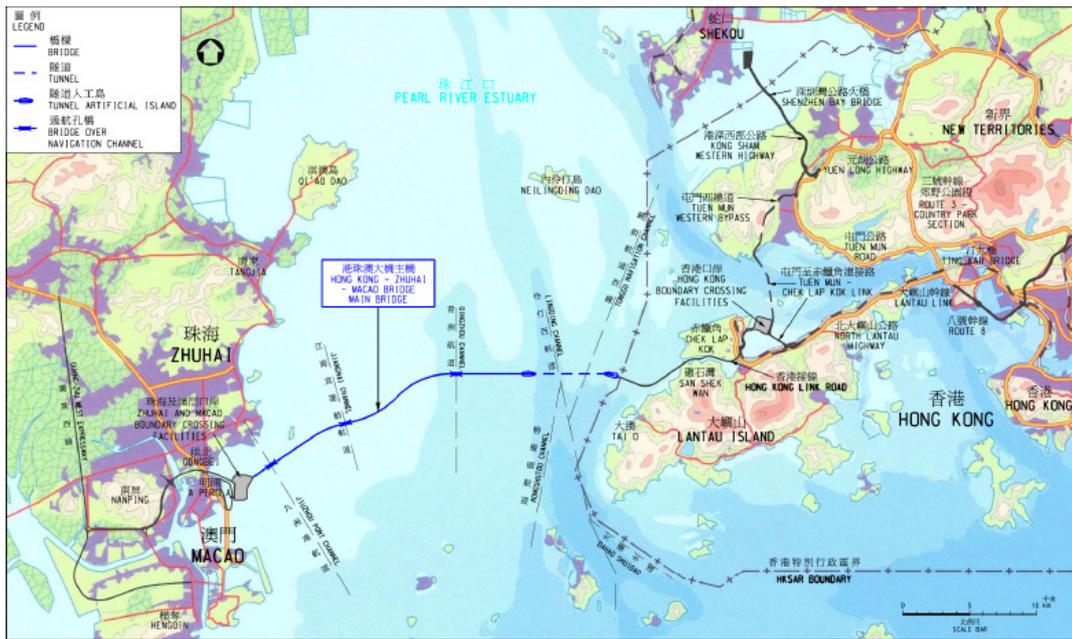
2.194 This is an example of HKIA's cooperation with other GPRD airports. HKIA enhances consumer choice by making smooth travel. A recent example is the Hong Kong-Shenzhen Airports Link, which is a service to make it more convenient to travel via HKIA or Shenzhen International Airport. Such efforts are however different from directing to other GPRD airports traffic which would have chosen Hong Kong due to market forces if there had been sufficient capacity at HKIA.

CHAPTER 3 HKIA : OPERATIONS AND CAPACITY

Internal and External Transportation Links

- 3.1** Hong Kong International Airport (HKIA) is located right at the heart of passenger and cargo conveyance between Hong Kong, the Pearl River Delta (PRD), Asia Pacific and the world.
- 3.2** HKIA has retained its accessibility despite moving from the Kowloon Peninsula to Lantau Island in 1998. It is part of a network of infrastructure projects that connect the new airport with the rest of Hong Kong. These include the North Lantau Highway, Airport Express, West Kowloon Expressway, Western Harbour Crossing, Lantau Link and Ting Kau Bridge (Route 3). HKIA is linked to Hong Kong's downtown by the Airport Express, which takes only 24 minutes to reach Central. Travellers can also travel between downtown Hong Kong and the airport by buses, taxis and hotel coaches/limousines.
- 3.3** After 1997, there has been a growing demand for cross-boundary links between HKIA and the PRD. With a view to expanding its catchment area and to improve connectivity with PRD, the airport began cross-boundary coach and limousine services as well as ferry connections. The opening of SkyPier in 2003 enabled HKIA to provide ferry services to six ports in the PRD and two in Macao. Passenger processing Terminal 2 (T2), which opened in 2007, consolidates cross-boundary coach and limousine services covering approximately 115 destinations in the PRD and it only takes less than 1 hour from T2 to the existing boundary crossing points.
- 3.4** In 2009, HKIA served about 2.8 million passengers travelling via land or sea to and from the PRD. With more cross-boundary infrastructure projects underway, the airport will become an even more convenient and well-connected multi-modal hub. For instance, the Hong Kong – Zhuhai – Macao Bridge (HZMB), expected to be operational by 2016, will provide fast and convenient access between HKIA and western PRD. Also under planning is the Tuen Mun – Chek Lap Kok Link, which will provide a direct link between HKIA and the northwest New Territories and Lantau (see Figure 3.1).

Figure 3.1 : Major Infrastructure Developments around HKIA

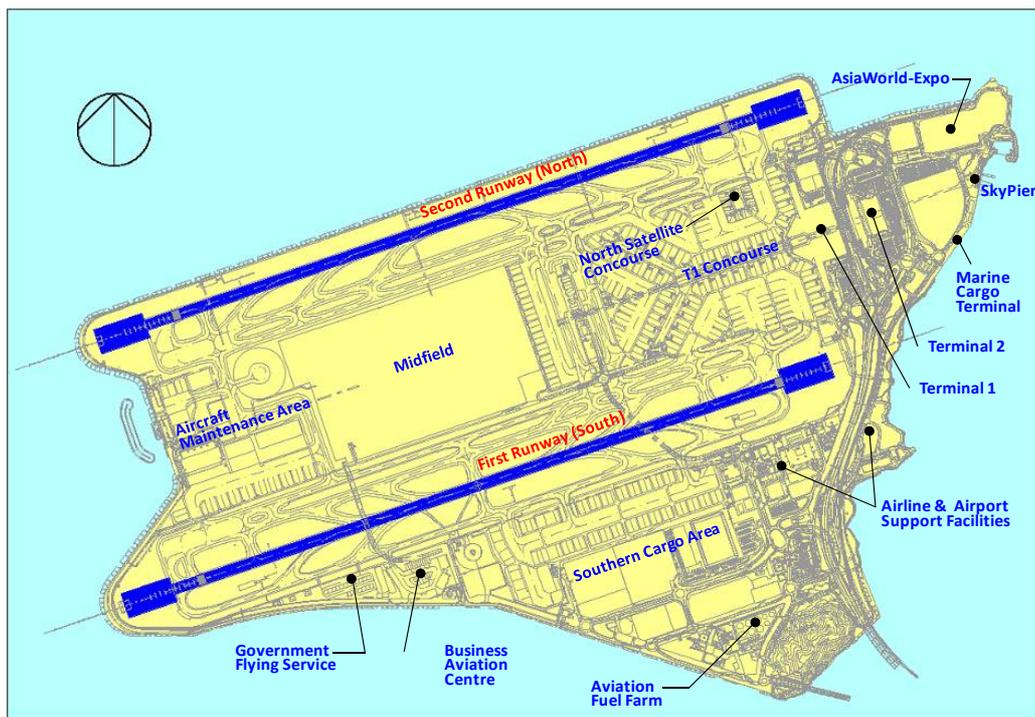


Source: Highways Department (April 2011)

Existing HKIA Layout

3.5 The existing airport layout (see Figure 3.2) consists of two runways, which are supported by two passenger processing terminals, two passenger concourses with 97 passenger aircraft parking stands, three cargo terminals, a cargo apron with 34 cargo parking stands, and other supporting facilities.

Figure 3.2 : Existing HKIA Layout



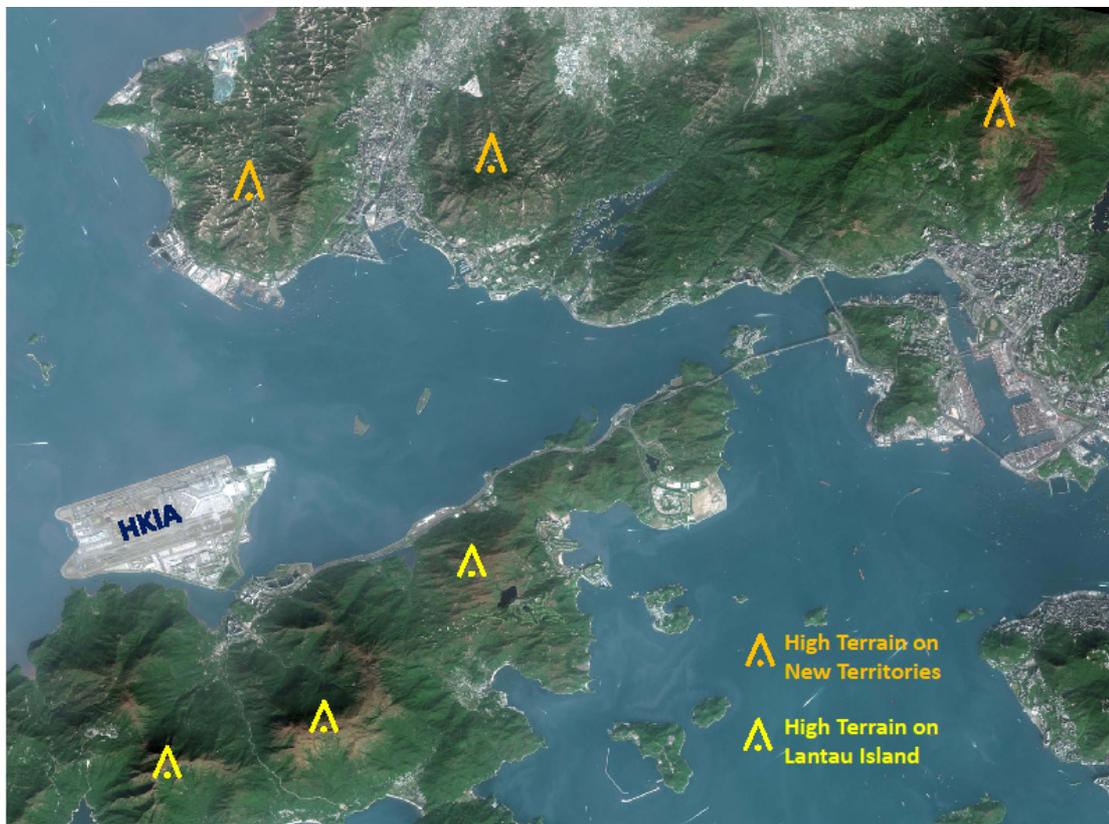
Practical Maximum Capacity of the Two-Runway System

3.6 Since 1998, HKIA has been meeting air traffic demand growth through progressively upgrading, maximising usage and increasing the efficiency of its facilities on the airport island. AAHK has always aimed to get the most out of HKIA's current capacity before considering expansion measures, as was the case with the one-runway Kai Tak Airport in the '80s and '90s.

Hourly ATM Capacity

3.7 The operating environment of HKIA is unique because of high terrain and a complicated and restrictive airspace surrounding the airport (see Figure 3.3).

Figure 3.3 : Geographical Constraints Surrounding HKIA



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3.8 AAHK has commissioned the British aviation experts "National Air Traffic Services" (NATS) to assess how the capacity of the existing two runways of HKIA can be maximised. NATS' recommendations include reforming the existing Air Traffic Control (ATC) philosophy, improving flight procedures and operations, increasing ATC-related manpower levels, enhancing airfield infrastructure, etc. **The practical maximum capacity that can be achieved with two runways will be 68 movements per hour** using the existing independent segregated mode of operations, i.e. one runway exclusively for departures and the other exclusively for arrivals (see Figure 3.4).

Figure 3.4 : Existing Independent Segregated Mode of Operations for the Dual Runways of HKIA



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3.9 Under independent segregated operations, each runway is limited only by its maximum arrival or departure rate. The following figure shows the levels that NATS has validated using fast time simulation modelling. These levels have already factored in International Civil Aviation Organisation (ICAO) recommended practices as well as other relevant factors (terrain, airspace, traffic mix, weather, etc.) (see Figure 3.5).

Figure 3.5 : Potential Runway Capacity of a Single Runway

Runway	ICAO Minimum Separation	Potential Runway Capacity
North Runway (Arrivals Only)	3 NM *	33 per hour
South Runway (Departures Only)	90 seconds **	35 per hour

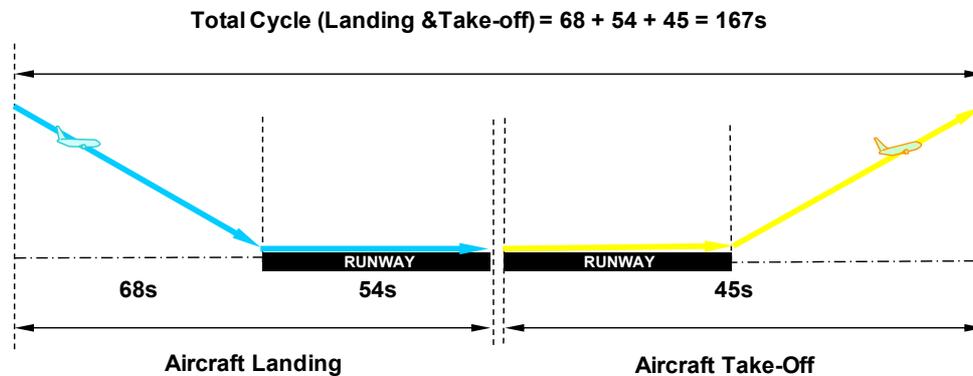
Note: * NM = Nautical Mile

** 90 seconds between all departures except 2 minutes vortex separation as appropriate

3.10 NATS has also determined that there will be no capacity gain by changing the dual-runway operations from segregated mode to mixed mode (i.e. both departures and approaches can take place on each of the two runways). Mixed mode operation can theoretically maximise the capacity of a single runway to 44 movements per hour. This is based on a typical six Nautical Mile (NM) spacing between approaches which can be translated into a typical time interval of 167 seconds for each landing and takeoff cycle

(note: 3,600 seconds (s) per hour/167 seconds per cycle x 2 = 44 movements as shown in Figure 3.6):

Figure 3.6 : Single-Runway Arrival/Departure Timeline in Mixed Mode



Note: The landing aircraft must be at least 3NM from the runway end when the departure begins and may not touchdown before the departing aircraft has left the runway.

3.11 NATS has concluded that only “dependent” mixed mode operations can be supported by the existing runways at HKIA, due to the following reasons:

- a) Due to the terrain on Lantau Island, the missed approach and departures procedures from the South Runway have to share the same track (see Figure 3.7). As a result, the minimum spacing between approaches has to be increased from 6NM to 8NM to adhere to the recommendation of the Manual of Air Traffic Control. This limits the hourly capacity to 34 movements under mixed mode operation. In contrast, there is no terrain constraint on the North Runway. This enables its missed approach and departure procedures to be separated under mixed mode operation, thus allowing the use of 6NM minimum spacing between approaches and 44 movements per hour in isolation.

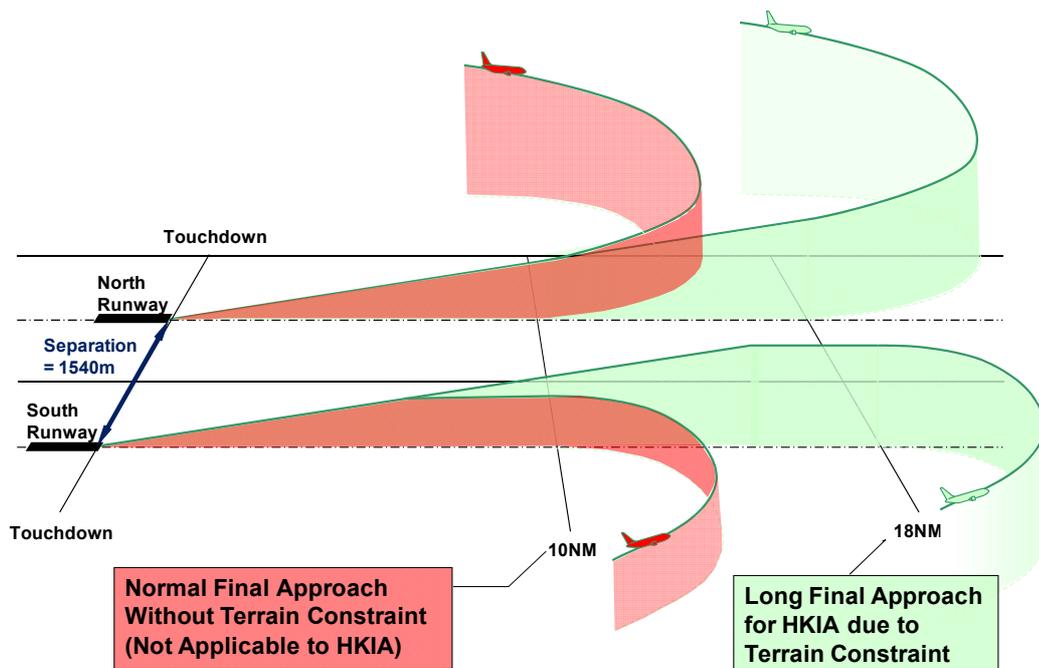
Figure 3.7 : Terrain Constraint on the South Runway Operations



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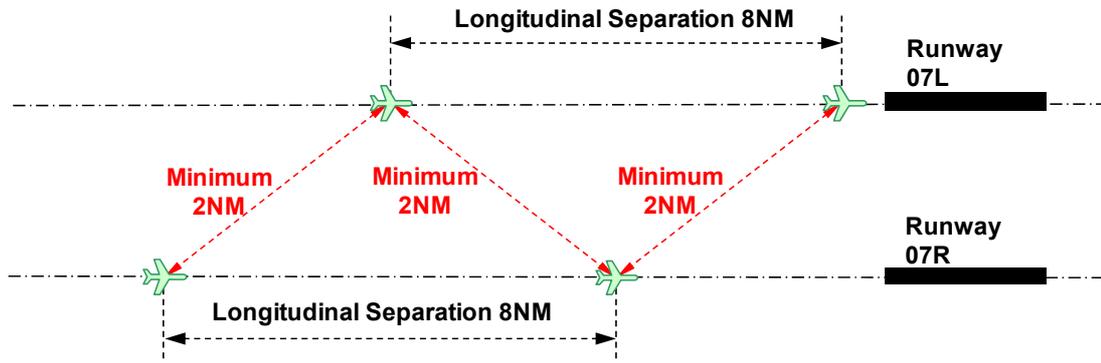
- b) The existing two runways cannot support independent parallel approaches. For independent parallel approaches to take place on both runways, a long final approach procedure (see Figure 3.8) needs to be adopted to avoid the terrain to the east (Tai Mo Shan) and interaction with Macao airport traffic to the west of HKIA (Note: the final approach is extended out to 18NM from touchdown, compared to the standard 10NM recommended in ICAO’s Manual).

Figure 3.8 : Independent Parallel Approaches Requirement for HKIA (Long Final Approach)



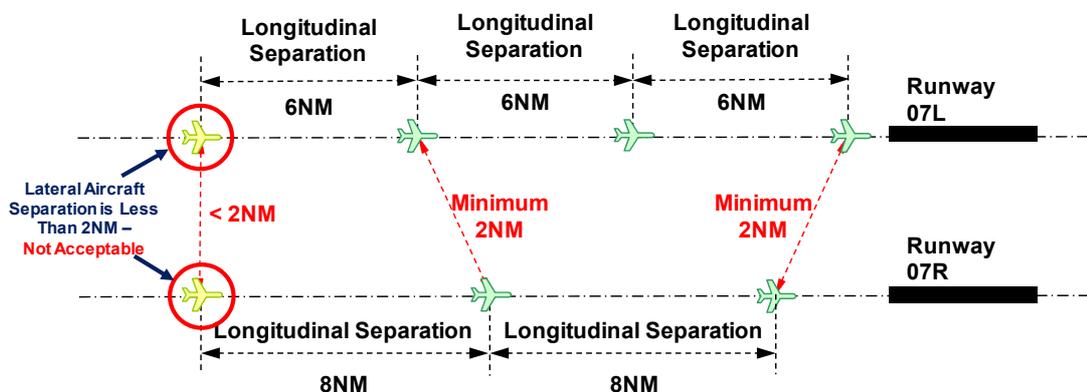
With a long final approach procedure needed for carrying out independent parallel approaches, a wider separation between runways than that currently available is needed to meet ICAO criteria for Instrument Landing System (ILS) performance. The current two-runway configuration is thus incapable of accepting independent parallel approaches and requires at least a 2NM stagger to be kept between respective approaches on the adjacent runways as per ICAO’s mandates (see Figure 3.9). In other words, even under “mixed mode” operation, the North Runway has to be dependent upon the South Runway.

Figure 3.9 : Dependent Parallel Approaches Requirement for HKIA



- c) While the North Runway can accept unconstrained mixed mode operations, which requires a 6NM spacing between landing aircraft, the South Runway can accept only constrained mixed mode operations, which requires an 8NM spacing between landing aircraft. It is considered impractical for landing aircraft on the two runways to comply with these different approach spacing requirements (see Figure 3.10).

Figure 3.10 : Impracticality of Maintaining Dependent (Staggered) Approaches on the Existing Two Runways with Different Approach Spacing



Therefore, a consistent approach spacing of eight NM would have to be applied to both runways if they were to be operated in mixed mode, resulting in an hourly capacity of 34 movements for each runway, or a total 68 hourly movements for both. This demonstrates that changing the operations of the two runways from the current segregated mode to mixed mode will not increase overall capacity.

3.12 NATS reckons there is only a nominal potential to stretch the maximum capacity of the two runways beyond 68 movements per hour, even if there are future advances in air traffic control technology that reduce landing aircraft’s arrival spacing. To further increase runway capacity, NATS recommended the evaluation of possible locations for a Third Runway and the associated potential for capacity expansion, taking into account operational challenges, ATC procedure design and PRD airspace considerations.

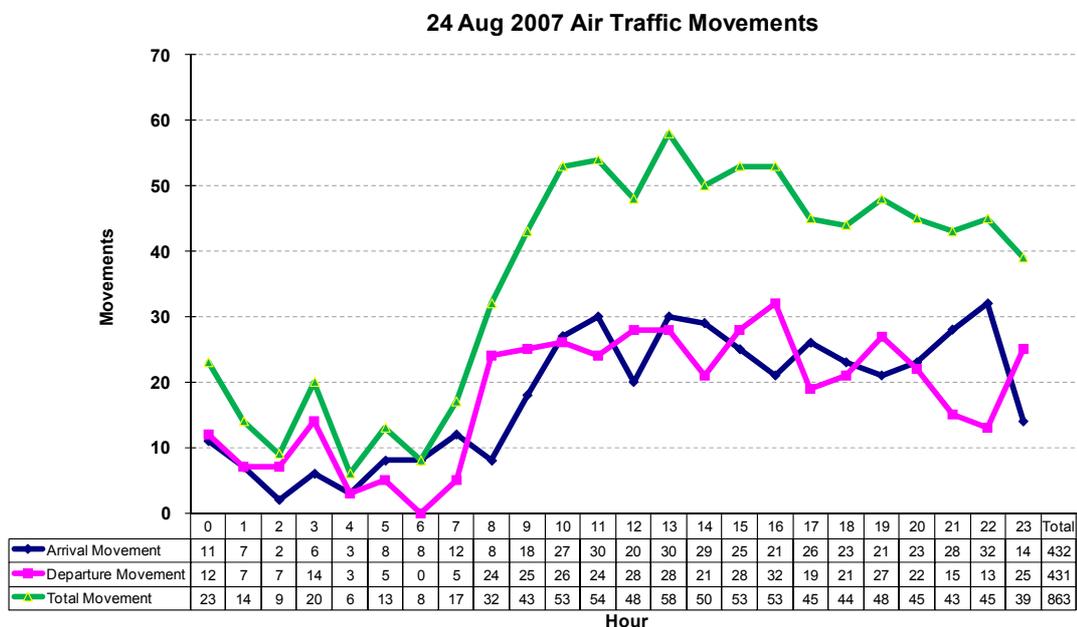
Daily and Annual ATM Capacity

- 3.13** The key factors in determining a realistic absolute capacity for the airport are:
- Selection of the core period of the day during which the maximum of 68 movements per hour may be achieved;
 - Estimation of sensible shoulder periods before and after the core period, (early morning arrivals and departures) during which demand is less than the maximum 68 movements per hour;
 - Identification of periods and the probable demand therein when single runway operations can be undertaken to allow for maintenance work.
 - Allowance for routine runway direction changes during the day; and
 - Provision of a contingency allowance for unexpected circumstances and recovery from periods of disruption.

3.14 Considering the above factors it is possible to estimate the daily and hence the annual capacity figures for HKIA; further details to be set out below:

a) HKIA has adopted IATA’s busy day as the design day. The busy day is defined as “the second busiest day in an average week during the peak month (excluding special events such as religious festivals, trade fairs, conventions and sport events)”. HKIA’s design day traffic profile on 24 August 2007 is shown in Figure 3.11.

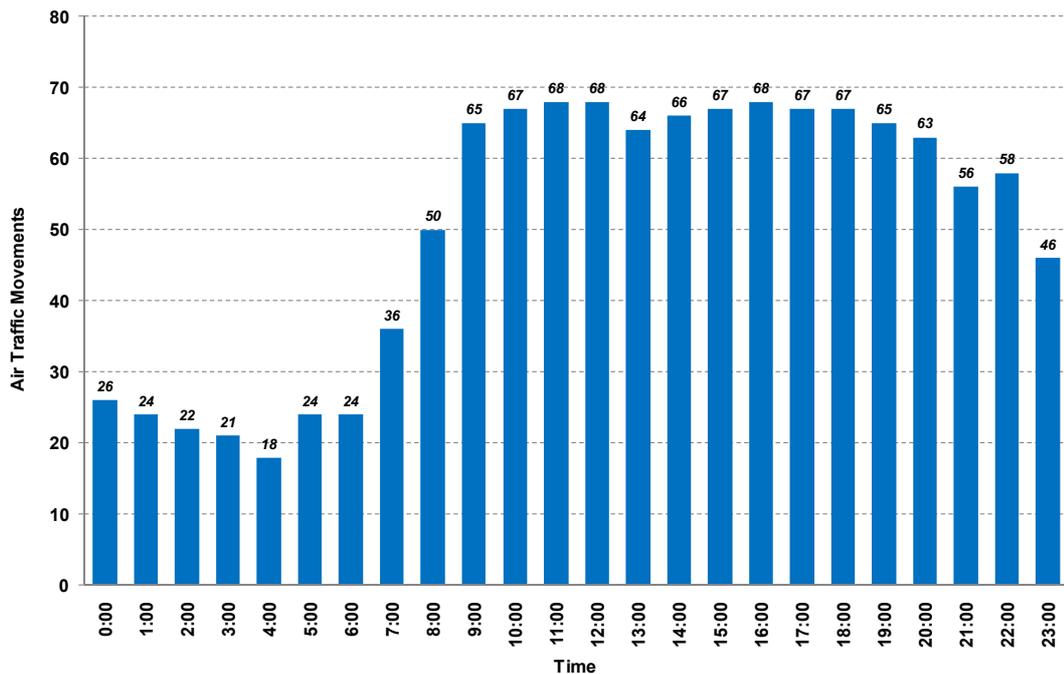
Figure 3.11 : HKIA Design Day Hourly Traffic Profile – 2007



b) Using the above information, NATS has recommended that the night runway closure run from 00:00 to 07:59. Thus, the peak period is 08:00 to 23:59, during which 68 movements per hour may be achieved;

- c) During the night-time single runway period, the current declared capacity of a single runway at HKIA is 37 movements per hour;
- d) Using the above single runway and peak periods, a maximum of 1,384 (8 x 37 + 16 x 68) movements per day is possible in theory;
- e) Consideration of the traffic mix allows the above design day profile to be scaled to a daily movement profile of 1,200 movements (see Figure 3.12).

Figure 3.12 : Daily Movement Profile Based on 1,200 Movements per Day



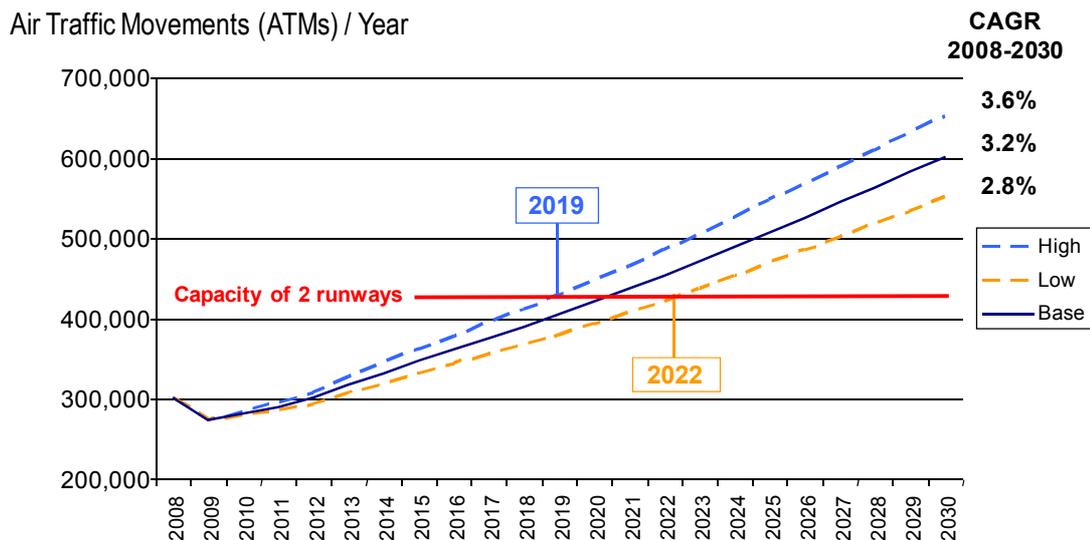
- f) As illustrated above, many hours, particularly in the peak period, are operating at or close to the maximum capacity of 68 movements per hour. Any slack during this peak period is required for routine events such as runway changes. Each routine change is expected to reduce capacity for five to ten minutes, resulting in a loss of up to eight movements. Therefore, assuming two routine runway changes, a loss of 16 movements needs to be allowed for. In the period between 09:00 and 21:00 there are only 21 free movements currently available to absorb this movement loss;
- g) The movement schedule also needs an allowance for contingencies. Unforeseen events such as aircraft incidents, adverse weather and equipment failure may impact capacity in some periods and some buffer has to be included to enable recovery from these periods of disruption. Assuming the theoretical maximum capacity of 1,200 movements, there are 184 unallocated slots, of which 16 movements are required to accommodate the two routine runway changes, leaving only 168 free slots. If weather disrupted operations for about two and a half hours, up to 170 flights could be affected — potentially using all the available slack to recover. Since the period between 09:00 and 21:00 is fully

scheduled, recovery would not be possible until the evening and night periods end;

h) It is therefore recommended that recovery periods should be built into the schedule. Estimates for the size of the contingency allowance and their placement in the schedule should be made after consulting all stakeholders.

3.15 Based on the above, a daily capacity in the range of 1,100 to 1,200 movements is achievable. Applying the historical design day/annual ratio of 0.0029, this would provide an annual capacity in the range of 379,310 to 413,793 movements. In the context of NATS’ finding that there is negligible potential to stretch the maximum capacity of the existing two runways beyond 68, **420,000 can be assumed to be the ultimate practical maximum annual ATM capacity if HKIA stays with the two-runway system.** Based on the high/base/low case of the unconstrained ATM demand forecast, it appears that the two runways’ **maximum capacity of 420,000 ATMs per year will be reached between 2019 and 2022**(see Figure 3.13).

Figure 3.13 : Air Traffic Movements to Reach the Two-Runway Capacity Between 2019 and 2022



Latest Infrastructure and Facility Developments

Capacity Enhancement Projects

3.16 In 2006, AAHK committed HK\$4.5 billion to capacity enhancement works to the Passenger Terminal Building (PTB) and Airfield. These works, which involve both the upgrading of existing facilities and provision of new facilities, aim to enhance airport operational efficiency, meet updated safety and security standards, and improve the ambience of the concourse for passengers’ comfort. These works include:

- Enhancements to the Airfield
 - North Satellite Concourse
 - 10 additional cargo stands

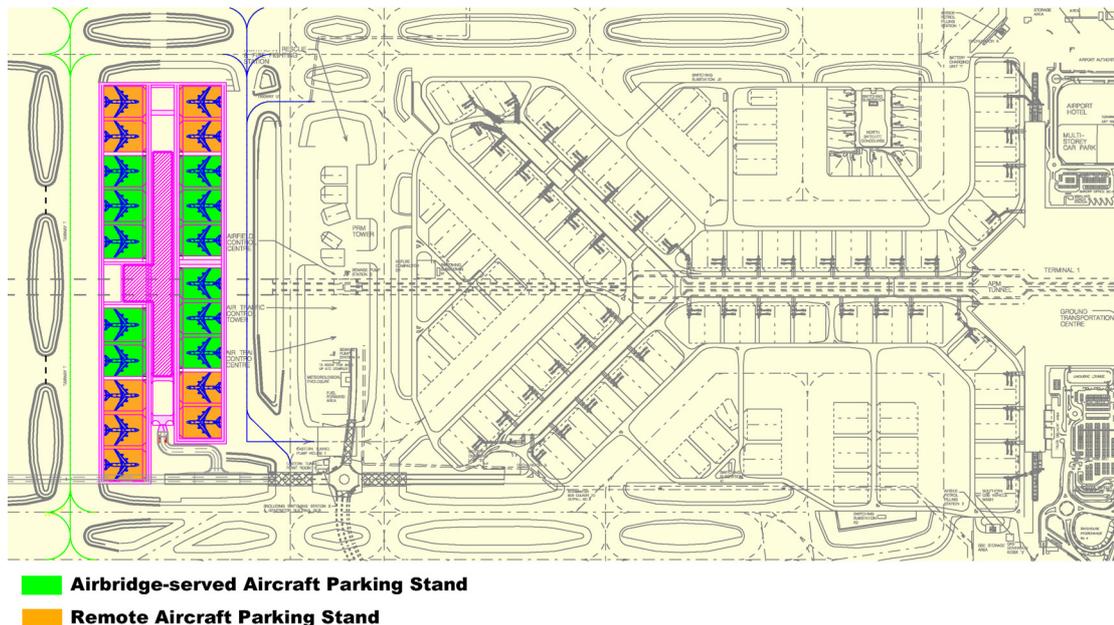
- Resurfacing of the two runways and the taxiways
- Enhancements to facilitate A380 operations
- Enhancements to Terminal 1
 - Increasing the capacity of the Baggage Handling System
 - Upgrading X-ray baggage screening machines
 - More transfer desks, security channels and immigration counters
 - Central Concourse extension

Midfield Development

3.17 AAHK has committed an additional HK\$9.3 billion to the first phase of the Midfield Development to ensure that there would be sufficient aircraft parking stands to serve the forecast passenger, cargo and ATM demand by 2015. These works include (see Figure 3.14):

- Construction of 11 airbridge-served aircraft parking stands and nine remote parking stands, as well as an “I-shaped” passenger concourse at Midfield (costing HK\$7.8 billion);
- Extension of the existing automated people mover (APM) system to the passenger concourse at Midfield from Passenger Processing Terminal 1 (T1) (costing HK\$1.3 billion); and
- Minor enhancements to the baggage handling system (costing HK\$0.2 billion).

Figure 3.14 : Planned Midfield Development by 2015



Long-Term Development

3.18 This Master Plan has reviewed two options for the development of HKIA in the longer term, beyond 2015 and up to the year 2030:

- Option 1 (two-runway system): The development plan is to serve the constrained demand forecast for passengers and cargo under the airport's existing two-runway system;
- Option 2 (three-runway system): The development plan is to serve the unconstrained demand forecast for passengers and cargo under a three-runway system.

Details of these two options are set out in Chapters 4 and 5.

CHAPTER 4 OPTION 1 : MAINTAINING THE TWO-RUNWAY SYSTEM

Constrained Air Traffic Demand Forecast under the Two-Runway System

4.1 HKIA’s two-runway capacity is forecast to reach its limit in 2020, but passenger and cargo demand is expected to keep growing even thereafter, albeit at a slower rate. While airlines would be reluctant to mount additional flight frequencies thereafter, they may try other approaches to accommodate demand. For example, during the last few years of single-runway operation at Kai Tak, passenger airlines managed to gradually stretch their annual average number of passengers carried per movement to a record high of 214 (see Figure 4.1) by “up-gauging” aircraft size and maximising passenger seat factors in response to the constrained situation.

Figure 4.1 : Historical Passenger Numbers per Passenger Flight Movement

Year	Average Number of Passengers per Passenger Flight Movement
1993	209
1994	204
1995	210
1996	214
1997	198
1998	194 (New airport opened on 6 th July, 1998)
1999	203
2000	208
2001	189
2002	191
2003	174
2004	185
2005	186
2006	191
2007	196
2008	194
2009	196

Source: CAD (1993-1996), AAHK (1997-2009)

4.2 Assuming a similar reaction by airlines to deal with the constraints of a freeze in air traffic movement (ATM, also known as flight movement) levels, the annual average number of passengers carried per movement is expected to gradually stretch from the unconstrained forecast of 200 in Year 2021 to 212 in 2030. Cargo airlines could gradually stretch the annual average cargo tonnage carried per freighter movement from the unconstrained forecast of 51 in Year 2021 to 55 in 2030. The Constrained ATM demand forecast and the resulting constrained passenger and cargo demand forecasts beyond 2020 are depicted in Figure 4.2, Figure 4.3 and Figure 4.4. Further explanation of the calculation can be found in Appendix 2.

Figure 4.2 : Constrained Air Traffic Movement Demand Forecast due to Runway Capacity Limit

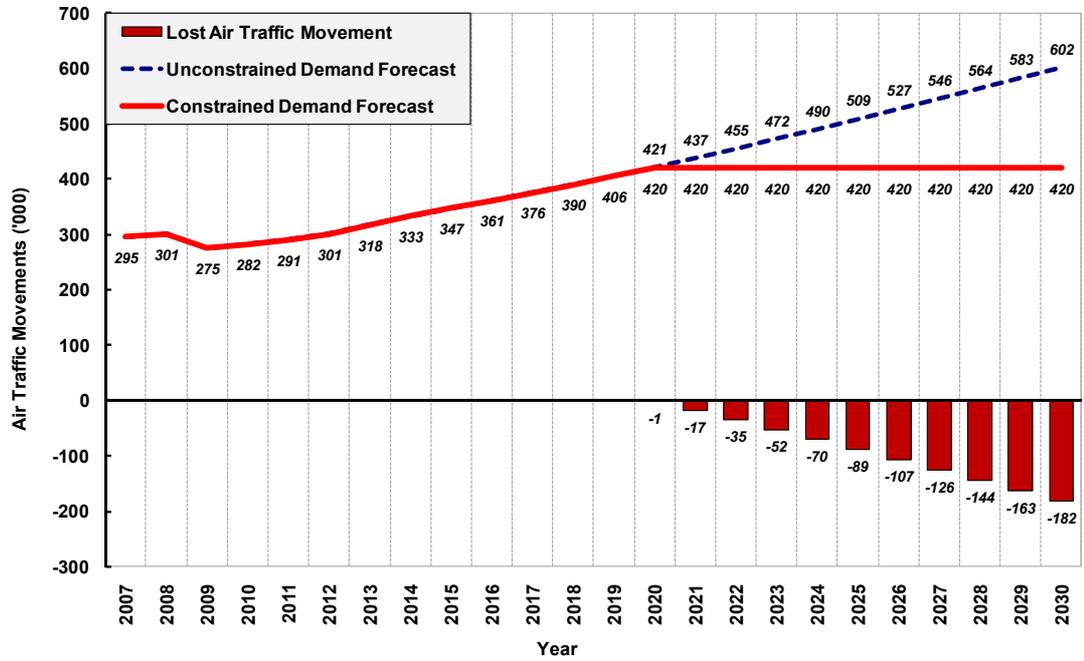


Figure 4.3 : Constrained Passenger Demand Forecast due to ATM Capacity Limit

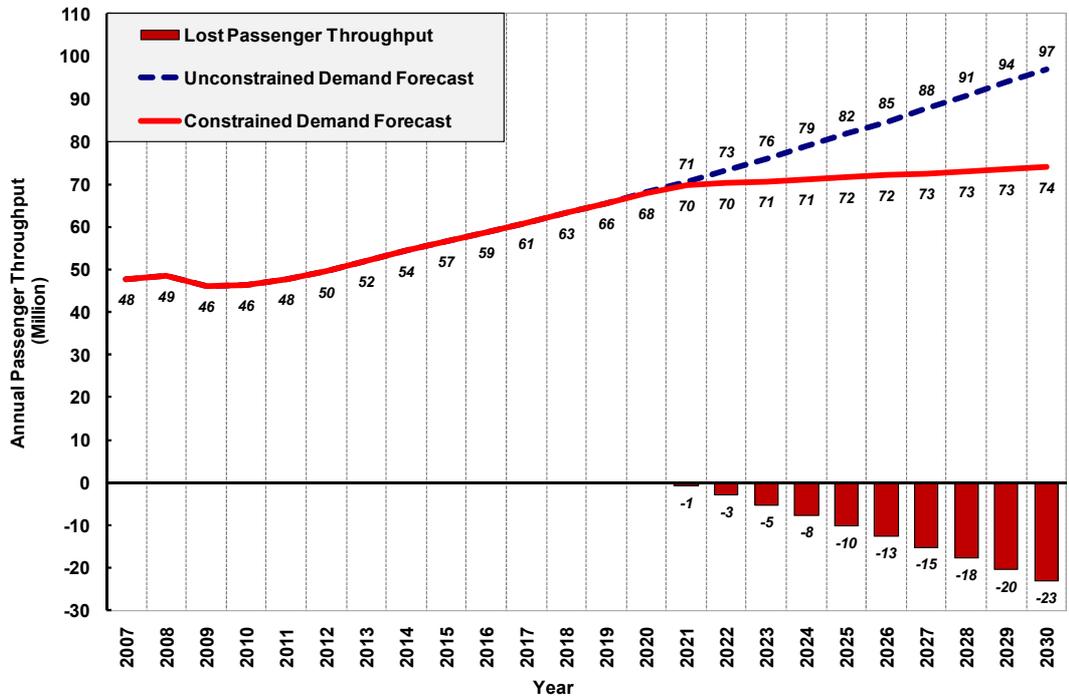
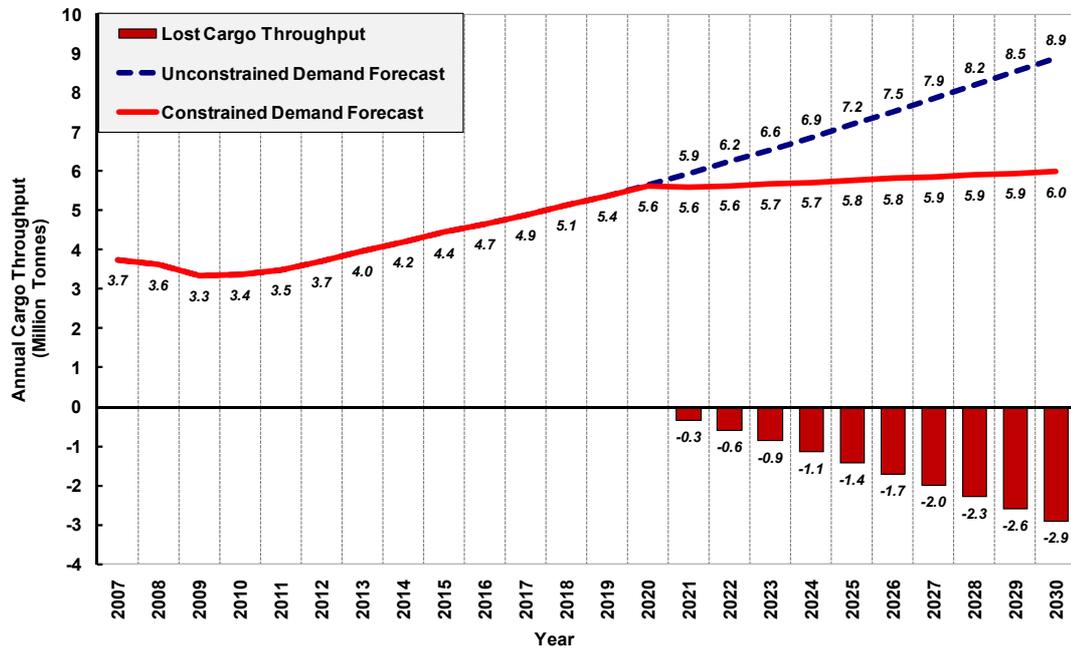


Figure 4.4 : Constrained Cargo Demand Forecast due to ATM Capacity Limit



Airport Infrastructure and Facilities Needed to Meet the Constrained Demand Forecast

Passenger Processing Terminal Requirements

- 4.3 Passenger processing Terminal 1 (T1), constructed as part of the original airport development in 1998, is currently one of the largest single airport terminal buildings in the world, with a total floor area of about 570,000 square metres. The passenger processing Terminal 2 (T2), with a floor area of 140,000 square metres, was built to the east of T1 in 2007. T2 is currently a departure-only terminal and is linked to the departure gates via an extension of the automated people mover (APM) system.
- 4.4 Airport facilities should be designed to ensure passenger safety and comfort and timely performance of airline operations even in busy periods. International Air Transport Association (IATA) defines a typical busy hour as the busiest 60-minute period on the second-busiest day in an average week during the peak month of the year (excluding special events such as religious events).
- 4.5 The original design capacity of T1 in the New Airport Master Plan published in 1992 was 45 million passengers per year, based on IATA’s Level of Service “C” criteria. According to the IATA Airport Development Reference Manual (9th Edition 2004), the level of service can be considered as a range of values or assessments of the ability of supply to meet demand. A range of Level of Service measures from A through F may be used to allow comparison among the various systems and sub-systems of an airport. Figure 4.5 and Figure 4.6 show the Level of Service Framework and the level of service for passenger flow. Level of Service C is recommended by IATA as the minimum design objective.

Figure 4.5 : Level of Service (LOS) Framework

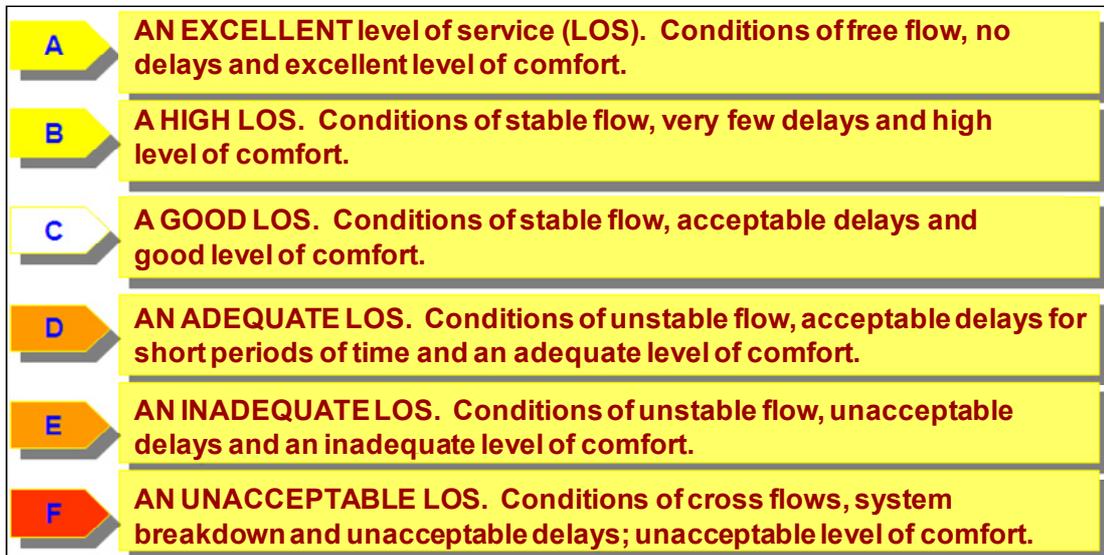
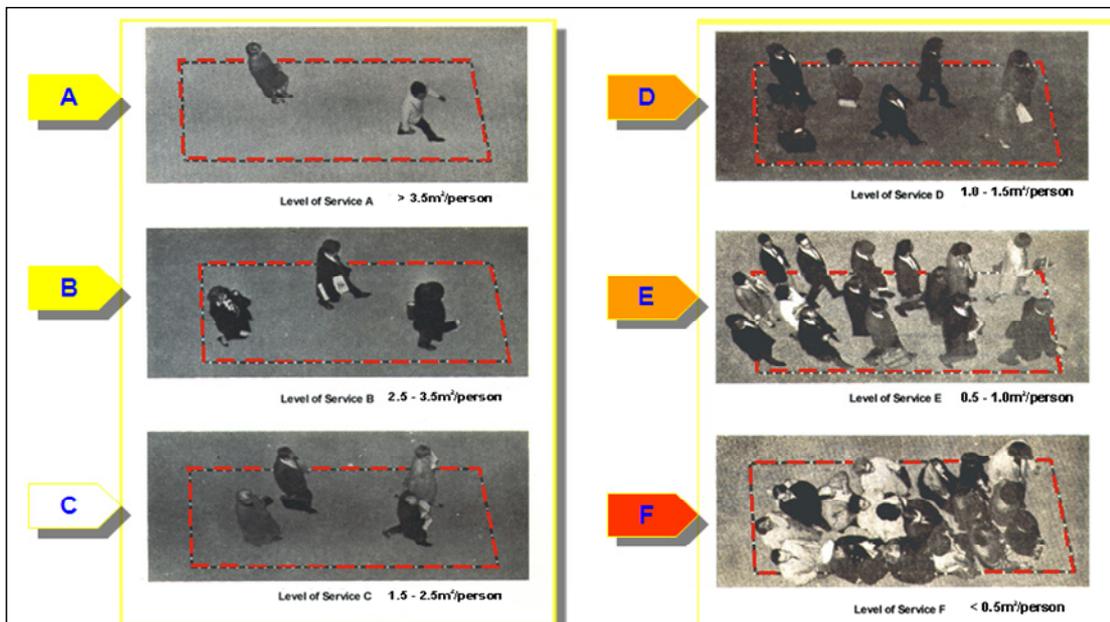


Figure 4.6 : Similar LOS Standard Used in Transportation Planning for Pedestrian Facilities



Source: John J. Fruin. 1987 Pedestrian Planning and Design, p.75

- 4.6 Several enhancement projects have been implemented at the airport to accommodate passenger traffic growth and maintain the facility at a high service level. Figure 4.7 shows the current handling capacity of the major passenger processing facilities at T1, after the HK\$1.5 billion passenger terminal capacity enhancement work committed in 2006, and the busy hour demand for them, as forecast in the Master Plan for 2030.

Figure 4.7 : T1's Facility Capacity and Busy Hour Demand Forecast

T1 Facility	Current Capacity (including Enhancement Projects Underway)	Busy Hour Demand Forecast in 2030 (at 74 million Passengers Per Annum)
Departures		
Check-in Counters	324	342
Departures Security (Unit)	30	27
Immigration – Conventional Counters	56	52
Immigration – e-Channels	16	16
Departure Kerbside Space (Vehicle Bay)	58	66
Arrivals		
Immigration – Conventional Counters	116	110
Immigration – e-Channels	18	18
Baggage Carousels*	12	16

Note: *Excluding existing two OOG (out of gauge) baggage belts

- 4.7 To meet the passenger demand forecast of 74 million passengers per annum by 2030 for the two-runway system, it will be necessary to enhance or expand the existing two passenger processing terminals, (as illustrated in Figure 4.7 for the case of T1) to provide additional departure and arrival processing facilities for circulation, concessions and amenities to maintain the existing level of quality service for passengers.
- 4.8 In particular, expansion by two additional bays each to the north and south of the existing T1 building envelope (see Figure 4.8) is required to physically accommodate additional baggage reclaim carousels at the arrival level (see Figure 4.9) and create kerbside space at the departure level (see Figure 4.10). T2 will also require a fit out of the remaining space in its check-in hall to increase its check-in counters from 56 to 112.

Figure 4.8 : Proposed Expansion by Two Additional Bays Each to the North and South of the Existing Terminal 1 Building

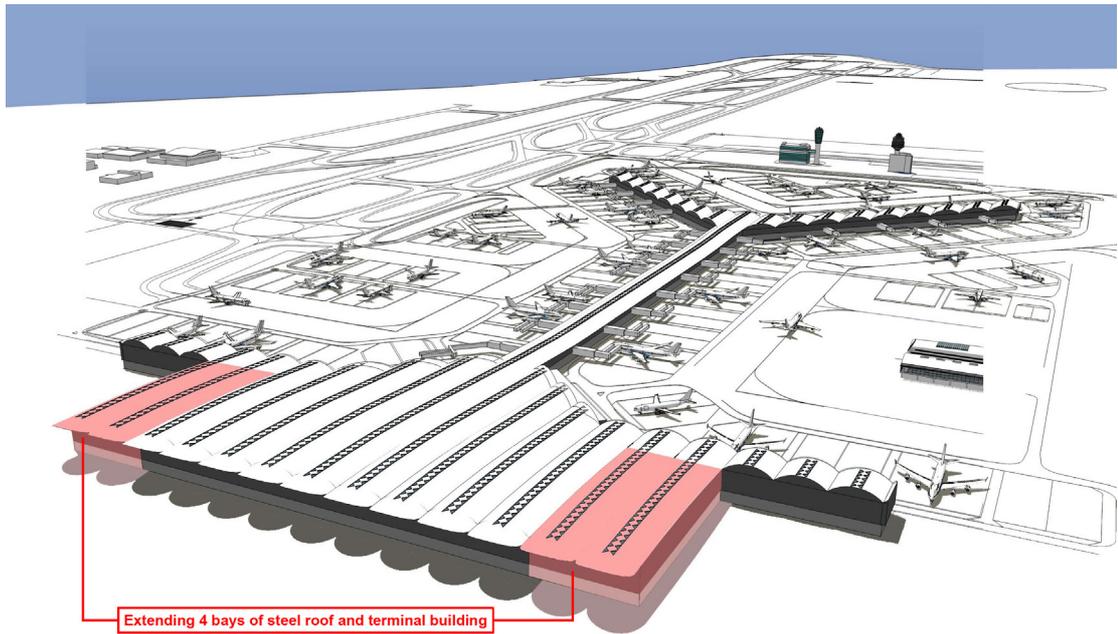


Figure 4.9 : Proposed Increase of T1 Baggage Reclaim Carousels from 12 to 16

T1 - BAGGAGE RECLAIM HALL EXPANSION

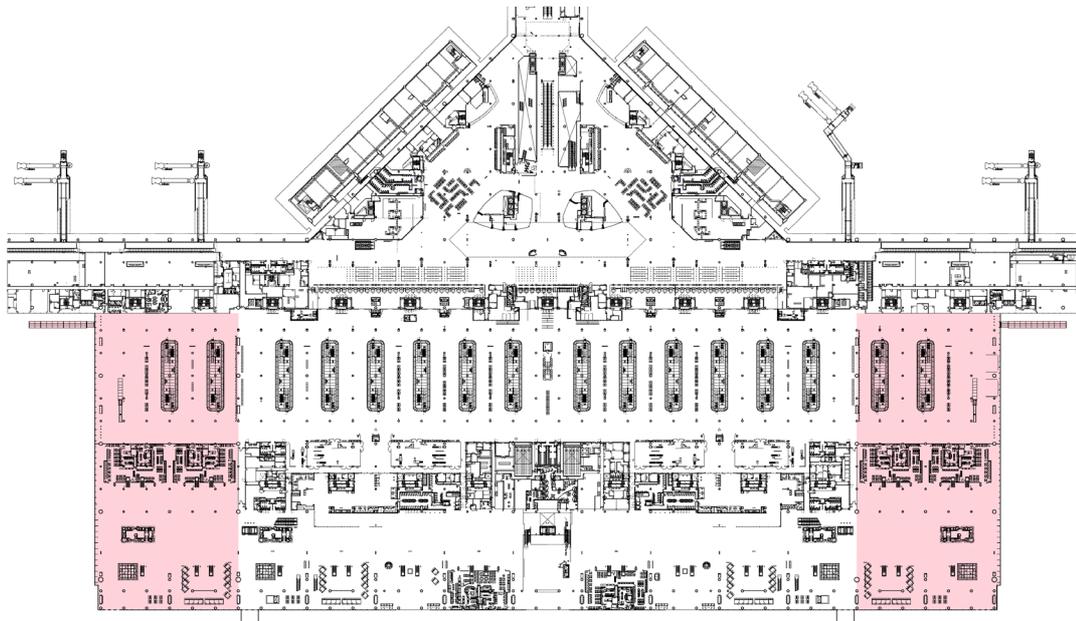
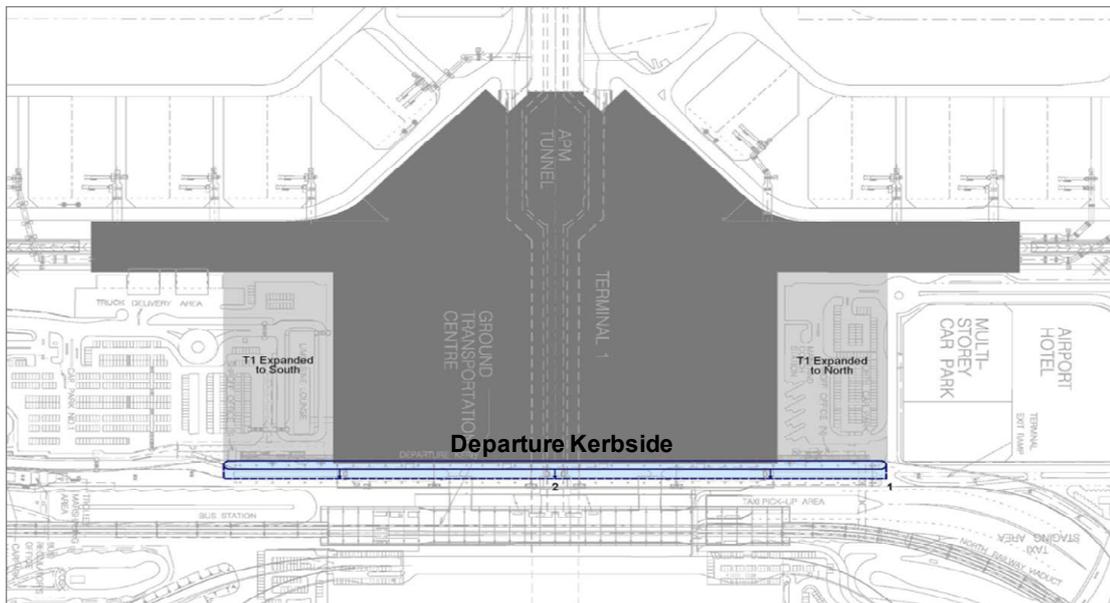


Figure 4.10 : Proposed T1 Kerbside Extension



Aircraft Apron and Passenger Concourse

4.9 Substantial progress has been made on the aircraft apron and passenger concourse development project as set out in MP2025. A significant portion of the HK\$3 billion airfield facility enhancement programme announced by AAHK in 2006 has been spent on providing additional passenger and cargo aircraft parking stands capacity. These works are detailed below:

- 10 new cargo stands were opened in 2007, taking the existing Southern Cargo Apron handling capacity up to a maximum of 34 wide-bodied cargo stands; and
- A new 20,000 square-metre North Satellite Concourse (NSC) with 10 airbridge-served stands for narrow-bodied aircraft at was opened in 2010. This is in addition to T1's original passenger concourse ("Y-shaped" concourse) of 49 airbridge-served and 27 full-services remote stands, and the 11 temporary stands at the eastern end of the Midfield area.

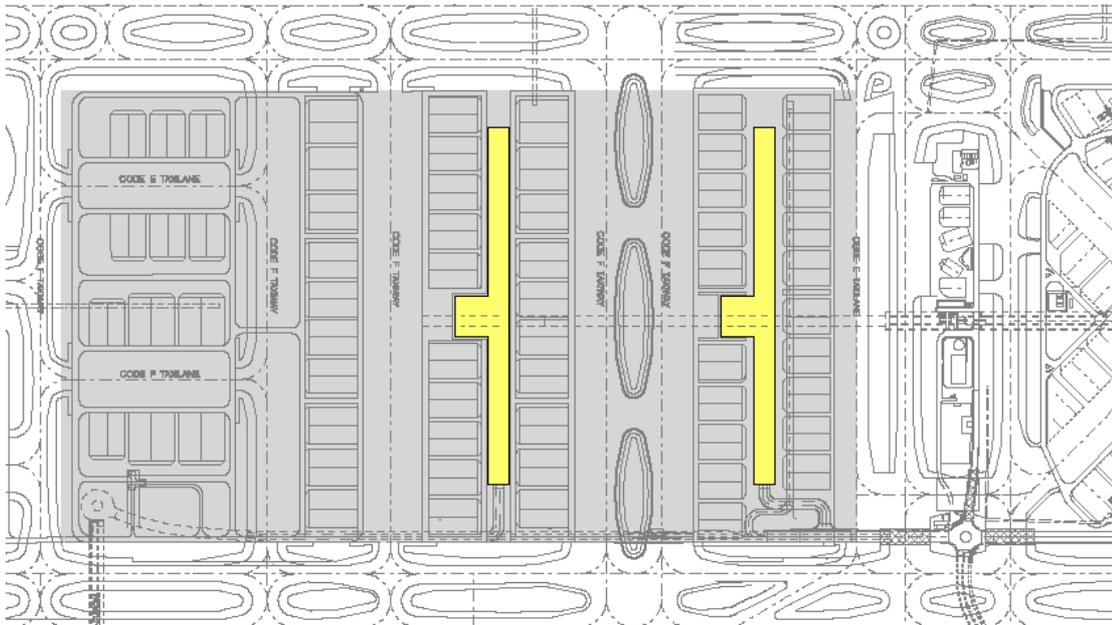
4.10 To meet the constrained passenger demand forecast of up to 74 million passengers and 6 million tonnes of cargo per annum by 2030, a staged addition of 40 airbridge-served passenger aircraft stands and 20 cargo stands in the Midfield area will be required over the next twenty years. The first stage of development, already committed to by AAHK up to 2015, has been outlined in Chapter 3 (see paragraph 3.17). The remaining development plans for 2015 and beyond are summarised in the following section on development phasing.

4.11 AAHK's service pledge is that approximately 95% of passengers will be served via airbridges for boarding or disembarking from the aircraft. Additionally, the distance between T1 and aircraft parked in the Midfield area makes it difficult to bus passengers between them. Passenger concourses will therefore be built in phases in the Midfield area so that all passenger aircraft stands there are eventually served by airbridges. The

existing automated people mover system (APM) will be extended to facilitate transportation of passengers from the Midfield concourses to T1 and vice versa.

- 4.12 The Midfield Concept Design Study, conducted in 2008, identified how the Midfield area should be utilised for aircraft parking stands, concourses, taxiways, taxilanes, airside roads, baggage handling system, APM system and other related support facilities to meet the maximum capacity of the two-runway system. It served as an update to the previous Midfield development study namely “The Strategic Overview of Major Airport Development” (SOMAD) that was conducted in 2001.
- 4.13 After considering relevant performance criteria including the total number of stands provided (airbridge-served stands and remote stands for cargo), airfield operations efficiency, passenger convenience such as walking distance and way-finding within the concourse, baggage facility arrangement and location, retail performance etc., the Midfield Concept Design Study has developed a range of 14 Midfield layout options, together with preliminary construction cost estimates, for subsequent evaluation.
- 4.14 Amongst layout options for the **ultimate development** of the Midfield area, the “I” shaped layout (see Figure 4.11) will provide the maximum capacity in the two-runway system. The scheme includes:
- Two “I” shaped concourses providing a total of 40 airbridge-served stands; and
 - 20 remote aircraft stands for freighter and aircraft base maintenance parking.

Figure 4.11 : A Possible Concept of Ultimate Midfield Development to Meet the Maximum Capacity of the Two-Runway System



Automated People Mover System

4.15 The Midfield Concept Design Study has recommended extending the existing automated people mover (APM) pinched loop system operating between T1’s East Hall and West Hall to the Midfield concourse as the most efficient way to facilitate passenger flow (see Figure 4.12).

Figure 4.12 : Existing APM System Operating Between T1’s East and West Halls



4.16 In parallel, the existing south tunnel will have to be extended from T1’s West Hall to the Midfield area to accommodate an additional APM Shuttle System, which will provide route recovery in case passengers disembark at the wrong station and also serve as a backup in the event of a breakdown on the T1 line.

Baggage Handling System

4.17 HKIA’s bag-passenger ratio is one bag per passenger and as passenger numbers increase, there will be a corresponding increase in baggage. Extensive works will be required to enhance the baggage handling system (BHS) to accommodate the higher volume and while maintaining the service standard of baggage delivery time from the Midfield concourse to T1 and vice versa. The 2008 Midfield Concept Design Study recommends the use of automated baggage transportation via a new high-speed baggage conveyance system known as Destination Coded Vehicle (DCV) (see Figure 4.13). This is to meet the following service level pledges of HKIA:

- **Arrival Bags:** Delivery of the 1st bag no later than 20 minutes, and delivery of the last bag no later than 40 minutes after the parking of the aircraft.
- **Departure Bags:** Delivery of a bag to the aircraft is within 40 minutes of closure of check-in services and before aircraft departure.

Figure 4.13 : High-speed Tray Baggage System or Destination Coded Vehicles

HIGH SPEED TRAY SYSTEM

- 2.5 km between T1 Baggage Hall and Midfield
- Speed at 10 m/sec – 4-min travel time

Source: Vanderlande Industries

4.18 Expansion of the existing baggage handling system at HKIA will comprise the following elements:

- Baggage Hall provision at the Midfield concourse to incorporate unloading docks, connections to the DCV and Midfield departure baggage handling systems, including baggage sortation system and make-up laterals;
- Extension of the existing north tunnel to link the Midfield concourse and T1 in order to install the DCV system to transport bags between the Midfield concourse and T1;
- Modifications to T1 to facilitate interface with the Midfield Concourse. An additional interface zone will need to be created for unloading bags from the DCV tunnel and transferring to conveyor feeds and reclaim carousels; and
- Additional baggage make-up laterals, which will be accommodated in the basement of the proposed four-bay expansion of T1.

Surface Access and Transportation Facilities

4.19 Providing good surface access to and from HKIA and optimising traffic circulation within the airport island are essential for smooth airport operations. Surface access includes both land and sea transportation.

4.20 Airport Access Road Network

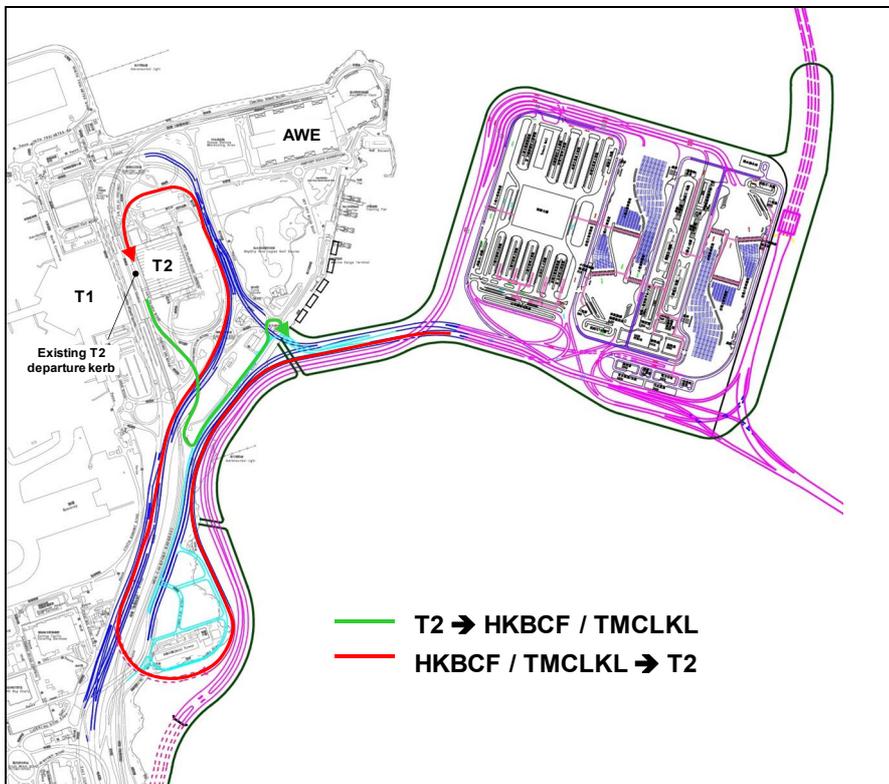
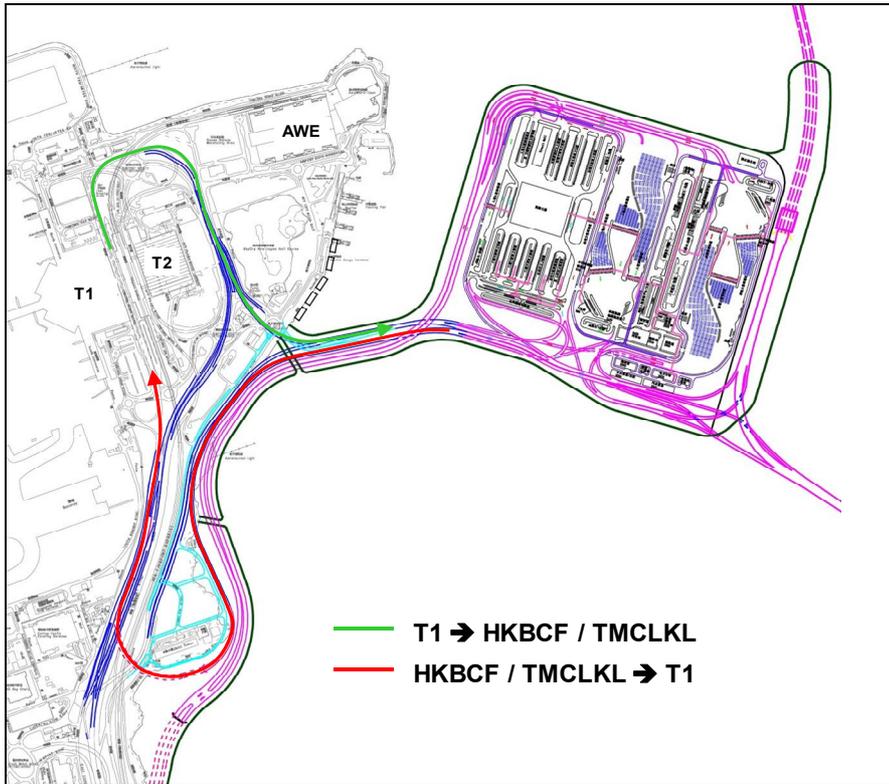
Based on the proposed road network and forecast traffic volumes, it is anticipated that the existing two access roads - Airport Road and Chek Lap Kok South Road, which connect to the North Lantau Highway - together with the planned third access road from Tuen Mun to the airport via the Tuen Mun-Chek Lap Kok Link (TMCLKL) and Hong Kong Boundary Crossing Facilities (HKBCF) – will provide sufficient road traffic capacity up to 2030. HKIA's accessibility from western PRD will be greatly enhanced when the Hong Kong-Zhuhai-Macao Bridge (HZMB) and HKBCF become operational around 2016. In addition, TMCLKL will provide a back-up route in case the Tsing Ma Bridge or North Lantau Highway is blocked (see Figure 4.14 and Figure 4.15).

Figure 4.14 : Indicative Layout of HZMB and TMCLKL Transportation Network



Source: Highways Department (March, 2011)

Figure 4.15 : Road Connections to and from the Airport via HKBCF/TMCLKL for Two-Runway Option



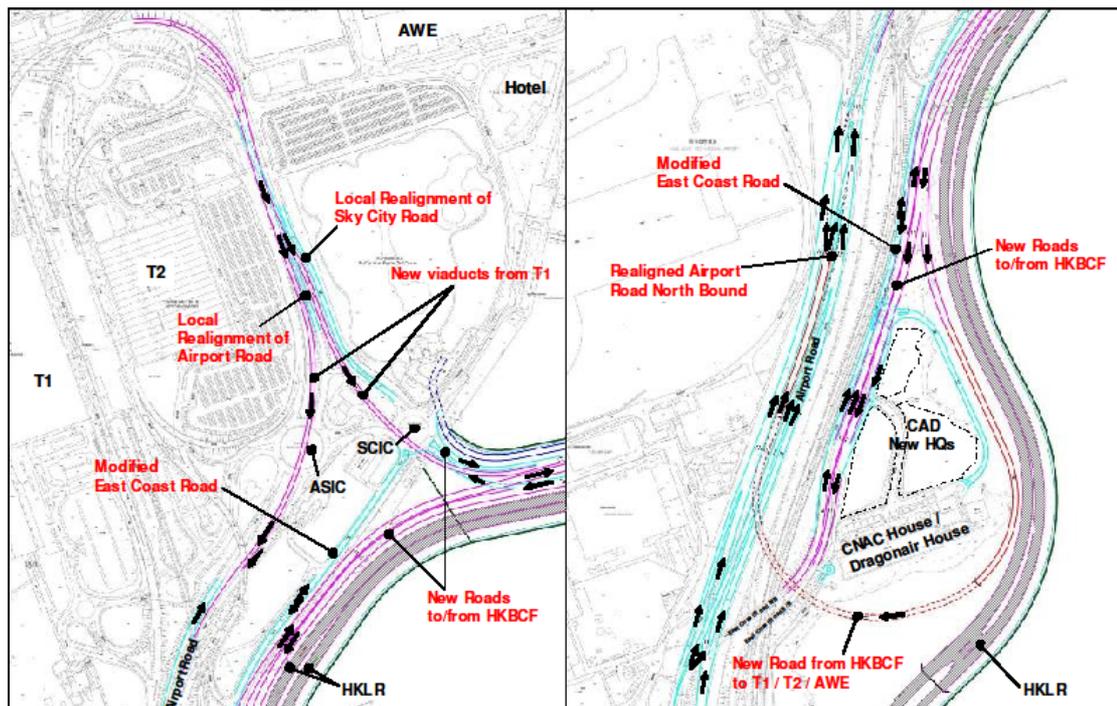
4.21 Passenger Terminal Area Road Network

The road system in the Passenger Terminal area will be modified in line with the expected increase in origin/destination passenger throughput. Elevated viaducts will be added to Airport Road to divert exit traffic from the passenger terminals from the current interchanges at grade, resulting in speedier access to either the North Lantau Highway or TMCLKL via HKBCF while simultaneously helping alleviate congestion along the Airport South Interchange (ASIC) and SkyCity Interchange (SCIC) (see Figure 4.16).

4.22 There will be new at-grade roads and tunnels for inbound traffic to passenger terminals, and existing roads on the airport island will be modified to increase the capacity of the passenger terminal access roads via the HKBCF (see Figure 4.16).

4.23 Other road improvement works that will be carried out in the passenger terminal area include the widening of Cheong Lin Road south of T1 to accommodate increased bus traffic and the widening of SkyCity Road East to serve additional airport and Asia World-Expo (AWE) traffic.

Figure 4.16 : Road System in the Vicinity of the Passenger Terminal Area



Transportation Facilities/Services

Figure 4.17 shows the proposed transportation facilities in the T1 and T2 area. The facilities include:

4.24 Buses, Coaches, Limousines and Taxis

The existing private car and hotel vehicle pick-up area south of T1 will be relocated and integrated into a multi-storey complex, built on the remainder of Car Park 1 that has not been taken up by the southward expansion of the T1 building's footprint (see Figure 4.17). The taxi pick-up area, taxi staging area and franchised bus terminus will remain at the same location, serving both T1 and T2. However, a project is underway to expand the existing franchised bus terminus which is expected to be completed in 2011.

4.25 Car Parking

The existing car parks are not fully utilised on a normal day. However, during holiday and seasonal peaks, significant surges in car parking demand have been experienced, almost reaching the total capacity of the existing car parks in the Passenger Terminal area (about 4,000 spaces in total). To cater for a 50% increase in passenger volume beyond 2020, it is estimated that 2,000 additional car parking spaces will be required. The development of two multi-storey car parks adjacent to T1 and T2 is expected to accommodate the additional car parking demand by 2020, including the re-provision of about 800 existing at-grade car parking spaces affected by the development of the multi-storey car parks (see Figure 4.17).

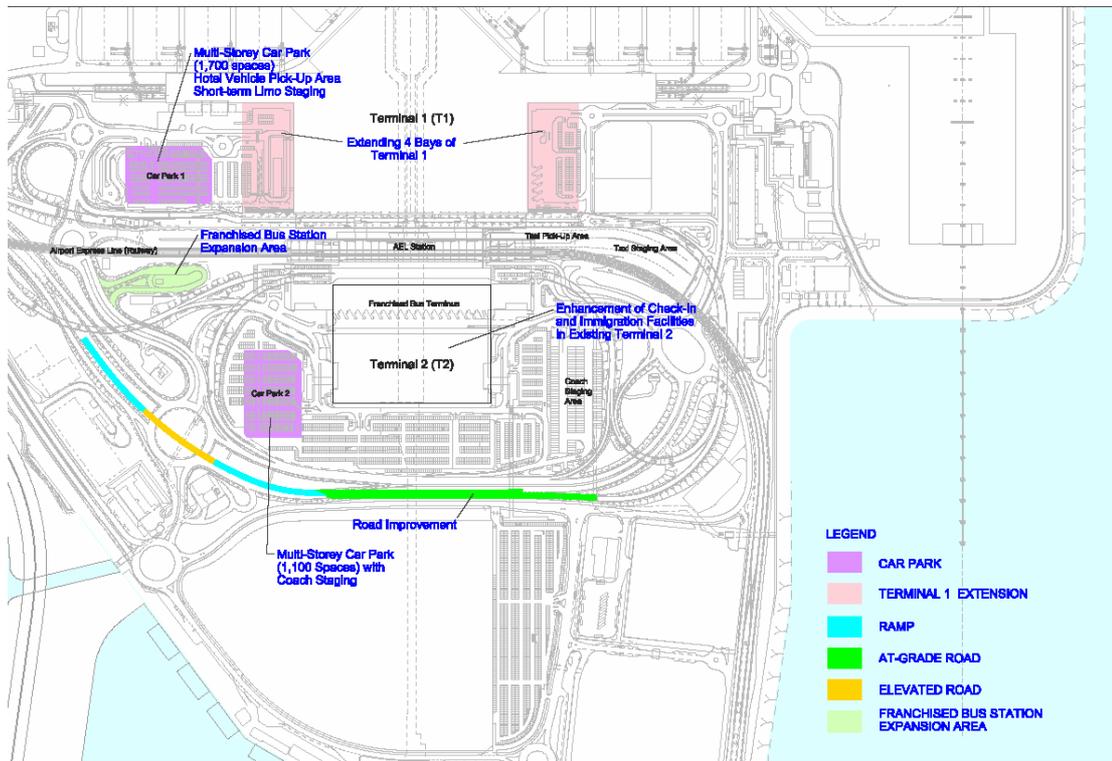
4.26 Coach Staging

The existing coach staging area north of T2 provides 150 spaces. This facility will be retained and designated for future use as a short-stay coach staging area. Further spaces will be provided on the lower levels of the new multi-storey car park complex to be built south of the existing T2 building, and will be allocated for longer stay and overflow coach staging. It will also be used as a taxi and limousine staging area, taxi/light goods vehicle parking area and pre-booked taxi pick-up area.

4.27 Airport Express Line

The Airport Express Line (AEL) has been designed to operate with up to nine passenger cars (giving each train a capacity of 572 seats) and a baggage car at a seven-minute headway, which is equivalent to 8.5 trains per hour running via Tsing Yi to the Airport section of the line. This gives a maximum AEL capacity of around 4,850 passengers per hour per direction. It is believed that AEL can expand its service levels to accommodate the anticipated increase in AEL passenger volume due to the broader expansion of the Hong Kong rail network.

Figure 4.17 : Proposed Transportation Facilities near T1 and T2



Cross-Boundary Multi-modal Transportation Services

4.28 SkyPier Terminal

The 16,500 square-metre SkyPier Terminal was opened in January 2010 to process the air-sea inter-modal transfer of HKIA passengers to and from cities in the PRD and Macao. It has an ultimate design handling capacity of 8 million passengers per annum, with an underground APM link to transfer passengers between the SkyPier Terminal and T1.

4.29 With more than 110 scheduled sailings a day, the SkyPier ferry services offer comprehensive coverage of the GPRD, including Macao (see Figure 4.18). Subject to traffic, SkyPier can operate eight berths (four at present) to support its maximum capacity of 8 million annual passengers.

Figure 4.18 : Ferry Network



4.30 Airport Coach and Limousine Services

Cross-boundary coach services cover about 115 destinations in major PRD cities and towns with 109 scheduled coach departures from T2 Coach Hall per day. Airport coach licensees have continuously run a hub-and-spoke connection with town coach operators at Mainland boundary-crossing points to increase coverage of and frequencies to PRD destinations.

4.31 The cross-boundary limousine service has also become increasingly popular, with the number of limousines serving the airport increasing to 290 vehicles, providing about 600 round-trip services between HKIA and PRD cities daily (see Figure 4.19).

Figure 4.19 : Coach and Limousine Services Network



4.32 Hong Kong-Shenzhen Western Express Line

The Hong Kong–Shenzhen Western Express Line (WEL), which is currently under feasibility study by the Government, includes a terminus at HKIA (either on the airport island or at the HKBCF). The potential alignment currently under evaluation is indicated in Figure 4.20.

4.33 The proposed WEL is intended to be a multi-function cross-boundary railway with the following objectives:

- a) To provide convenient services for air passengers of the two locations, i.e. HKIA and Shenzhen Airport;
- b) To provide cross-boundary travellers with environmentally friendly and efficient railway services between Hong Kong and Shenzhen; and
- c) To facilitate the development of northwest New Territories in Hong Kong and Qianhai in Shenzhen.

Figure 4.20 : Potential Hong Kong-Shenzhen Western Express Line (WEL) Alignment



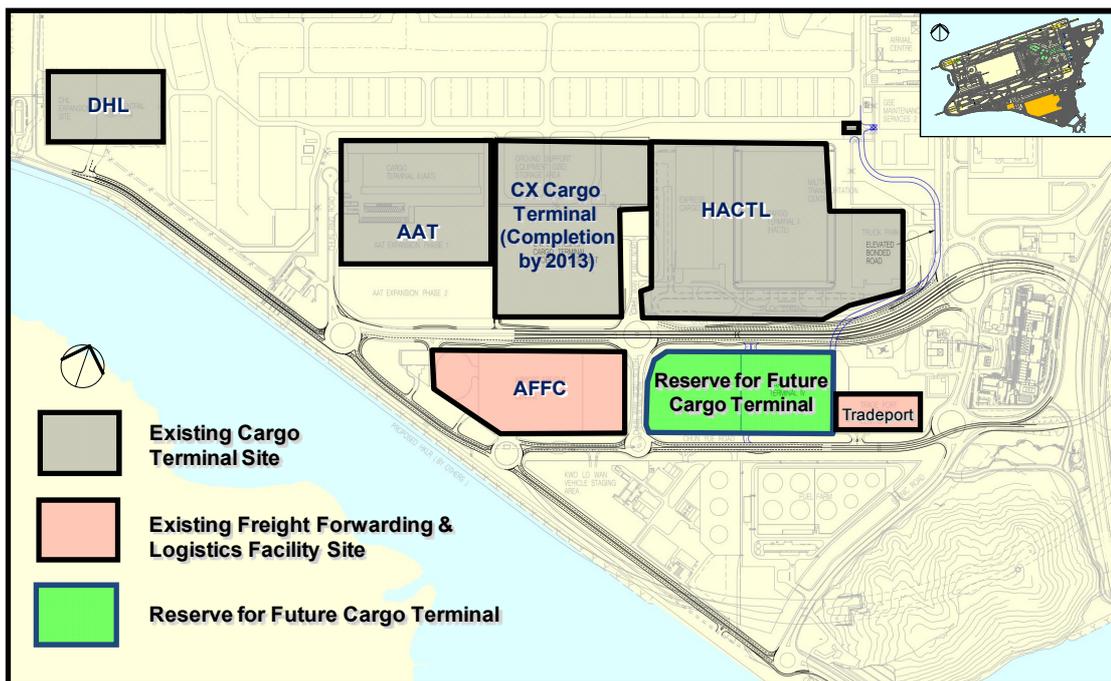
Aviation Support Facilities and Infrastructure

4.34 Cargo Terminals

The three existing cargo terminals (namely HACTL, AAT and DHL) and the upcoming Cathay Pacific Cargo Terminal will offer a total design capacity of around 7.4 million tonnes per annum. These four cargo terminals are expected to be able to handle the constrained forecast growth, capped at around 6 million tonnes per annum beyond 2020 due to aircraft movement limitations on the two runways. However, more flexibility may be needed in cargo terminal capacity planning to respond to market dynamics that might impact operating efficiency (e.g. 100% cargo screening may be required for all freighter operations on a piece-by-piece basis at the cargo terminal), create more competition, and/or create specialised services in the future.

4.35 Based on feedback from the cargo industry that cargo terminals should be located together for the operational efficiency of freight forwarders and truck drivers, it is prudent that some land be reserved in the Southern Cargo Precinct to construct an additional (fifth) cargo terminal with links to the airside as well as the cargo stands as illustrated in Figure 4.21 (shaded in green).

Figure 4.21 : Layout of the Southern Cargo Precinct

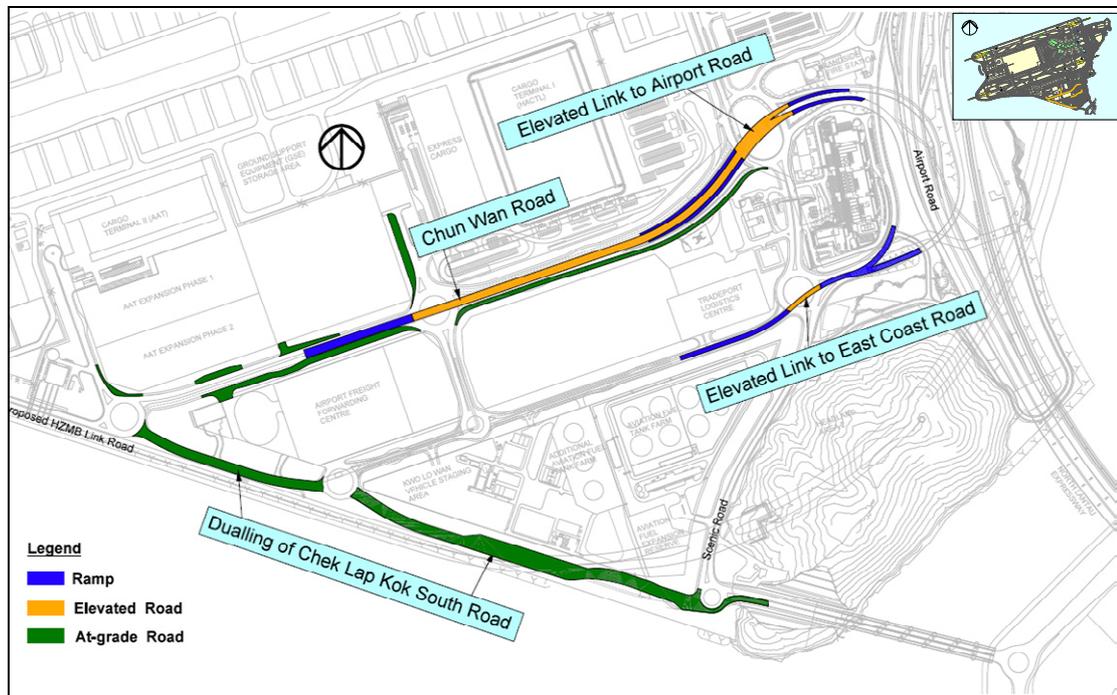


4.36 Cargo Terminal Area Road Network

The road system in the Southern Cargo Precinct will be modified in line with the expected increase in the cargo terminals’ throughput by adding elevated road links to both Chun Wan and Chun Yue roads to divert through-traffic from the at-grade

interchanges; widening at-grade sections of Chun Wan and Chun Yue roads, and converting Chek Lap Kok South Road to a dual carriageway (see Figure 4.22).

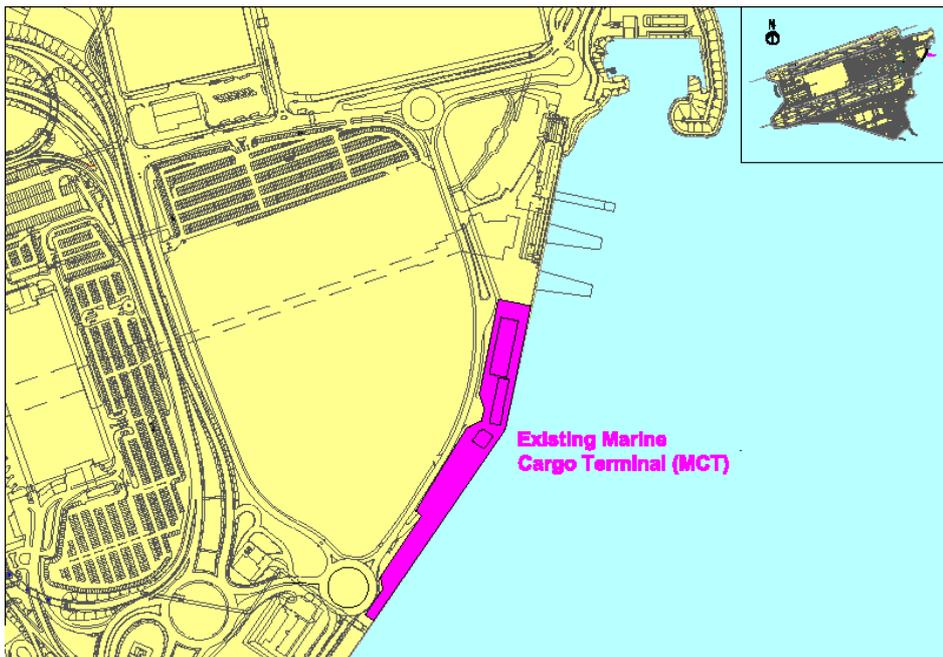
Figure 4.22 : Proposed Road Improvements in the Southern Cargo Precinct



4.37 Marine Cargo Terminal

The Marine Cargo Terminal (MCT) is a component of aviation logistics services at HKIA offering one-stop air-sea inter-modal transportation services connecting HKIA with 18 ports in the Pearl River Delta (PRD) region. The role of the MCT is to facilitate cargo distribution and provide an alternative mode of transportation between PRD and HKIA. The tonnage throughput of the MCT has been expanding at a CAGR of 24% since 2002 and was about 93,000 tonnes in 2010. The existing MCT site (see Figure 4.23 for its location) has the capability to handle marine cargo demand in the medium term. However, given the changes to HKIA landscape after the planned commissioning of HZMB and TMCLKL around 2016, the future development needs of the MCT and its most suitable location will be further reviewed in due course.

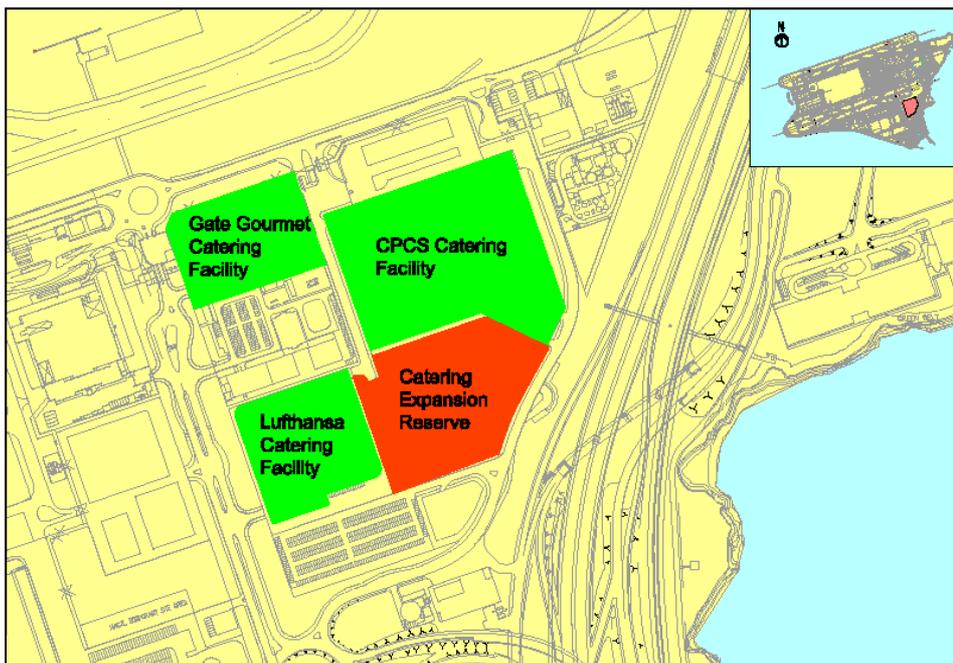
Figure 4.23 : Existing Location of Marine Cargo Terminal (MCT)



4.38 Aircraft Catering

The demand for space for aircraft catering facilities (to prepare airline meals) is declining due to the trend of supplying “pre-packed frozen food”. While HKIA is not expected to require additional aircraft catering facilities, space is available in the existing aircraft catering precinct if needed. Figure 4.24 illustrates the land area reserved for the expansion of aircraft catering facilities.

Figure 4.24 : Land Reserved for Catering Facilities



4.39 Aircraft Maintenance

Currently, there are two aircraft base maintenance operators at HKIA: Hong Kong Aircraft Engineering Company Limited (HAECO) and China Aircraft Services Limited (CASL). With the second phase of HAECO’s third hangar coming into operation by 2015, the capacity of aircraft base maintenance at HKIA will reach about 4.2 million man-hours per annum.

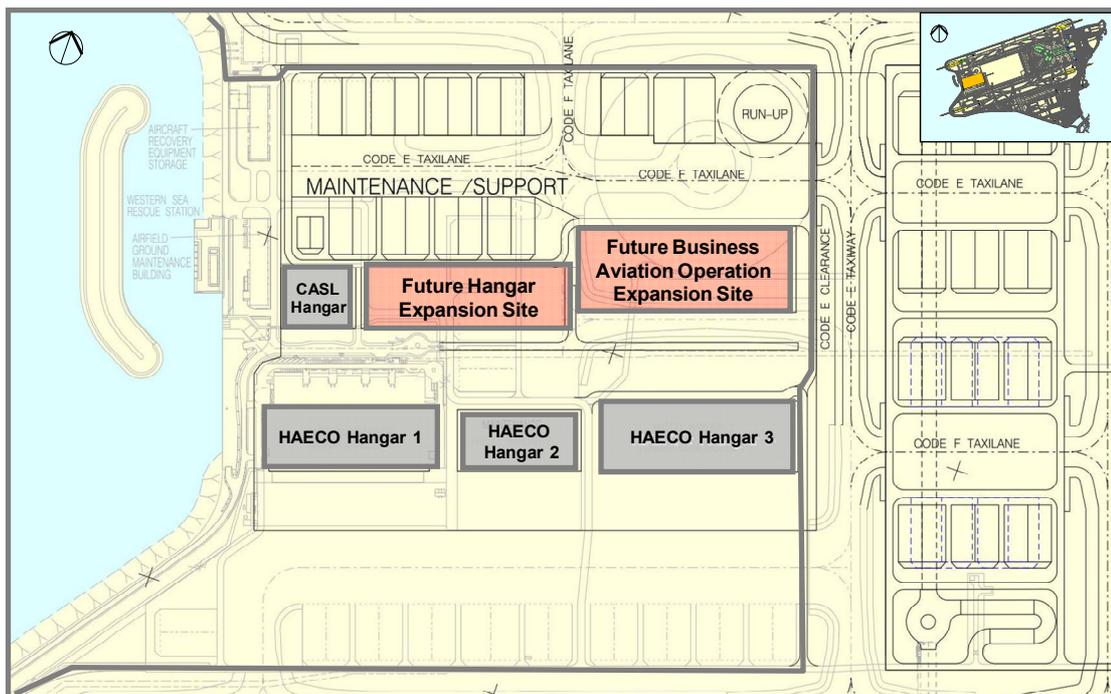
4.40 Demand for aircraft base maintenance is driven not just by projected aircraft movements at the airport, but also by airlines’ commercial considerations, and competitiveness of aircraft base maintenance operators around the world. Some areas have been reserved for maintenance hangars (see Figure 4.25).

4.41 Business Aviation Centre

The Mainland’s economic growth will fuel both business and leisure demand for business jet travel. Hong Kong is geographically well positioned to gain from the increase in business aviation. Business jet movements for 2009, recorded at over 4,000 movements, represented 1.5% of total aircraft movements. This is forecast to increase in line with total aircraft movement growth.

4.42 Subject to market demand, for possible development in future, an area for a second business aviation facility has been earmarked at the western end of the Midfield area, with convenient access to both the aircraft parking apron and the approach roads to and from the airport (see Figure 4.25).

Figure 4.25 : Reserved Area for Hangar, Maintenance Facilities and Business Aviation



4.43 Ground Support Equipment Maintenance

Ground support equipment (GSE) maintenance services are provided by two operators located adjacent to the flight catering complex, namely, Ground Support Engineering Ltd (GSEL) and Dah Chong Hong – Dragonair Airport Services. They provide maintenance and support to the following categories of equipment:

- Powered equipment such as tugs, pallet loaders, tractors, buses, catering trucks, etc.;
- Non-powered equipment such as dollies, trailers, generators and mobile stairs; and
- Baggage and cargo containers for use on aircraft, such as the Unit Load Device (ULD).

4.44 GSE maintenance activities are forecast to grow in line with the growth in the number of aircraft stands. These are undertaken for heavy specialised equipment and other equipment that cannot travel on public roads, and usually take place on-airport, with direct access to the airside. Some component parts of the GSE may be repaired/refurbished at specialised off-airport facilities if required.

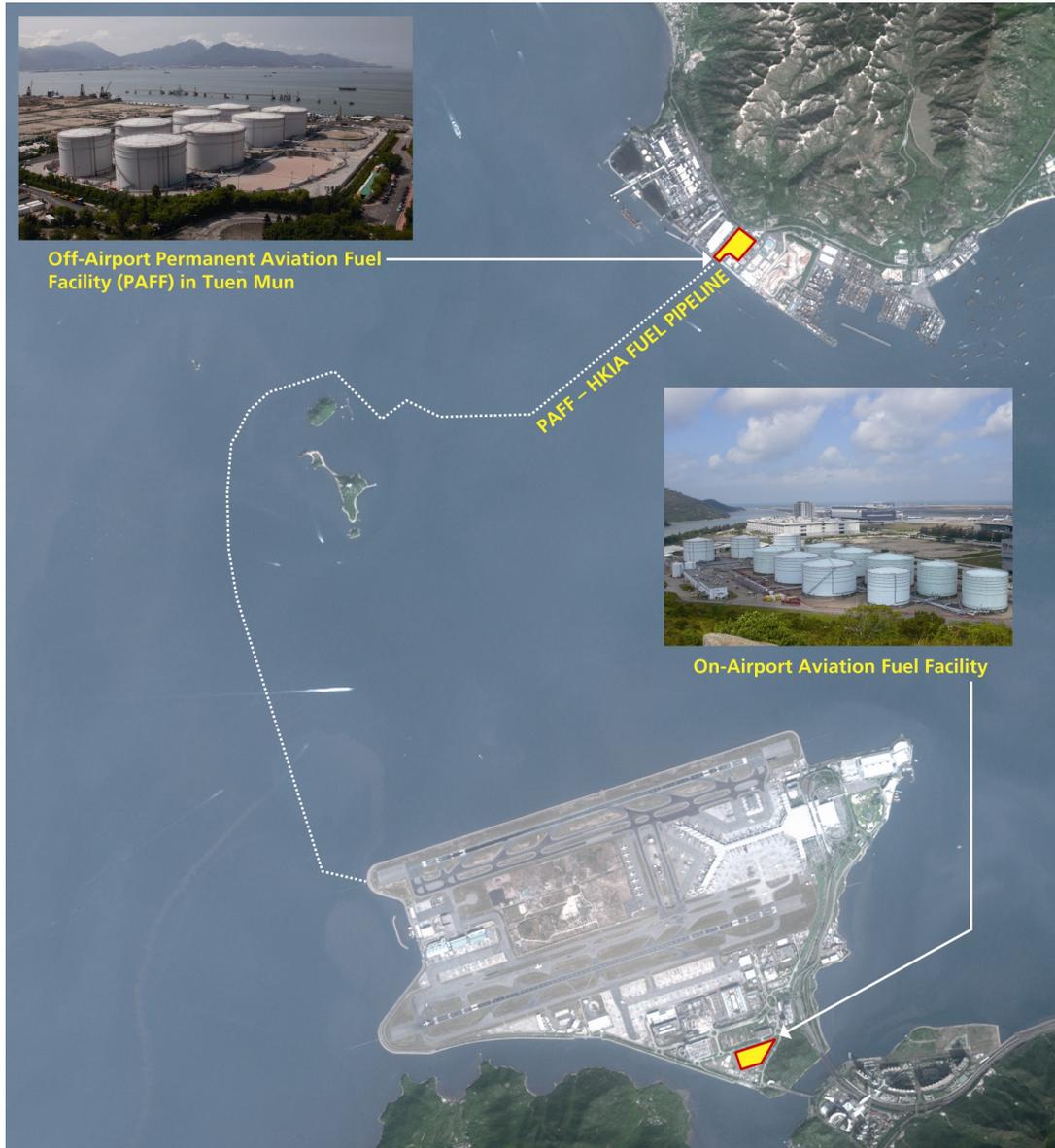
4.45 As demand for space at existing GSE facilities increases, more work could be outsourced by trucking equipment (e.g. ULDs and non-powered equipment) off-airport or by component removal and shipping to specialist repairers. This would significantly augment the capacity of existing GSE maintenance facilities to cope with the expected increase in repair-related services.

Aviation Fuel Facilities

4.46 There are currently 12 aviation fuel storage tanks on the airport island, with a total storage capacity of 223,000 cubic metres. This facility occupies an area of 71,000 square metres. Currently, the HKSAR Government requires a minimum of 11 days' supply of aviation fuel to be maintained as reserve.

4.47 To ensure that the minimum reserve requirement is met as traffic grows, the storage capacity for aviation fuel was expanded when the Permanent Aviation Fuel Facility (PAFF) at Tuen Mun Area 38 came into operation in 2010. It consists of eight aviation fuel storage tanks providing a storage capacity of 264,000 cubic metres. Together with the on-airport fuel storage tanks, these facilities provide a total capacity of 487,000 cubic metres, which is adequate to support the two-runway system operation at maximum capacity. PAFF has safeguarded space for four additional fuel storage tanks, which would be built subject to future aviation fuel demand.

Figure 4.26 : Aviation Fuel Facilities of HKIA



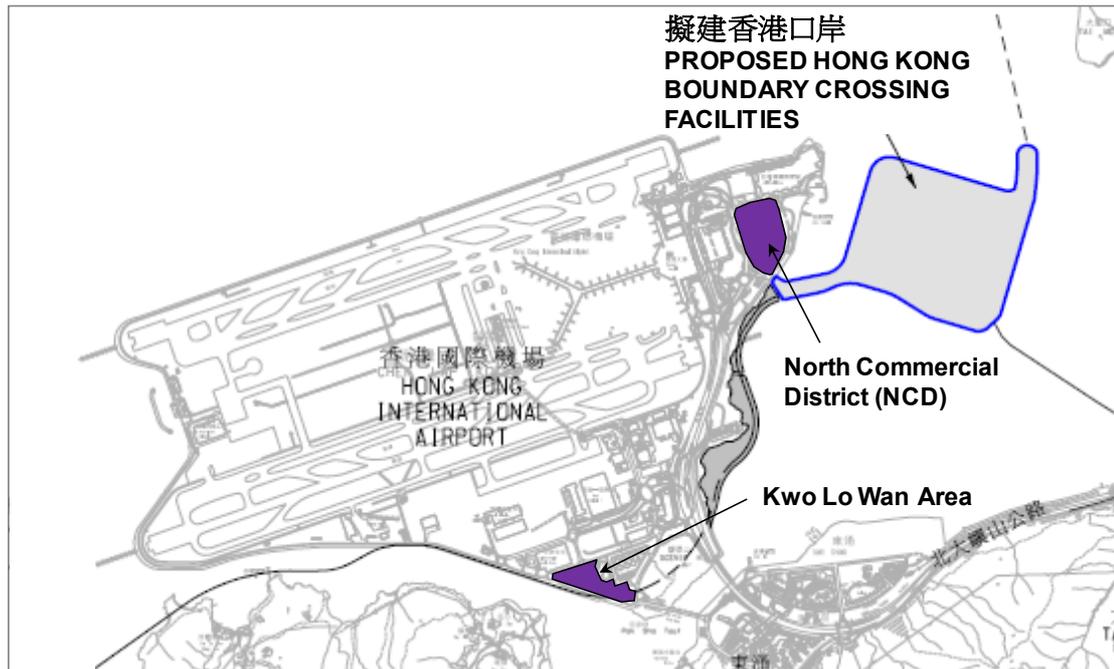
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Airport Related Development

- 4.48** Given the scarcity of land on the existing airport island, airport related development planning will be subject to a detailed business case analysis, conducted in accordance with the Airport Authority Ordinance (Cap 483). This Ordinance stipulates that the Airport Authority must operate and develop HKIA with the objective of maintaining Hong Kong’s status as a centre of international and regional aviation, conducting its business according to prudent commercial principles and paying particular regard to safety, security, economy and operational efficiency.
- 4.49** AAHK would like to explore opportunities arising from the enhanced connectivity between the airport and the Pearl River Delta (via the HZMB and TMCLKL). To this end, consultants have been appointed to evaluate the landside commercial opportunities associated with the airport city and the Hong Kong Boundary Crossing Facilities’

bridgehead economy. The scope covers land in both the North Commercial District of HKIA and its neighbourhood including Tung Chung, North Lantau and Northwest New Territories, (i.e. the wider airport region) and consultation with and incorporating input from relevant Government bureaux and departments. This would form the basis of developing an integrated development strategy for the North Commercial District (see Figure 4.27) on the airport island, which is being temporarily used as a golf course at the moment.

Figure 4.27 : Location of North Commercial District and Kwo Lo Wan on the airport island



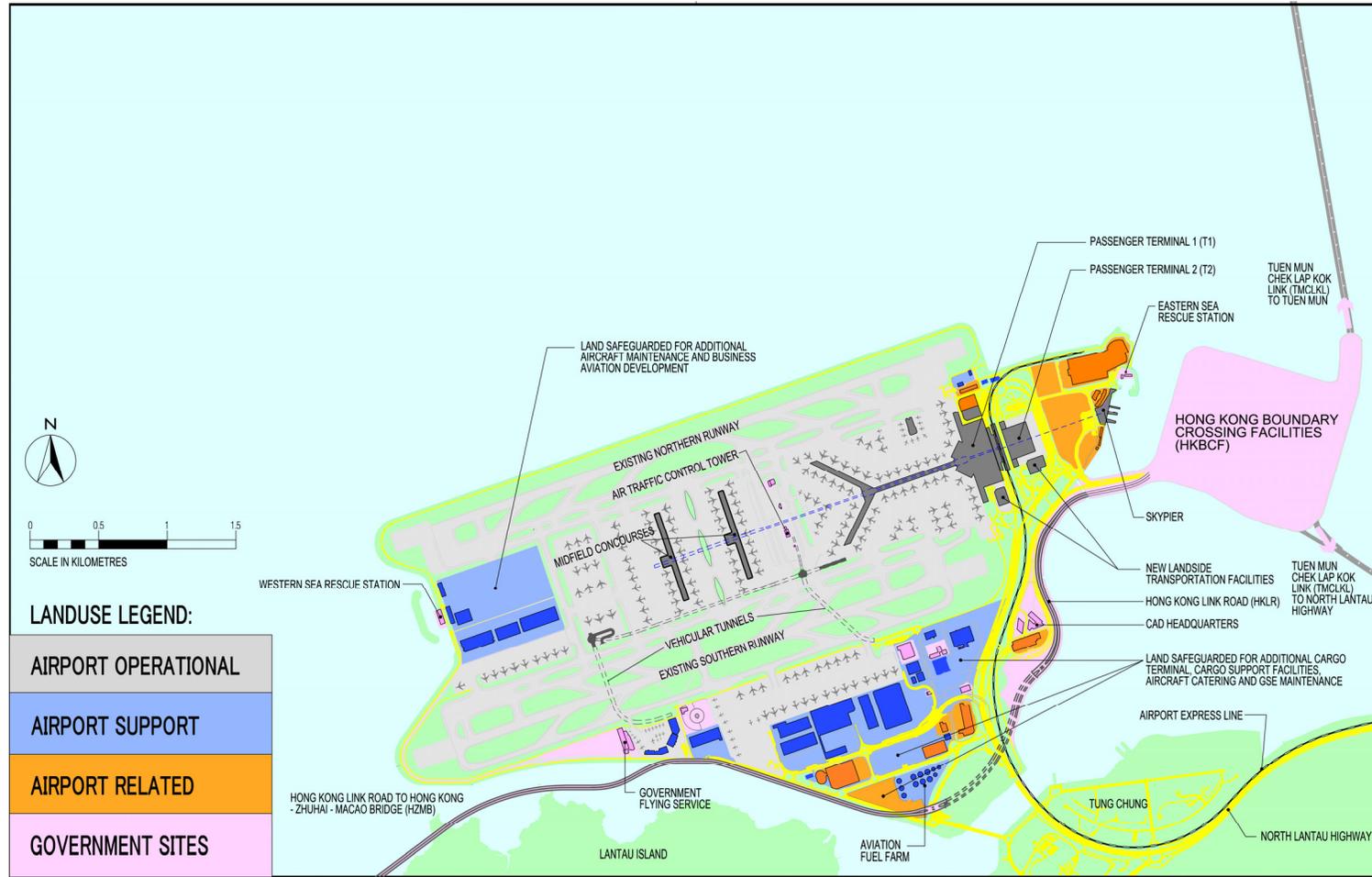
4.50 Apart from the North Commercial District, the existing Southern Cargo Precinct has reserved approximately five hectares of land at the Kwo Lo Wan site (see Figure 4.27) for airport related development to support air cargo operations. This may include facilities like:

- A centralised common-use cargo screening facility to facilitate the implementation of air cargo screening as mandated by civil aviation authorities (e.g. US Transport Security Authority's requirement to screen all air cargo going on board passenger aircraft to USA);
- A common-use truck parking facility to reduce road and cargo terminal congestion; and
- More freight forwarding facilities to undertake timely consolidation and breakdown, as well as collection and distribution of airfreight.

Government Sites

4.51 The current and planned government facilities on the existing airport island are considered adequate to support the eventual capacity of the two-runway system. Figure 4.28 shows the layout of HKIA under Option 1.

Figure 4.28 : Option 1 (Two-Runway System) – Airport Layout Plan in 2030



Definitions:

- 1) Airport Operational Development (AOD) refers to operational facilities such as the runways, taxiways, parking aprons, passenger processing terminals and passenger concourses, ground transportation centre and vehicle parking spaces, etc.
- 2) Airport Support Development (ASD) refers to support facilities such as cargo terminals, aircraft maintenance and engineering, aircraft catering, ground services equipment maintenance, aircraft fuelling, etc.
- 3) Airport Related Development (ARD) refers to commercial facilities such as freight forwarding, hotels, offices, retail and exhibition centre, etc.
- 4) Government Sites refer to Government facilities such as the Government Flying Service (GFS), the Headquarters Building of Civil Aviation Department and the Air Mail Centre, etc.

Preliminary Engineering Feasibility

4.52 To explore the two-runway system option, preliminary engineering feasibility was conducted which focused on reviewing and establishing the 'hardware' requirements for meeting the forecast traffic demand up to 2030. With input from the consultants, airport community, professionals and management experts, the requirements were translated into feasible engineering options and implementation plans. The technical challenge was achieving seamless integration between the existing and new facilities/systems, while factoring in elements like capacity optimisation, maintaining system robustness, compliance with safety and other statutory requirements, maintenance and product obsolescence, etc. Specific areas that have been examined under the two-runway option include passenger terminals/concourses, automated people mover (APM), baggage handling system (BHS) and access infrastructures. The following paragraphs summarise the developments required for each specific area.

Airfield and Apron Works

4.53 Preliminary designs have been prepared for the airfield and apron which cover pavement construction, drainage, utilities, firefighting systems, aviation fuel system, airfield ground lighting, apron systems, and airside roads. The grading of the new airfield and apron will meet CAD and ICAO requirements and can be matched with the existing airport. It is proposed to use flexible pavement construction for the taxiways and taxilanes and rigid pavement for the aircraft parking stands. The tributary stormwater drainage and oil separation systems should be similar to the existing system at the airport.

4.54 Since the Midfield is bounded on all four sides by operational taxiways the only regular means of access will be via the eastern and western vehicular tunnels. The vehicular ramp that currently provides access to the temporary stands (T-stands) from the eastern vehicular tunnel will be reprofiled and extended to give access to the Midfield concourses and its aprons. For the western vehicular tunnel, a new access ramp will be constructed at both ends of the existing tunnel structures underneath the South Runway. These preliminary designs have taken into account the requirements of the CAD and Hong Kong Observatory (HKO) facilities.

Passenger Processing Terminal and Concourse Development

4.55 Expansion of Terminal 1 (T1)

Under the two-runway option, the expansion requirements for T1 are driven by the increasing demand for baggage handling capacity. This breaks down into:

- Additional baggage make-up capacity; and
- Additional arrivals baggage reclaim capacity.

4.56 The expansion of the baggage hall provides a potential addition of 24 make-up locations. This incorporates the plan for an imminent expansion and reconfiguration of the central island of the baggage hall.

4.57 The demand analysis for the arrivals system suggests that eventually a total of 16 carousels will be needed. This number can be fitted into T1 if the building is extended by

six 12m grids to both the north and the south. This can be achieved with the relocation of the existing Out Of Gauge (OOG) reclaim conveyor lines (for oversize and odd-size baggage) and the inclusion of four carousels. The interim arrangement for carousel sharing will further increase the capacity of the baggage reclaim facility in the medium term, generating some extra time for long-term planning and expansion projects.

- 4.58** Expansion by means of two additional bays each to the north and the south of the existing T1 building envelope will be needed in order to physically accommodate four additional baggage reclaim carousels at arrivals level and to provide more kerbside space at departure level (see Figures 4.8 - 4.10).

4.59 Expansion of Midfield Concourse

A second “I”-shaped passenger concourse parallel to the Midfield concourse currently under design will be built. The “double I” concourse layout is one of the many options studied that have taken into consideration the alignment with the two runways and T1, cross field access to the two runways, and the flexibility and feasibility of phased construction over a long time span of 15 years to maintain a high level of services to satisfy the forecast demand. The second concourse will provide an additional 20 airbridge-served passenger aircraft stands. Together with 20 remote aircraft parking stands for freighters to be built at the extended apron, the expansion can meet the constrained demand of up to 74 million passengers and 6 million tonnes of cargo by 2030.

- 4.60** The planning of the second concourse as well as the facilities for interfacing with T1 not only have to address the main passenger arrival and departure flows but also various transfer, route recovery, and backup scenarios. Figure 4.31 shows the layout of the second “I” concourse.

Automated People Mover System

- 4.61** The key criteria to be considered in the concept design of the APM System are to:
- Maintain airport protocol for passenger segregation and security;
 - Ensure a convenient means of route recovery between the Midfield Concourse and T1;
 - Meet normal mode passenger flow requirements;
 - Provide an acceptable level of service at degraded operation mode; and
 - Take into full account the APM station platforms and vertical circulation elements for peak design flows in various design years.
- 4.62** The proposed APM system to the Midfield concourse from T1 will consist of two lines and a depot:-

T1 Line Extension

For the T1 line extension, an important design factor is the possible simultaneous arrival of large size aircraft at both the Midfield and West Hall. In this case, the configuration would result in peak-within-peak periods where the APM is filled up at Midfield and passengers are unable to board at the West Hall in T1. To resolve this, either the train

could be so configured that some doors do not open at the Midfield to make empty carriages available when the train arrives at the West Hall, or the number of passengers moving down to the platforms by escalators at the Midfield concourse and/or West Hall could be monitored. Provision for both is allowed in the design for providing future flexibility of operations.

Another important factor while determining fleet size and headway is the platform clearance time required at the East Hall arrival platform for alighting passengers. The chosen solution has to ensure that passengers alighting at the East Hall will be cleared before the next train arrives.

Route Recovery Line

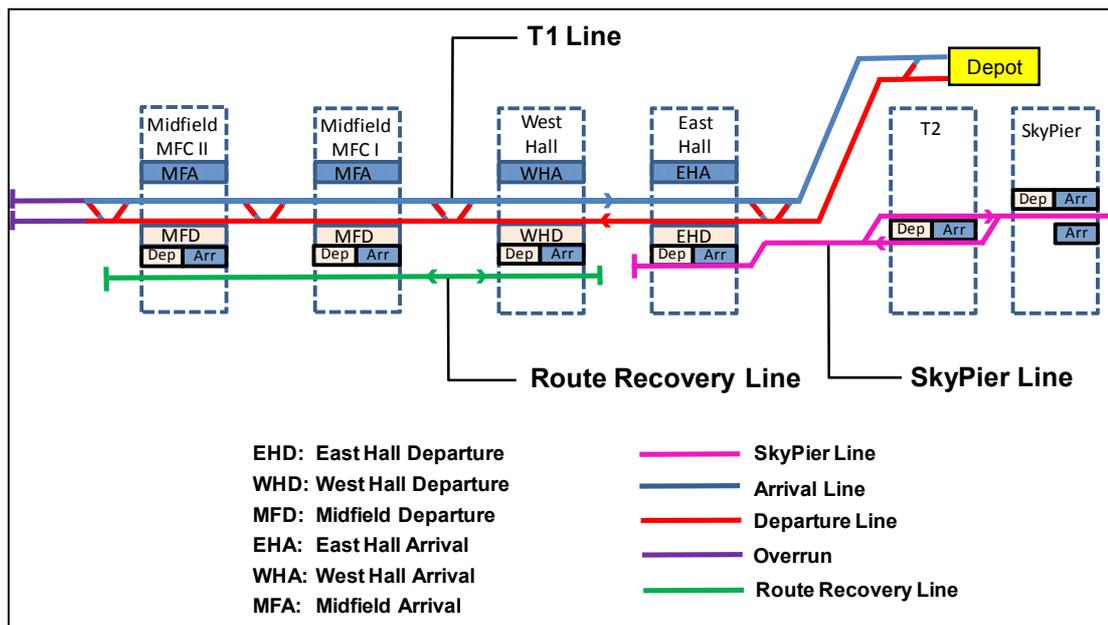
APM technology will also be deployed for the Route Recovery Line. The Route Recovery Line will be connected with the T1 system at the west of the Midfield concourse. As the expected demand for route recovery is not high, a two-car train would normally be sufficient. The Route Recovery Line running in a single shuttle configuration would also be used as a backup system to supplement the capacity of the T1 main line in the event of T1 line failure.

The proposed APM track schematics are presented in Figure 4.29.

APM Depot

With the completion of two passenger concourses in the Midfield area by 2030, HKIA would require an ultimate APM fleet size of approximately 68 cars to handle its maximum annual throughput of 74 million passengers. The existing underground APM depot beneath T2 will be relocated to the east of T2, and sized to accommodate the ultimate APM network capacity. Construction may however be completed in phases.

Figure 4.29 : APM Track Schematics



Baggage Handling System

4.63 The baggage handling process flows have been translated into technology concepts in co-ordination with wider terminal and airfield planning activities. Schematic layout concepts have been developed, drawing on previous work undertaken within the baggage handling system (BHS) master plan, the baggage handling system upgrade and enhancement project, as well as other reviews conducted by AAHK.

4.64 The development of the BHS concept is based on a number of key requirements/assumptions summarised below:

- The baggage system (T1/Tunnel/Midfield) will be capable of handling all bags that are currently handled by the T1 system;
- Out of gauge (OOG) and non conveyable bags will be handled by separate processes consistent with the current T1 system;
- All check-in counters within T1 and T2 will be able to service all airlines and flights departing from Terminal 1 and the Midfield Concourse – subject to the constraints within the current system;
- Other baggage input points (in-town check-in, transfer input docks, etc.) will be able to service all airlines and flights;
- All arrivals reclaim devices at T1 will be able to receive bags from flights arriving at both Midfield Concourse and T1;
- Make up positions will be based on single tier laterals which can accommodate up to a tug and six dollies;
- Transfer offload docks will be based on being able to accommodate up to a tug and six dollies;
- Transfer offload docks will be based on an assumed offload rate of 20 bags per minute;
- All transfer bags will be unloaded from containers at their point of flight arrival i.e. T1 or Midfield Concourse;
- The key customer service metrics are:

- Check-in close out time (40 minutes)
- Minimum connecting time (50 minutes)
- First bag/last bag on arrivals reclaim (20 and 40 minutes)
- Early bag store (EBS) release will typically occur 2 hours 20 minutes before the Scheduled time of departure (STD) – based on make up positions being open at 2 hours 30 minutes before STD. Variations on this may occur to optimise the EBS/make up provision on a flight by flight basis;
- To allow optimisation of make up operations, the EBS will not be used as a “dynamic bag store” to selectively release bags based on a sub-sort (e.g. all first class bags for a flight);
- Make up positions remain allocated until 5 minutes prior to STD; and
- All bags on flights departing HKIA require security screening in line with current international practice and the particular requirements of the CAD. For the purpose of the concept design, and in line with current practice, it is assumed that transfer bags that have been screened at their previous port (or origin or transfer) require re-screening in Hong Kong.

All bags being transported between T1 or T2 and the Midfield Concourse or vice versa will either be screened or unscreened. This is to avoid the risk of cross contamination between “cleared” and “uncleared” bags or of tampering with “cleared” bags.

Airport Access and Infrastructure

- 4.65** The primary links currently serving the HKIA are the Airport Road and Chek Lap Kok South Road between Tung Chung and the airport island. Additional links in the form of the Hong Kong-Zhuhai-Macao Bridge (HZMB), HZMB Hong Kong Link Road, and the Tuen Mun-Chek Lap Kok Link (TMCLKL) are under implementation and the additional capacity provided by these links should be sufficient to cater for the forecast 2030 traffic demand.
- 4.66** The road system in the vicinity of the passenger terminal area has been studied in light of the increasing traffic load. Modification plans for the road system have been drawn up in line with the expected increase in origin/destination passenger throughput. More information is provided in paragraphs 4.21 to 4.23.
- 4.67** The plan for the provision of other transportation facilities to support T1 and T2 has also been studied. Information is provided in paragraphs 4.24 to 4.27.

Indicative Infrastructure/Facilities Development Phasing Plan

- 4.68** In keeping with the prudent commercial principles of AAHK, facilities development requirements envisaged at the master planning level are outlined with an indicative phased implementation programme, say at 5-year intervals as illustrated in Figure 4.30 and Figure 4.31. AAHK will keep close tabs on competition dynamics and demand growth trends and regularly review and make final decisions on the timing and scope of the facilities development projects closer to the time of implementation.
- 4.69** Under the two-runway option, developments proposed include the expansion of the aircraft parking apron, passenger terminal, and concourse facilities and systems to maintain good service levels as well as operational efficiency while taking HKIA’s

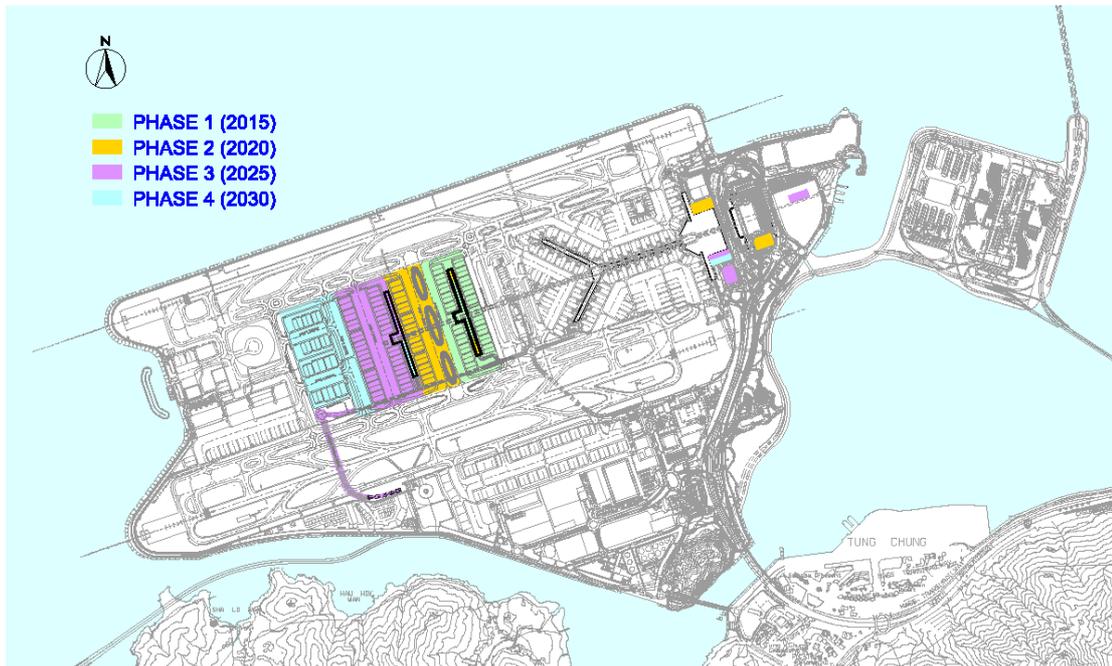
handling capacity to its limit of 74 million passengers and 6 million tonnes of cargo per annum.

Figure 4.30 : Indicative Infrastructure/Facility Development Phasing for the Two-Runway System

	Constrained Development				Total
	Phase 1 (2015)	Phase 2 (2020)	Phase 3 (2025)	Phase 4 (2030)	
Midfield Apron Development:					
Additional Number of Airbridge-served and Remote [#] Aircraft Parking Stands	20	10	20	10	60
Passenger Processing Terminal and Concourse Development:					
Terminal 1 (T1) Building Expansion	-	Addition of two bays to the north of T1 building envelope	Addition of one bay to the south of T1 building envelope	Addition of one more bay to the south of T1 building envelope	Four additional bays
New Passenger Concourse at Midfield	First phase of the first "I" shaped concourse completed	Second phase of the first "I" shaped concourse completed	First phase of the second "I" shaped concourse completed	Second phase of the second "I" shaped concourse completed	Two "I" shaped concourses

Note: # Remote aircraft parking stands can be used by both passenger aircraft and freighters.

Figure 4.31 : Indicative Infrastructure/Facility Development Phasing Plan for the Two-Runway System



Indicative Infrastructure/Facility Development Phase 1 (completion by 2015)

4.70 As explained in Chapter 3, HKIA has already committed to the development programme under Phase 1 to ensure that there would be sufficient facilities to serve the forecast demand by 2015. To recap, the Phase 1 programme includes:

- The construction of a Midfield concourse with 11 airbridge-served stands and 9 remote parking stands, the latter for common use by passenger and freighter aircraft;
- An additional cross-field taxiway to serve the stands on the west side of the Midfield concourse;
- An extension of the APM line and APM tunnel from T1 West Hall to connect with the Midfield concourse, with a back up system in case of APM breakdown or for route recovery;
- Minor BHS enhancement; and
- An additional ramp providing access to the Midfield concourse from the existing eastern tunnel roundabout, with a tunnel extending west under the new taxiway.

Indicative Infrastructure/Facility Development Phase 2 (completion by 2020)

4.71 Phase 2 of the development programme will include:

- Further expansion of the Midfield concourse with conversion of the 9 remote parking stands built in Phase 1 into airbridge-served stands;
- An additional 10 remote parking stands to the west of the Midfield concourse for common use by passenger and freighter aircraft;
- A second cross-field taxiway to serve the additional remote parking stands to the west of the Midfield concourse;
- Increasing APM capacity to six cars per train;
- T1 expansion by adding two bays on the northern side, with additional departure

- and arrival facilities; and
- Addition of one multi-storey car park with 1,100 additional parking spaces.

Indicative Infrastructure/Facility Development Phase 3 (completion by 2025)

4.72 Phase 3 of the development programme will include:

- The construction of a second Midfield concourse further west and conversion of 5 remote parking stands built in Phase 2 into airbridge-served stands;
- An additional 20 aircraft stands to the west of the second Midfield concourse, including 5 airbridge-served stands and 15 remote parking stands for common use by passenger and freighter aircraft;
- An additional cross-field taxiway to serve the stands on the west side of the second Midfield concourse;
- Further extension of the APM line with back up system to the second Midfield concourse;
- Installation of a new high-speed BHS from T1 to the second Midfield concourse via the extended northern baggage tunnel;
- Opening of the western vehicular tunnel with new access ramps;
- T1 expansion by adding one bay on the southern side, with additional departure and arrival facilities;
- Relocation of hotel limousine pick-up to the southern side of T1;
- Addition of one more multi-storey car park with 1,700 additional parking spaces;
- Construction of a new APM depot under the existing North Commercial District; and
- Improvement of landside road networks at the eastern side of T2 and south cargo area.

Indicative Infrastructure/Facility Development Phase 4 (completion by 2030)

4.73 Phase 4 of the development programme will include:

- Further expansion of the second Midfield concourse with the conversion of 10 remote parking stands built in Phases 2 and 3 into airbridge-served stands;
- An additional 10 remote parking stands in the remaining area of the Midfield mainly for freighter aircraft use; and
- T1 expansion by adding one more bay on the southern side, with additional departure and arrival facilities.

Estimated Construction Costs

Estimated Costs

4.74 Figure 4.32 shows the preliminary estimated costs for the development programme described above.

Figure 4.32 : Preliminary Phased Development Cost Estimates for the Two-Runway System

Constrained Development Phases	Construction Cost HK\$ Billion	Design and Project Management HK\$ Billion	Contingency HK\$ Billion	Total Cost Estimate HK\$ Billion
Phase 1 (by 2015)	7.9	0.6	0.8	9.3
Phase 2 (by 2020)	5.4	0.5	1.0	6.9
Phase 3 (by 2025)	8.9	0.9	1.7	11.5
Phase 4 (by 2030)	3.8	0.4	0.8	5.0
Total (Phases 2 – 4)				23.4

 Committed

Estimating Approach & Methodology

- 4.75** The rates used in computing the cost estimates are fixed-price competitive tender rates prevailing during the Fourth Quarter of 2010 subject to future inflation adjustment. The rates used in the cost estimates were compared whenever possible with the relevant government contract rates for similar types of civil works. The preliminary cost estimate was based on the best information available at the master planning stage. These estimates also include contingency, design fees and project management fees. Phase 1 development which is already committed, is at Money-of-the-day (MOD) prices. The two-runway option's development phases from 2016 up to 2030 are estimated to cost HK\$23.4 billion in 2010 dollars or HK\$42.5 billion at MOD prices.
- 4.76** Approximate quantities of works entailed have been measured, where practical, corresponding to the level of design detail available. Where appropriate, costs per unit of construction floor areas employed from other similar projects have been applied. For items of uncertain scope, lump sum budget allowances have been inserted accordingly. For airport specialist systems such as the baggage handling system and automated people mover system, quotations from specialist manufacturers have been obtained, supplemented by reference to existing airport project benchmarks.

Environmental Considerations

- 4.77** Care for the environment is at the heart of HKIA's long-term commitment to sustainable growth. In the 1992 published New Airport Master Plan, a pledge was made to "prepare a comprehensive and environmentally acceptable scheme ... for a new airport". A voluntary Environmental Impact Assessment (EIA) was conducted to provide a thorough evaluation of the potential environmental impacts associated with airport development

and operations, and the outcome was a range of commitments designed to ensure that environmental impacts would be effectively managed over the lifetime of the airport.

- 4.78** Under Section 15 (1)(f) of the EIA Ordinance, the Director of Environmental Protection established a register of EIAs approved by Government prior to the enactment of the Ordinance in February 1997. Included in this register is the New Airport Master Plan-EIA (NAMP-EIA), the NAMP-EIA supplement and the EIA of the Aviation Fuel Receiving Facility at Sha Chau. Section 9(2) (g) of the Ordinance exempts a project from obtaining an Environmental Permit if it has commenced construction or operation prior to enactment. As a result, the development of the New Airport did not require an environmental permit to complete its construction or for its operations, unless future airport development qualified as environmentally significant “material change” to the project.
- 4.79** The phased development plan up to 2030 under this Option entails some changes over that described in the NAMP. Should Option 1 be pursued, an assessment of the “environmental significance” of these changes will be undertaken based on evaluation guidelines as presented in Section 6 of the Technical Memorandum of the Environmental Impact Assessment Process. Based on the outcome of such assessment, the Director of Environment Protection would be able to confirm whether an environmental permit is required for Option 1 as a result of these changes.

CHAPTER 5 OPTION 2 : EXPANDING INTO A THREE-RUNWAY SYSTEM

Unconstrained Air Traffic Demand Forecast under a Three-Runway System

- 5.1 The ultimate handling throughput of HKIA is constrained by the practical maximum air traffic movements (ATMs, also known as flight movements) capacity of the two-runway system (420,000 ATMs per year). To remove capacity constraints and serve the unconstrained air traffic demand forecast for 2030 and possibly beyond, HKIA needs to build a Third Runway.
- 5.2 The three-runway system could support a practical maximum ATM capacity of 102 per hour or about 620,000 per annum. This may increase by around 10% in future if there are enhancements in aircraft or air traffic control (ATC) technology or the Pearl River Delta (PRD) airspace structure, which can improve operations further. Increasing runway capacity would allow the airport to meet baseline unconstrained demand forecasts of air traffic movements, passengers and cargo (see Figures 5.1 to 5.3) until 2030.

Figure 5.1 : Unconstrained Air Traffic Movement Demand Forecast

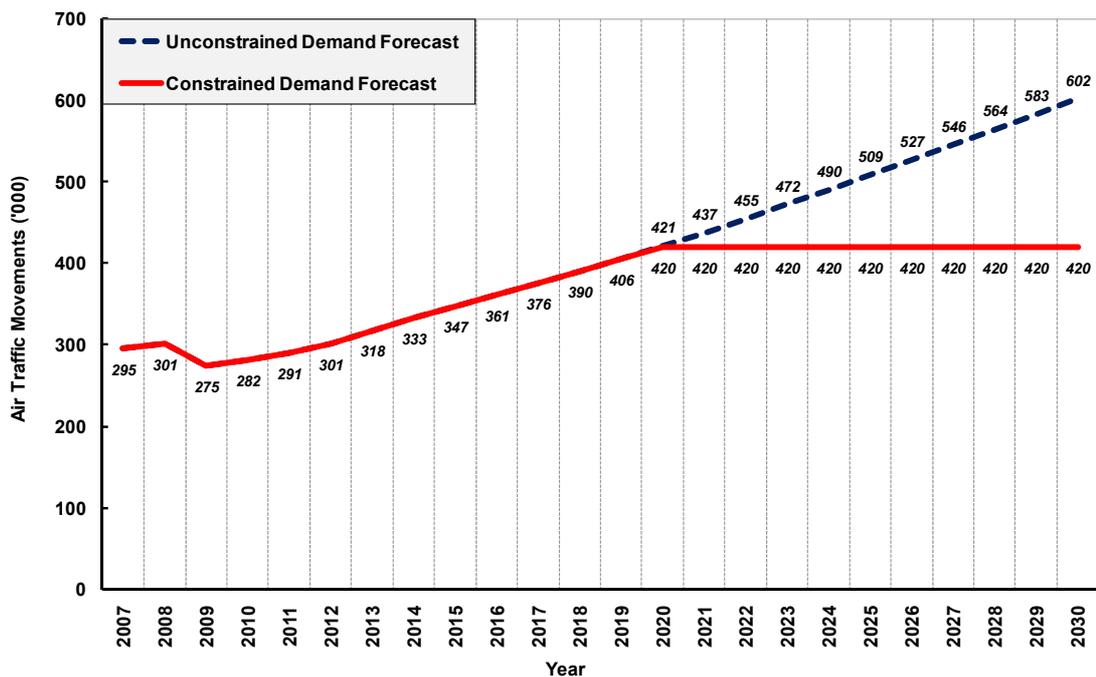


Figure 5.2 : Unconstrained Passenger Demand Forecast

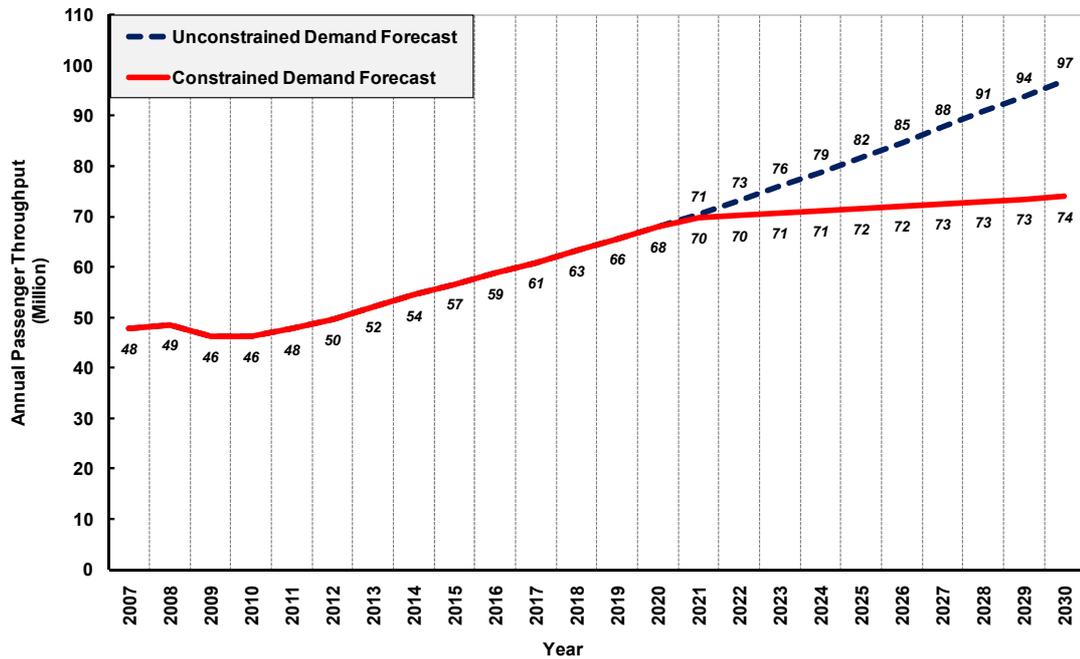
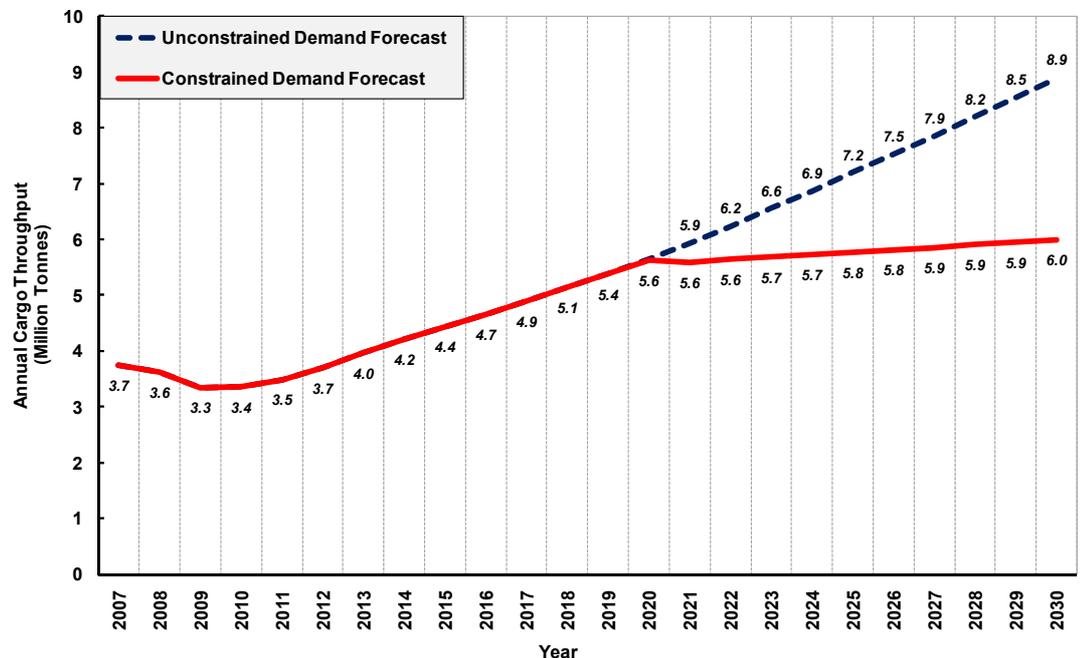


Figure 5.3 : Unconstrained Cargo Demand Forecast



5.3 The annual demand is forecast to be 97 million passengers, 8.9 million tonnes of cargo and 602,000 air traffic movements by 2030. Therefore the addition of a Third Runway needs to be matched by a corresponding expansion in operational and support facilities on the ground.

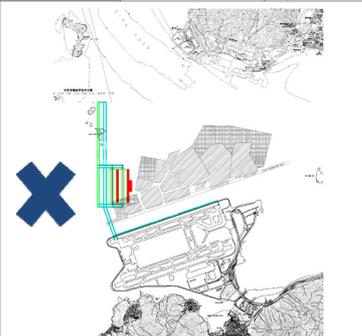
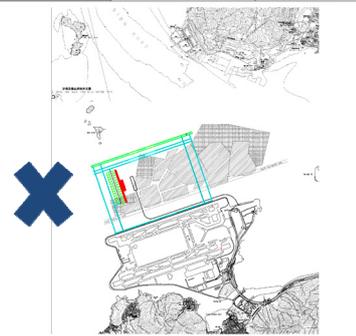
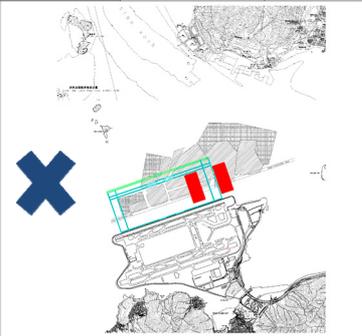
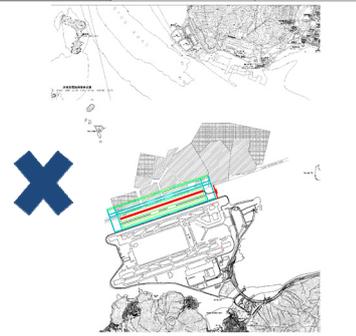
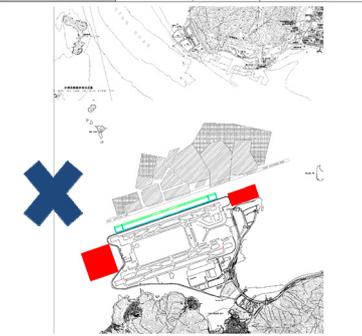
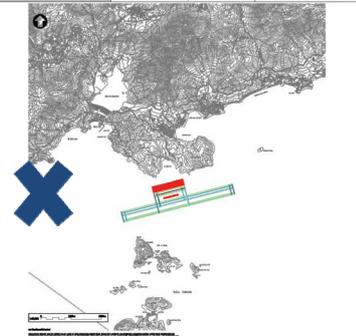
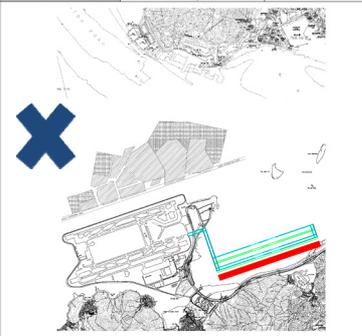
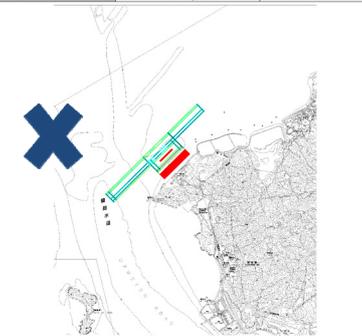
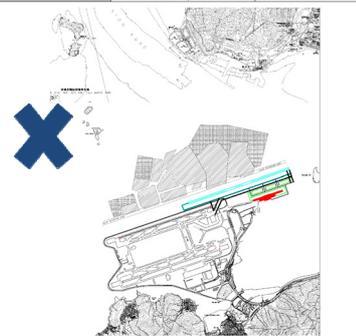
- 5.4** The first stage of airport expansion is evaluation of the airfield configuration (i.e. runways and taxiways), which in turn drives the development strategy of the passenger terminal, concourse and apron complex, cargo terminal and apron complex, support and ancillary facilities, surface access and airport related developments, etc., such that safety standards, integrity and efficiency of airport operations are maintained even as the capacity increases.

Airfield Configuration Evaluation

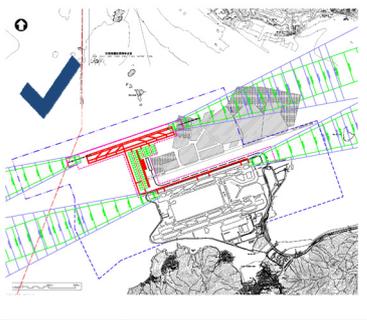
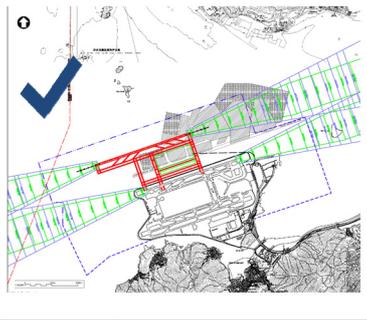
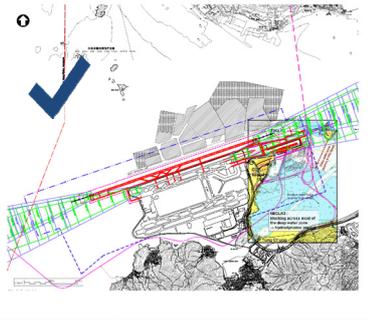
Third Runway Alignment options

- 5.5** The Third Runway needs to be located on Chek Lap Kok, the existing airport island. Locating it elsewhere would lead to a split of flight operations into two “de-facto” airports resulting in very inconvenient and time-consuming landside flight connections between the two airports. This could completely negate HKIA’s long standing competitive edge as an efficient transfer hub with a minimum connection time as low as 50 minutes.
- 5.6** NATS has considered the following factors while assessing the feasibility of the Third Runway:
- Limitations due to terrain, wind direction and other meteorological factors;
 - Identification of safe and viable modes of operation (arrivals only, departures only or mixed mode) for the three-runway system;
 - Modification of air traffic procedures for the immediate airspace surrounding the airport; and
 - Modification of air traffic procedures for the wider PRD airspace, in particular independence of operations from those of the surrounding airports.
- 5.7** Considering the geographical constraints on the potential expansion of HKIA, viz. the terrain to the south of HKIA on Lantau and to the north-east of HKIA in North West New Territories (see Figure 3.3), NATS has generated 15 possible runway alignment options, including parallel, angled or crossed runways (see Figure 5.4) for comparative evaluation in the study.

Figure 5.4 : 15 Runway Alignment Options Evaluated by NATS

<p>Option A</p> <p>Hong Kong International Airport Third Runway Study Other Options</p> <p>Runway Separation: N/A – Proposed Runway Aligned North/South</p> 	<p>Option B</p> <p>Hong Kong International Airport Third Runway Study Other Options</p> <p>Runway Separation: N/A – Proposed Runway Aligned NE/SW</p> 	<p>Option C</p> <p>Hong Kong International Airport Third Runway Study Other Options</p> <p>Parallel Runway Runway Separation: Approx 2800m</p> 
<p>General Description</p> <p>A near perpendicular runway with a self-contained set of airside, passenger terminal and landside facilities located adjacent to its southern end. Intended to avoid mud pits.</p>	<p>General Description</p> <p>Acutely angled runway with a self-contained set of airside, passenger terminal and landside facilities located adjacent to its southern end. Intended to avoid mud pits. Sketch shows single full length parallel taxiway, but twin parallel taxiways possible if runway moved north.</p>	<p>General Description</p> <p>A parallel runway, with sufficiently separation to ensure the runways, aprons and terminal facilities are not located over the mud pits (although apron and terminal area limited for that reason). New taxiways must cross mud pits.</p>
<p>Option D</p> <p>Hong Kong International Airport Third Runway Study Other Options</p> <p>Parallel Runway Runway Separation: Approx 1525m</p> 	<p>Option E</p> <p>Hong Kong International Airport Third Runway Study Other Options</p> <p>Parallel Runway Runway Separation: 1035-1524m</p> 	<p>Option F</p> <p>Hong Kong International Airport Third Runway Study Other Options</p> <p>Parallel Runway Runway Separation: 915-1034m</p> 
<p>General Description</p> <p>A parallel runway, with sufficiently separation to permit independent operation of all three the runways. Aprons and terminal facilities are located in mid-field and/or east end zone over the mud pits.</p>	<p>General Description</p> <p>A parallel runway, with sufficiently separation to permit independent IFR departures, requiring radar monitoring for independent parallel instrument approaches. Aprons and terminal facilities are located in mid-field and/or east end zone. About half the development would be over the mud pits.</p>	<p>General Description</p> <p>A parallel runway, with sufficiently separation to permit independent IFR departures, requiring radar monitoring for independent parallel instrument approaches. Aprons and terminal facilities are located in mid-field and/or east end zone. About half the development would be over the mud pits.</p>
<p>Option G</p> <p>Hong Kong International Airport Third Runway Study Other Options</p> <p>Parallel Runway Runway Separation: 760-914m</p> 	<p>Option H</p> <p>Hong Kong International Airport Third Runway Study Other Options</p> <p>Parallel Runway Runway Separation: 380-759m</p> 	<p>Option J</p> <p>Hong Kong International Airport Third Runway Study Other Options</p> <p>Runway Separation: N/A – Proposed Runway South of Lantau</p> 
<p>General Description</p> <p>A parallel runway with a separation of at least 760m to achieve independent IFR departures and segregated Arrival/Departure operations. Aprons and terminal facilities are located in either the east or west end zones shown. The new runway would be developed over the mud pits.</p>	<p>General Description</p> <p>A parallel runway with a separation of at least 380m to facilitate dependent operations. Aprons and terminal facilities are located in either the east or west end zones shown. With a 380m separation, the new runway would be developed clear of the mud pits.</p>	<p>General Description</p> <p>A new runway with all supporting airside and landside infrastructure.</p>
<p>Option K</p> <p>Hong Kong International Airport Third Runway Study Other Options</p> <p>Parallel Runway Runway Separation: >1035m</p> 	<p>Option M</p> <p>Hong Kong International Airport Third Runway Study Other Options</p> <p>Runway Separation: N/A – Proposed Runway North of HKIA</p> 	<p>Option N</p> <p>Hong Kong International Airport Third Runway Study Other Options</p> <p>Parallel Runway Runway Separation: >= 380m</p> 
<p>General Description</p> <p>A parallel runway to the South east of the existing 25L/07R with nearly a 5000m stagger to the east.</p>	<p>General Description</p> <p>A new runway with all supporting airside and landside infrastructure.</p>	<p>General Description</p> <p>A parallel runway with a separation of at least 380m plus a stagger of approximately 3000m to enable the aprons and terminal to be located adjacent to the runway.</p>

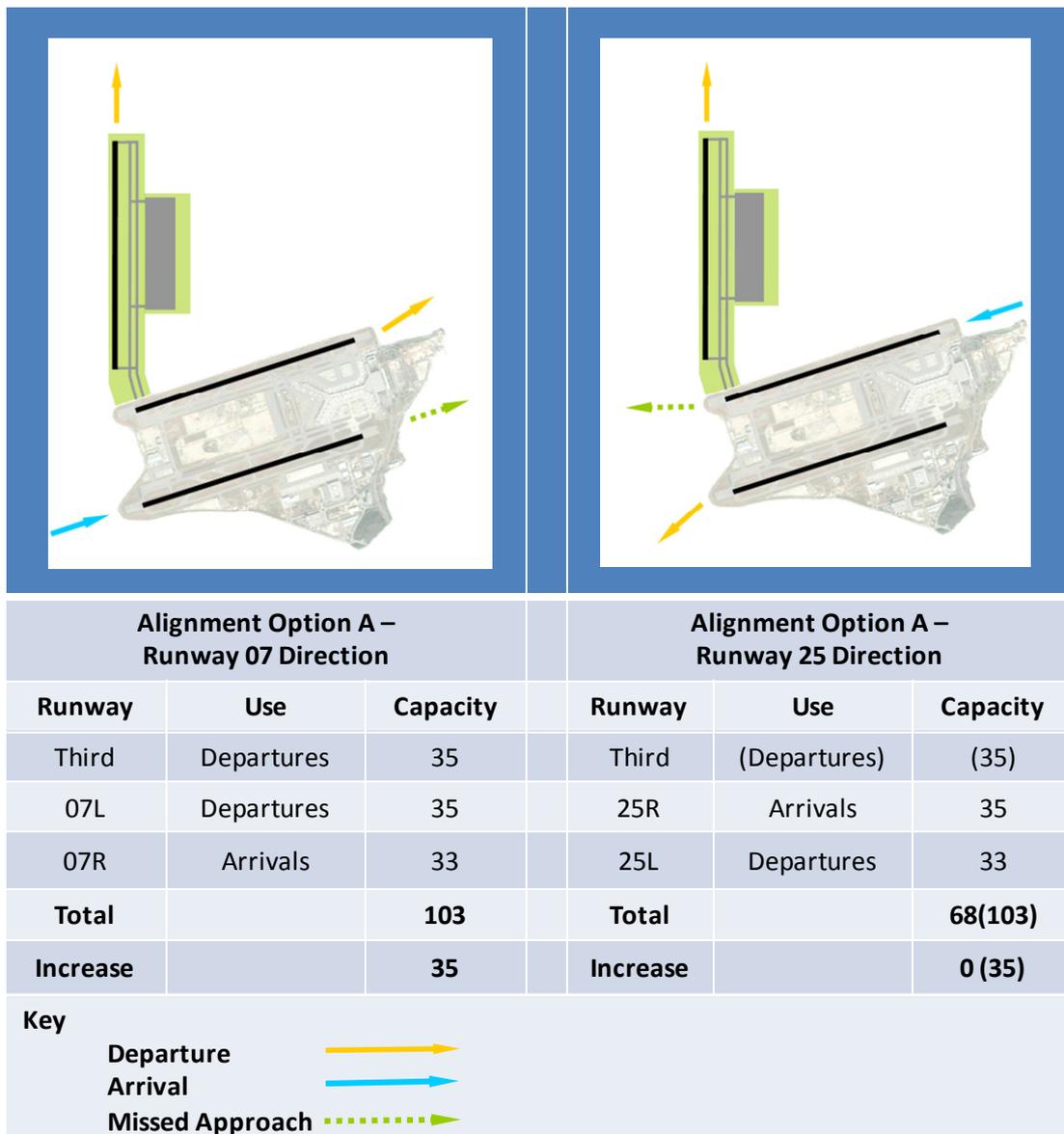
Note: X = options not taken forward in developing the Third Runway option due to considerations of wind direction, runway capacity, ATC operational and PRD airspace issues etc.

Option P	Hong Kong International Airport Third Runway Study Detailed Options	Parallel Runway Runway Separation: 2240m
		
<p>General Description A parallel runway, with a westerly stagger of 2000m to enable the terminal and aprons to be provided outside the mud pits. The runway has been shortened to ensure that the approach lights do not enter Chinese Territorial Waters.</p>		
Option R	Hong Kong International Airport Third Runway Study Detailed Options	Parallel Runway Runway Separation: 1525m
		
<p>General Description A parallel runway positioned with a western stagger of approximately 1430m. The terminal and apron facilities can be provided in mid field zone.</p>		
Option S Ext Variant D	Hong Kong International Airport Third Runway Study Detailed Options	Parallel Runway Runway Separation: 380m
		
<p>General Description A very long parallel runway with a separation of 380m. The 1889m stagger in the westerly direction provides close to SOIR compliance between the 07C SID and the 07L missed approach in respect of the runway offset. In the Runway 25 direction, the additional 1000m offset over Variants A, B and C provides some additional separation between the 25C SID and 25R missed approach while not fully SOIR compliant.</p>		

5.8 The 15 alignment options can indeed be categorised into three main families of alignment options for evaluation in terms of operational safety, obstacle clearance, PRD airspace constraint issues, air traffic control procedures, and optimum mode of operations including runway usability and capacity.

5.9 Alignment Option A – Construct a near-perpendicular runway (see Figure 5.5) to the existing runways. In this case the Third Runway can be used for departures to the north only, resulting in a huge imbalance in departure and arrival capacity. Furthermore, in the Runway 25⁵⁵ direction, the Third Runway can be used in certain wind conditions only. Therefore this category appears infeasible for capacity expansion.

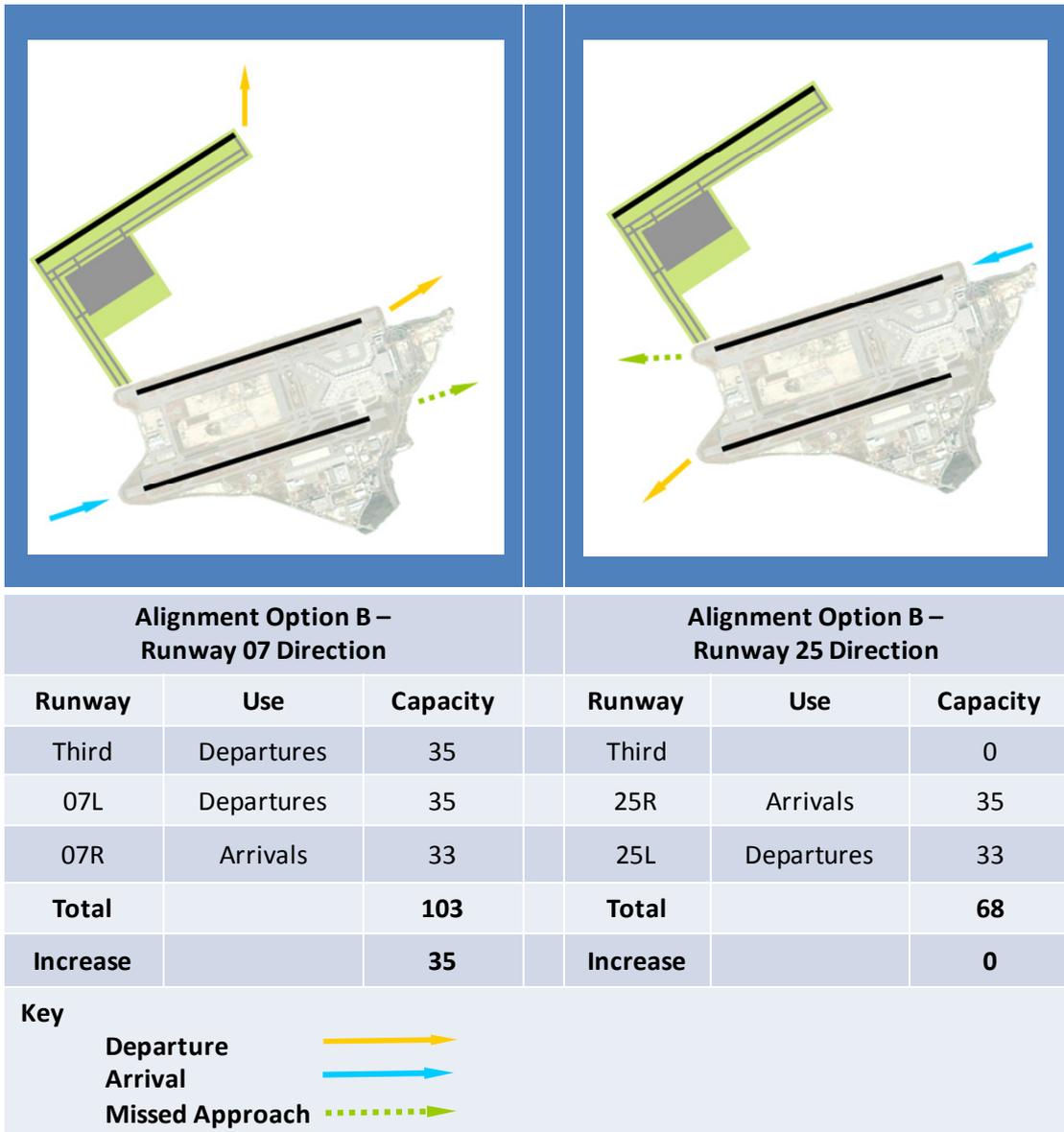
Figure 5.5 : Alignment Option A - Near Perpendicular Runway to the Existing Runways



⁵⁵ Runway number, times 10, corresponds with the direction of the runway in degrees from magnetic north. For example, runway 25 direction refers to the direction 250 degrees from north. The L/R after the runway number designates the side (left or right side) that the runway is on if there is more than one runway facing the same direction. For example, 07L refers to the runway on the left side when flying towards the direction 70 degrees from north, and 07R the runway on the right side.

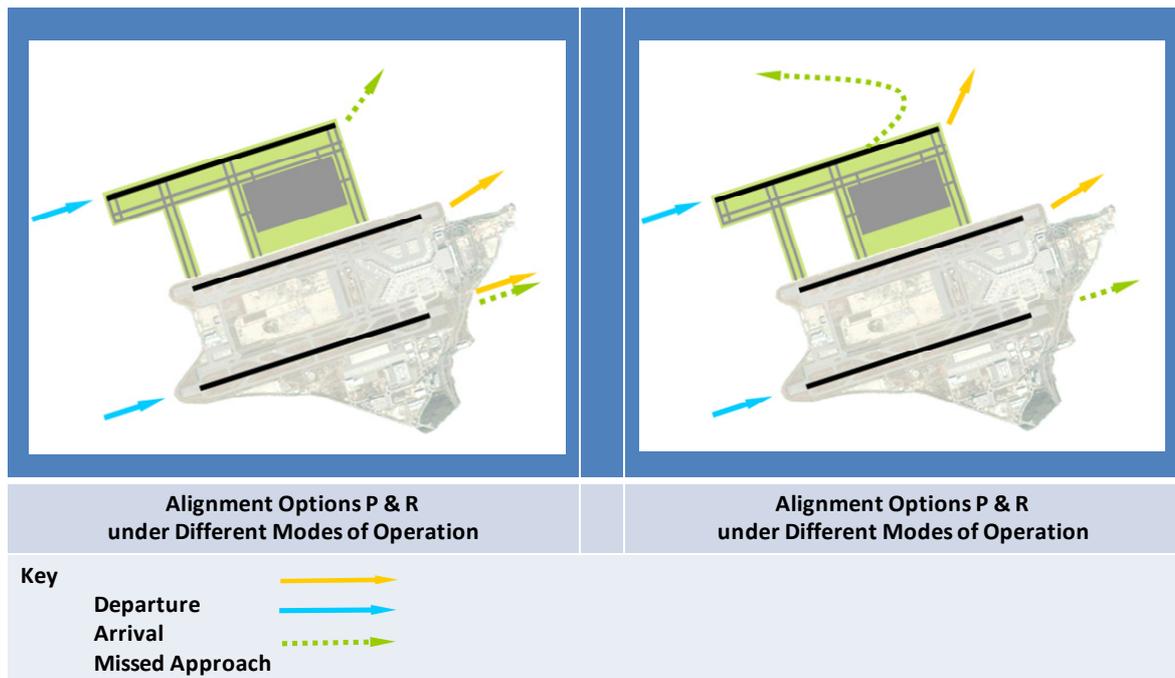
5.10 Alignment Option B – Construct a Third Runway aligned at an angle to the existing runways (see Figure 5.6). This conflicts with air traffic procedures between the Third Runway and the existing runways in the Runway 25 direction. Here, dependent operations create little or no additional capacity increase. The lack of usability of the Third Runway in Runway 25 direction makes this option impractical.

Figure 5.6 : Alignment Option B – Runway Aligned at an Angle to the Existing Runways



5.11 Alignment Option C – The most effective alignment should allow fully independent parallel operations of all three runways. This is achievable only through a parallel alignment of the Third Runway, provided that the runway separation is adequate for independent operation (see Figure 5.7). As per International Civil Aviation Organisation (ICAO) guidelines a runway separation of at least 1525m will allow independent parallel approaches in variable meteorological conditions.

Figure 5.7 : Alignment Option C - Parallel Runway with the Existing Runways

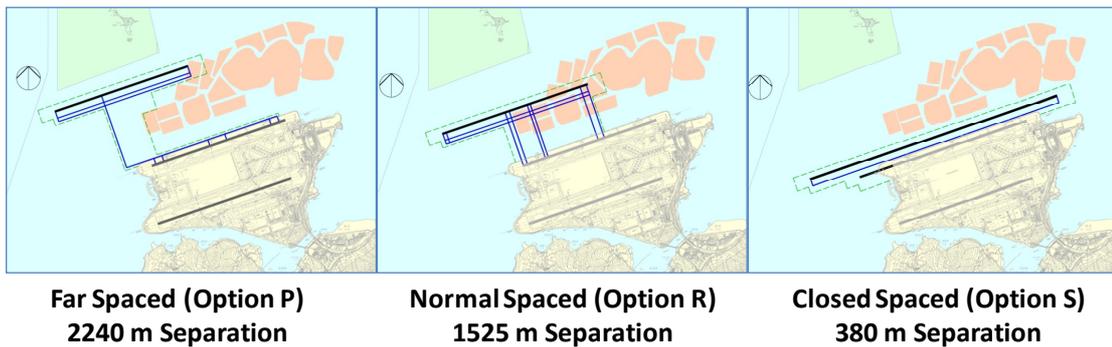


5.12 In conclusion, NATS has eliminated any non-parallel new runway options due to the following:

- Terrain constraints on Lantau Island south of the airport restrict the use of the non-parallel runway aircraft either departing to or arriving from the north;
- Conflicts with air traffic procedures for the existing runways;
- Clashes with traffic flying into and out of Macao and Shenzhen Airports;
- The difficulty of landing safely on a non-parallel runway without imposing very restrictive operating dependencies on the existing runways; and
- The negligible gains in capacity offered by a non-parallel alignment.

5.13 Given the geographical constraints of the airport, viz. Tung Chung township and Lantau Island to the south, the Hong Kong Boundary Crossing Facilities (HKBCF) and Tuen Mun-Chek Lap Kok Link (TMCLKL) to the east, and the territorial boundary of HKSAR waters to the west, only three runway alignment options have been shortlisted from NATS' recommendations (see Figure 5.8). Different separation distances from the existing North Runway require different extent of overlap with the existing contaminated mud pits (situated to the north of the airport island).

Figure 5.8 : Shortlisted Three-Runway Alignment Options



Need to Stagger the Third Parallel Runway

5.14 The east-west position of the Third Parallel Runway depends on the terrain surrounding the airfield such as Tai Mo Shan and Castle Peak. Preliminary procedure design work by NATS indicates that a fully parallel alignment of the Third Runway with respect to the existing two runways' positions would provide for better integration of airport operations but would have an unacceptable climb gradient for missed approach and departure in the Runway 07 direction. As a result, some staggering of the runway to the west by around 1,000 - 1,500m (see Figure 5.9) with respect to the existing North Runway's threshold position will be required. The subsequent airport layout evaluation steps have recommended a western stagger by around 1,140m for the Third Runway, which will be subject to further ATC procedural design studies during the detailed design stage.

Figure 5.9 : Requirement to Stagger the Third Parallel Runway to the West due to Terrain



Third Runway Length

5.15 The length of the runway required depends on performance characteristics of the critical aircraft, runway elevation and weather considerations at the airport site. Take-off operations require greater runway length than landing operations, with the most critical

wide-bodied aircraft type taking off at maximum design take-off weight requiring a runway length of around 3,800m.

- 5.16 The proposed primary use of the Third Runway is for arrivals. The suggested length is 3,800m, which is the same as the existing two runways, in order to retain the flexibility of switching the Third Runway to a mixed mode runway (a combination of departures and arrivals), thereby increasing the total capacity of the system in the future.

Optimising Runway Capacity with a Third Runway

Mode of Operations and Hourly Capacity of the Three-Runway System

- 5.17 Runways can be operated in one of the three modes: departures only; arrivals only; or mixed mode, each of which sets a different limit on its maximum capacity (see Figure 5.10 and Chapter 3 for more details):

Figure 5.10 : Practical Maximum Runway Capacity of a Runway Under Different Modes of Operation

Runway Mode of Operation	ICAO Guidelines on Minimum Separation	Maximum Runway Capacity (Hourly Movements)
Arrivals Only	3NM *	33
Departures Only **	90 seconds	35
Constrained Mixed Mode	8NM arrival spacing	34
Unconstrained Mixed Mode	6NM	44

Note: *'NM' means nautical miles

**90 seconds between all departures except two minutes vortex separation as appropriate

- 5.18 NATS recommends the primary mode of operation for the three-runway system to be “Arrivals only, Departures only, Mixed” (ADM) for the new Third, Second (current North) and First (current South) Runways respectively (see Figure 5.11). This mode was derived to maximise runway capacity, while considering factors like terrain, flight track separation, wake vortex⁵⁶, operability and capacity. The recommendation is based on the following:

- a) The Third Runway can only be used for arrival operations in order to avoid conflict with the Shenzhen airport arrival circuit in the Runway 07 direction (i.e. take off to the north east). Departure traffic using the Third Runway for takeoff would pass abeam the Shenzhen arrival circuit at roughly the same altitude (3,000 feet to 4,000 feet) and is therefore not possible.
- b) Independent mixed mode operations cannot occur on both the First and Second Runways (as explained in Chapter 3 paragraph 3.11).
- c) As independent parallel approaches are not permitted for the First and Second Runways, the Second Runway is restricted to departures, while the First Runway

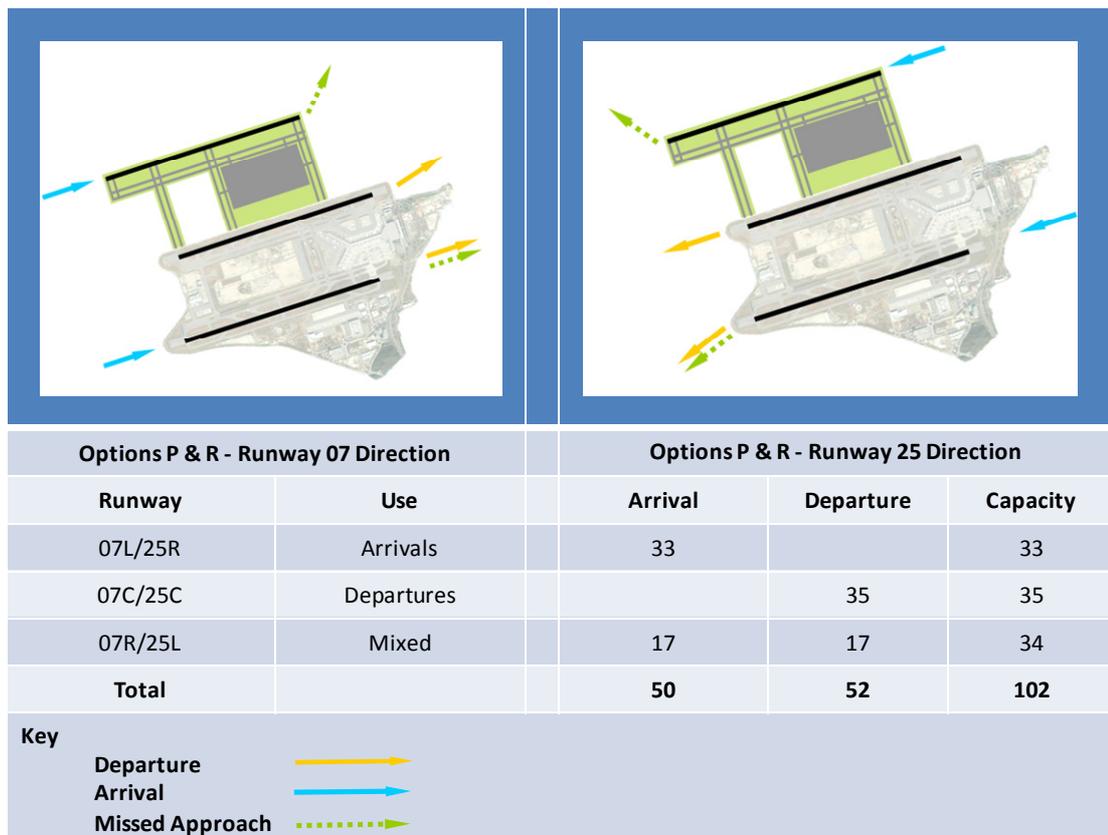
⁵⁶ An aircraft leaves a wake in the air. An aircraft's wake is in the form of two counter-rotating swirling rolls of air (or wake vortices) that trail from the wings of the aircraft. The wake vortex pair may last for several minutes and stretch for many kilometres behind the aircraft. The strength of the vortices basically depends on the aircraft weight, divided by the product of air density, flying speed and wingspan. This property generally increases with aircraft weight.

operates in mixed mode to balance the overall take-off and landing slot availability in each hour.

- d) The proposed alignment would also permit independent parallel approaches to the First and Third Runways which are the widest apart.

The ADM mode of operation for a three-runway configuration (see Figure 5.11) provides a maximum total capacity of 102 movements per hour. With the development of future aircraft navigation technology and improvements in airspace and air traffic management, runway capacity could potentially be stretched even further.

Figure 5.11 : Proposed Primary Mode of Operations (Third Runway as Arrival, Second Runway as Departure and First Runway as Mixed)



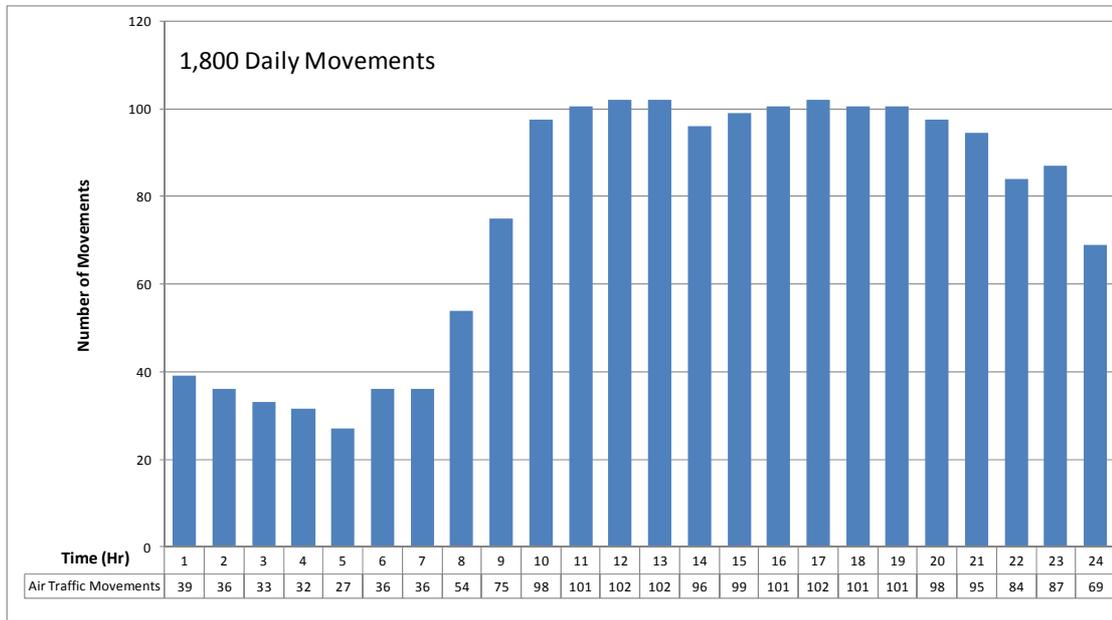
Practical Maximum Capacity of the Three-Runway System

5.19 NATS estimates the practical maximum ATM capacity to be 1,650 to 1,800 movements a day for the three-runway system as opposed to the 1,100 to 1,200 movements a day for the two-runway system. Using the historical Design Day/Annual ATM ratio of 0.0029, this provides an annual ATM capacity ranging from 570,934 to 622,837 for the three-runway system.

5.20 As with the two-runway option, the projected practical maximum daily movement profile of the three-runway system (see Figure 5.12) needs to build in a contingency allowance for runway direction changes for all three runways. At night, one of the three runways will be closed for maintenance and it is assumed that the hourly distribution of flights at that time will have a similar profile to the two-runway system wherein the South Runway stays in standby mode where possible to reduce noise impact. Recovery periods

to cope with these contingencies have been built into the schedule incorporating all stakeholder inputs on their duration and placement.

Figure 5.12 : Daily Movement Profile Based on 1,800 Movements per Day



PRD Airspace Restructure Requirement of the Three-Runway System

5.21 Based on NATS’ analysis, to fully realise the potential capacity gain of a Third Runway, the PRD airspace will need to be redesigned to be able to provide:

- A northern circuit at HKIA;
- Long final approach tracks; and
- Independent arrival procedures.

5.22 The development and implementation of the required changes in the PRD airspace requires further discussions amongst the Civil Aviation Administration of China (CAAC), Hong Kong Civil Aviation Department (CAD) and Autoridade de Aviacao Civil Macao (AACM) in the Pearl River Delta Tripartite Working Group. This alignment will have to take place in tandem with the physical development of airport infrastructure.

Airport Layout Options Evaluation

5.23 Based on the three short-listed Third Runway alignment options, the consultant for airport facilities planning, AECOM, has developed 18 airport layout options (see Figure 5.13) to cover all possible permutations of apron, passenger terminal and concourse expansion locations. These were then evaluated comprehensively across key operational and functional parameters.

5.24 For the purpose of high level master planning, (see Figure 5.14 for evaluation criteria), the 18 airport layout options have been streamlined into two families for further in-depth assessment.

Figure 5.13 : Eighteen Airport Layout Options

Option 1 (P)

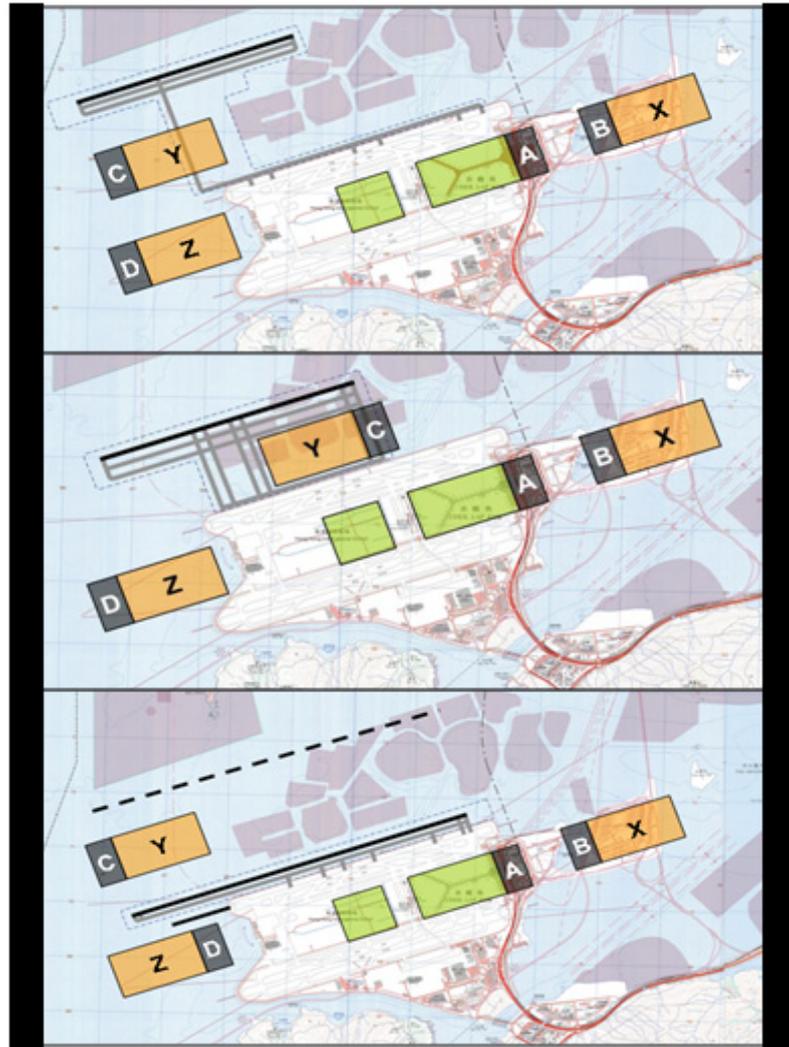
- A+X
- A+Y
- A+Z
- B+X
- C+Y
- D+Z

Option 2 (R)

- A+X
- A+Y
- A+Z
- B+X
- C+Y
- D+Z

Option 3 (S)

- A+X
- A+Y
- A+Z
- B+X
- C+Y
- D+Z



LEGEND

A, B, C & D show the possible location of Passenger Processing Terminal (where passengers are processed for check-in, Customs/Immigration/Quarantine and security screening)

X, Y & Z show the possible location of Aircraft Apron and Passenger Concourse Area (where aircraft gates are located)

P, R & S denote spacing between the Third and existing North runways (i.e. far-spaced, normal-spaced and close-spaced) respectively

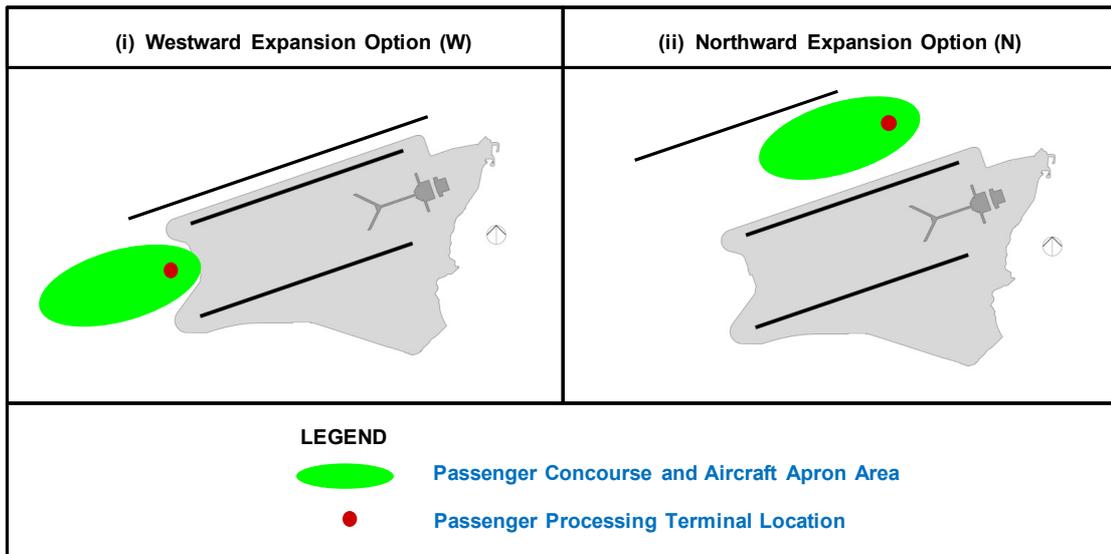
Figure 5.14 : High Level Evaluation Criteria

1.	AIRFIELD	
	- Taxiing Time/Distance	Relative compared to each option
	- Runway Crossings	Relative compared to each option
	- Additional Control Tower	If needed for operations or for blocked lines of sight
	- Balance East/West	—
	- Cargo Connectivity	Proximity of stands/access to cargo
2.	TERMINAL	
	- Passenger Connectivity	Minimum transfer time, APM complexity and capacity
	- Baggage Connectivity	Connection time/complexity
	- Duplication of Facilities	Terminal processor, Retail, Surface Access Interchange, APM, etc
	- Synergy with Airport Related Development (ARD)	Proximity
3.	SURFACE ACCESS	
	- Road Access & Capacity	Extension of existing roads and capacity of new road
	- Airport Express Line (AEL)	Ability to extend existing line, or the need to create a secondary bifurcation
	- Cross Boundary Transport Facilities	Ability to serve cross boundary air/surface transit passengers via Coach, SkyPier and potentially WEL
4.	LONG-TERM CAPACITY/FLEXIBILITY	
	- Strategic Consideration	Ability to meet demand growth beyond 2030
5.	CONSTRUCTIBILITY/COST	
	- Runway/Taxiways	Runway/Taxiway Length or area
	- Construct Over Mud Pits	Cost (and possible lead time)
	- Terminal Processor	Expansion/Extension of Terminal 1 (T1)/Terminal 2 (T2), or reclamation for a new terminal
	- Surface Access – Road/Rail	Short extension of existing versus major line extensions/bifurcation
	- Total Land Reclamation Area	Land take-up
	- Operational Impact	—

The two families of airport layout options, as shown in Figure 5.15 are:

- Westward expansion: The Third Runway adopts a close-spaced runway separation, at around 380m from the existing North Runway; and
- Northward expansion: The Third Runway adopts a similar runway separation as that between the existing two runways. The Third Runway is around 1,645m from the existing North Runway, while the existing two runways are 1,540m apart.

Figure 5.15 : Expansion Options



5.25 After analysis of both families of options from the airport planning, engineering and environmental perspectives, the consultant has recommended the northward expansion option as the basis for developing the preferred airport layout. The comparative performance between the two expansion options is summarised below:

Figure 5.16 : Comparative Performance between the Two Expansion Options

Criteria	Westward Expansion	Northward Expansion
Airfield Efficiency	x	✓
Passenger Convenience	x	✓
Surface Access	x	✓
Cargo Operations Efficiency	x	✓
Degree of Environmental Impact	x	✓

(More information about the comparative evaluation is in Appendix 3.)

The development needs of the key components of the preferred airport layout option are outlined below.

Airport Infrastructure and Facilities Needed to Support the Three-Runway System

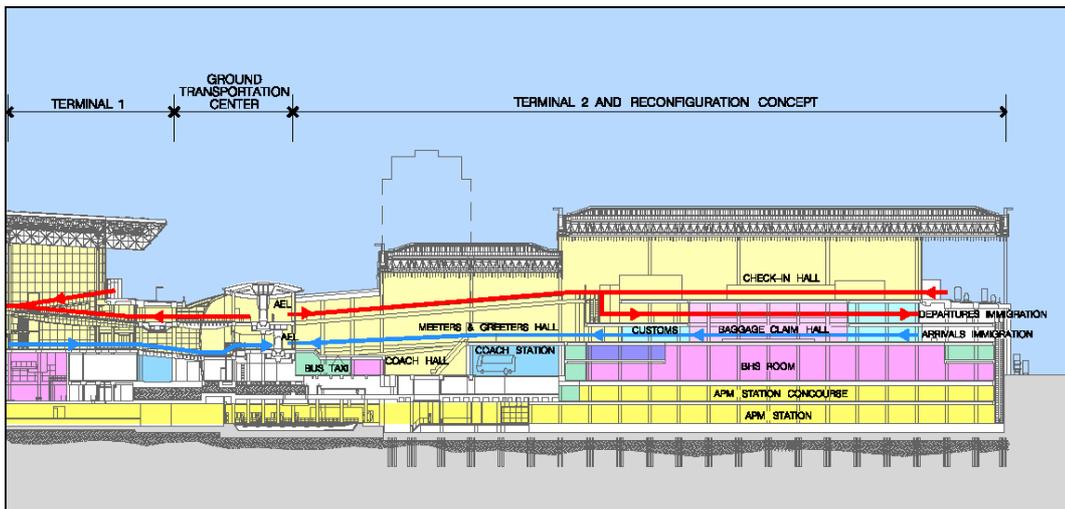
Passenger Processing Terminal

5.26 Passenger Processing Terminal Expansion Considerations

Passenger processing terminal handling capacity at HKIA needs to increase significantly to meet the unconstrained passenger demand forecast of 97 million per annum by 2030.

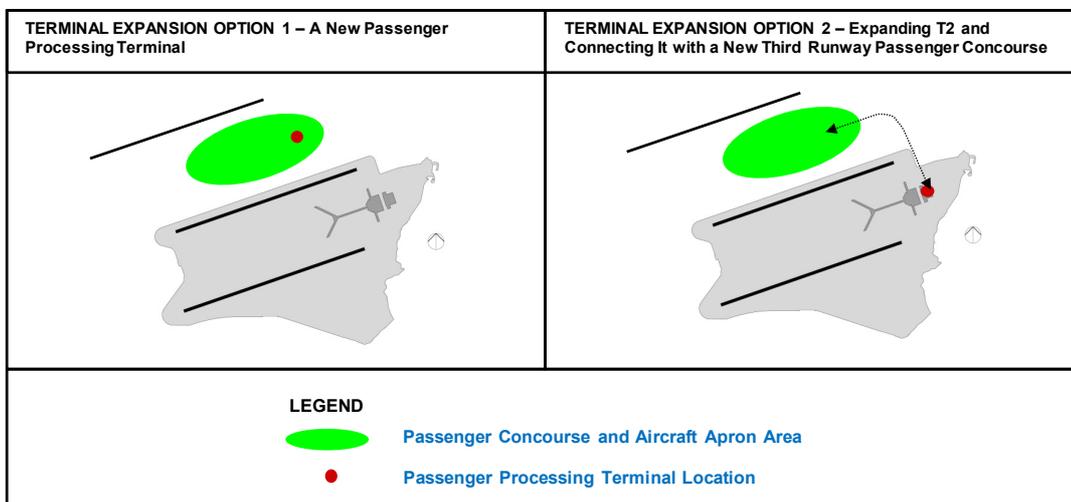
- 5.27 No enhancement of the Terminal 1 (T1) passenger concourse is required, as passenger traffic from T1 will be redistributed to a reconfigured/expanded Terminal 2 (T2). T2 will be linked to the new Third Runway passenger concourse by automated people mover (APM) and baggage handling system (BHS).
- 5.28 The reconfiguration/expansion of T2 involves adding an arrivals floor; increasing the building footprint to accommodate the new APM and BHS systems; and relocating the departures kerb from the western side to the eastern side of T2, with an increased number of departure kerb lanes (see indicative cross section of reconfigured/expanded T2 in Figure 5.17).

Figure 5.17 : Indicative Cross Section of Reconfigured/Expanded T2



- 5.29 Both alternatives for the passenger hall processing terminal required to meet demand beyond 2020, viz. reconfigure/expand T2 or build a new Terminal 3 in the reclaimed area adjacent to the third passenger concourse, were studied (see Figure 5.18). Building a new Terminal is not recommended for the reasons below:

Figure 5.18 : Terminal Options to Enhance Passenger Processing Terminal Handling Capacity

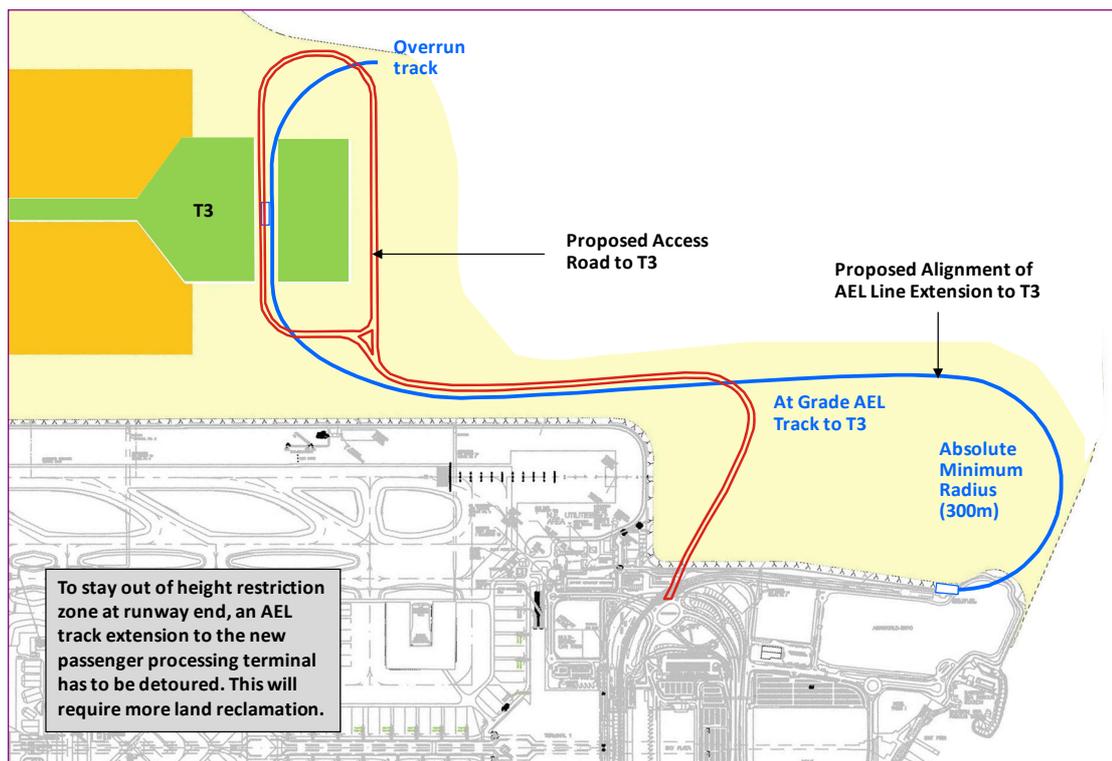


5.30 Option 1: Building a New Passenger Processing Terminal Adjacent to a New Third Runway Passenger Concourse

This has the benefit of a shorter travelling distance (approximately 1 minute) between the passenger processing terminal and concourse, versus three to four minutes for option 2 (expansion of current terminal). However, there are several disadvantages:

- The existing airport access road and tunnel system would have to be extended to serve the new passenger terminal, entailing more land reclamation.
- It is technically challenging to develop a suitable alignment for the direct extension of the Airport Express Line (AEL) that allows it to stay out of the height restriction zone of the Second Runway (see Figure 5.19). A more circuitous AEL route and hence more reclamation would be required.
- Route recovery would be very difficult for departing passengers who inadvertently arrive at the wrong passenger processing terminal, because of the physical distance between the new terminal and T1/T2.
- Additional land reclamation would also be needed for all the new access roads and car parking facilities.

Figure 5.19 : Explored Alignment of AEL Track and New Access Road to a New Passenger Processing Terminal



5.31 Option 2: Reconfiguring/Expanding T2 and Connecting It with the New Third Runway Passenger Concourse

This has several advantages:

- The Airport Express Line (AEL) is already connected to T2;
- There is an easier route recovery between T1 and T2 for departing passengers; and
- Less reclamation is needed.

5.32 The major disadvantage of this option is a longer (two to three minutes more) APM ride between T2 and the new Third Runway passenger concourse.

5.33 Overall however, **Option 2 - having a reconfigured/expanded T2 with links to the new Third Runway passenger concourse - is preferred.**

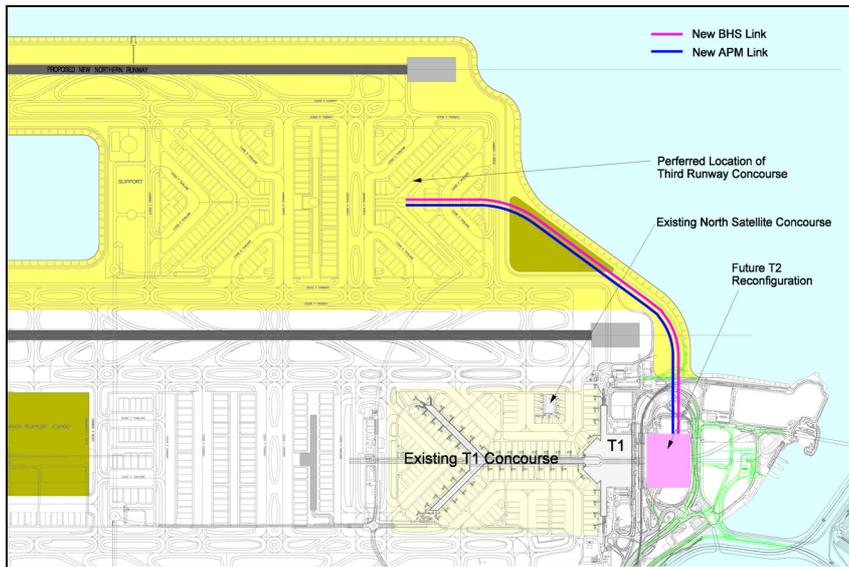
Passenger Aircraft Apron and Passenger Concourse

5.34 A new passenger concourse (Third Runway passenger concourse) with its associated aircraft parking apron should be located between the Second and Third Runways (see Figure 5.20). This will improve airfield operational efficiency and shorten passenger travelling distance to and from its passenger processing terminal T2.

5.35 By 2020, 116 passenger aircraft parking stands will be required, increasing to 169 by 2030 to fulfil the unconstrained passenger demand forecast. Given the existing 86 full-service aircraft parking stands⁵⁷ and the incremental 20 that AAHK has already committed to develop at Midfield by 2015, around 60 more passenger aircraft stands will need to be added in phases between 2016 and 2030.

⁵⁷ The 86 full-service aircraft parking stands exclude the 11 temporary parking stands. These temporary parking stands are planned to be converted into full-service stands, as part of the 20 new parking stands at Midfield.

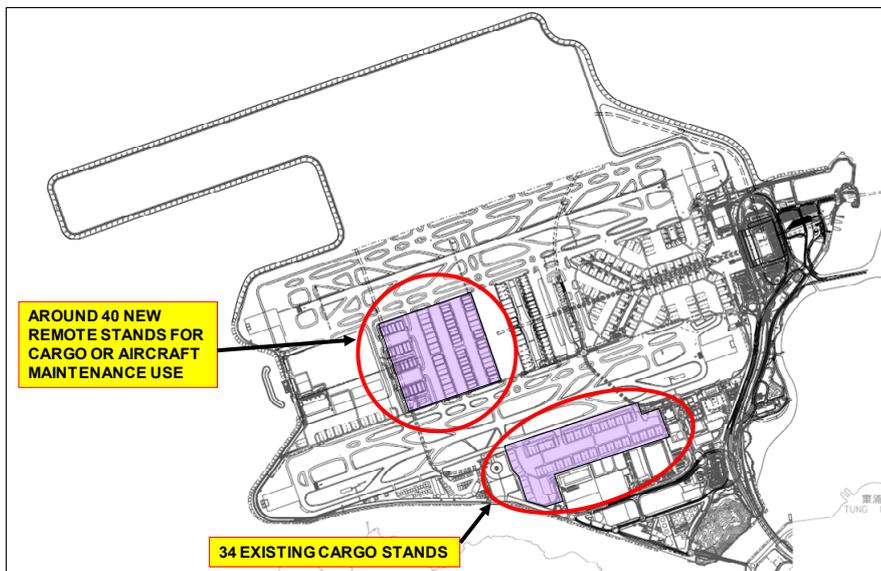
Figure 5.20 : Proposed Third Runway Passenger Concourse and Aircraft Parking Areas with Associated APM and BHS Links with T2



Cargo Aprons

- 5.36 By 2020, 47 cargo stands will be required, increasing to 72 by 2030 to meet the unconstrained cargo aircraft movement forecast. Given the existing 34 cargo stands, around 40 more will be needed gradually over the next 20 years to support forecast demand.
- 5.37 Since the planned cargo terminals are to be located in the Southern Cargo Precinct, these new stands should be located as close as possible to the cargo area. Since expanding the South Cargo Apron, which already holds 34 cargo stands, is infeasible, the new cargo stands will be located in the Midfield area (see Figure 5.21).

Figure 5.21 : Proposed Freight Stand Development in the Midfield Area



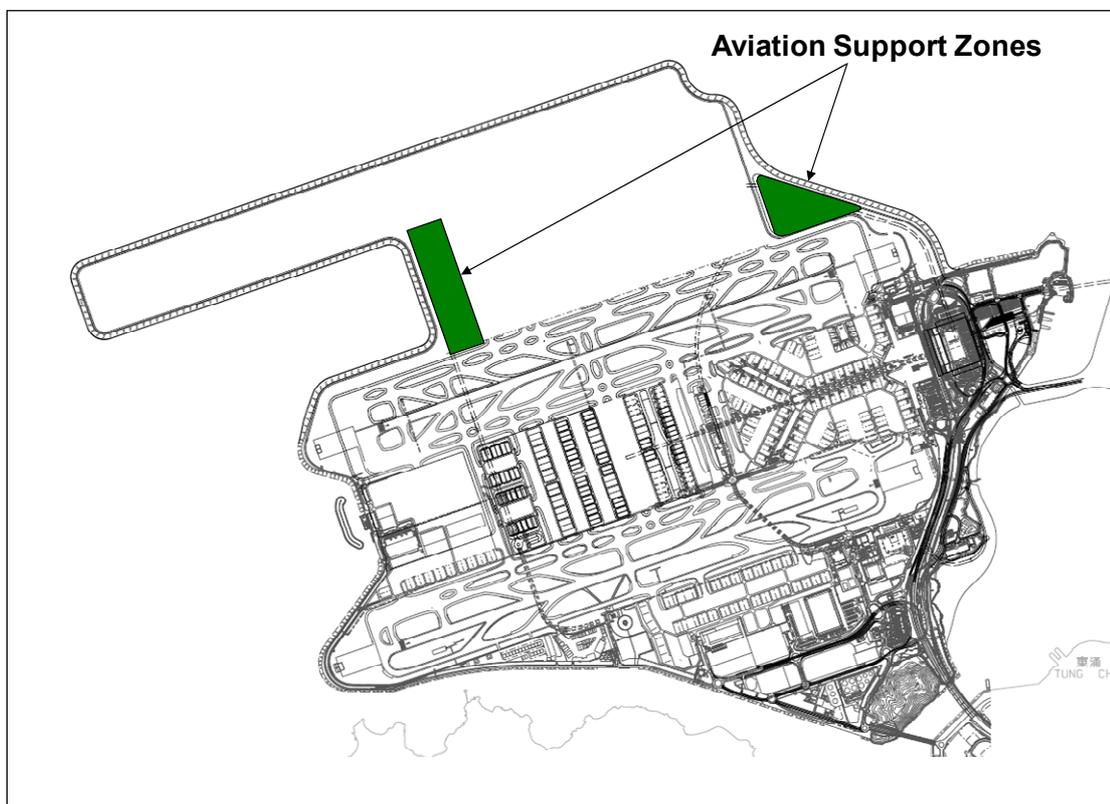
Aviation Support Facilities at the Apron

5.38 Additional space between the Second and Third Runways should be safeguarded for aviation support and government facilities which operational needs require proximity to the new apron such as:

- Aircraft maintenance;
- Ground support equipment (GSE) maintenance;
- Navigational aid and meteorological installations;
- Airline catering
- Airport rescue and fire fighting; and
- Second operational ATC Tower.

Figure 5.22 shows the aviation support zones suggested in the proposed land reclamation area.

Figure 5.22 : Proposed Aviation Support Zones

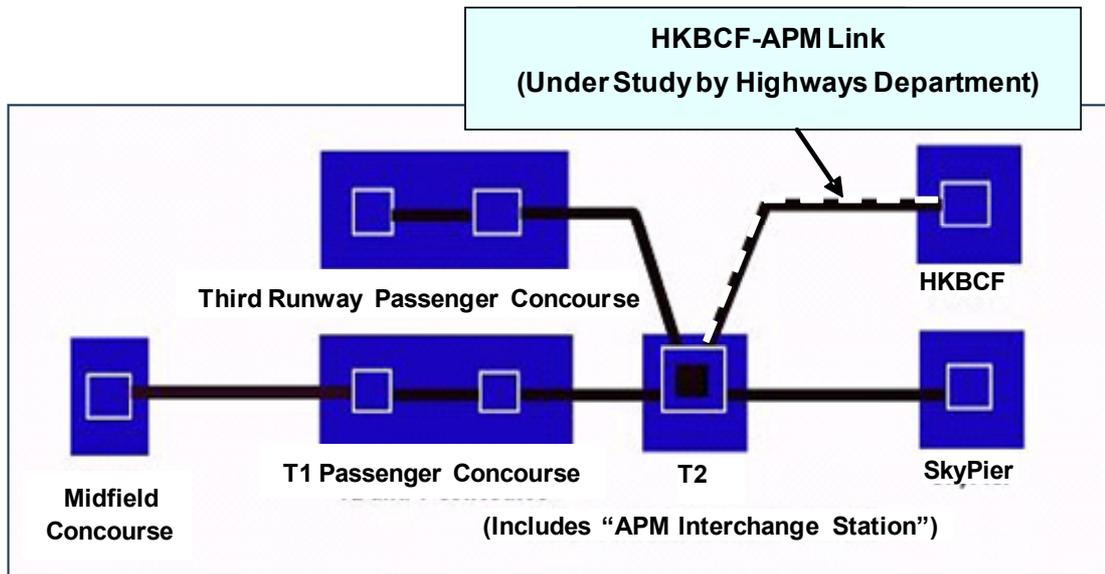


Automated People Mover System

5.39 The automated people mover (APM) system will be the main artery for transporting passengers between the various passenger processing terminals, concourses, SkyPier and potentially the HKBCF. The present APM system connects the West Hall and East Hall of T1, T1 to T2 and the SkyPier to T1. As in Option 1 (two-runway system), the APM system will be extended to connect the Midfield area to T1 by 2015. To meet the 2030 demand, the APM system will need further expansion to include a connection to the Third Runway passenger concourse.

5.40 An outline of the future APM system, which includes a unique “APM Interchange Station” at T2 for interchanges, is shown below.

Figure 5.23 : Proposed Airport APM Network with APM Interchange Station



5.41 Due to the expansion of the APM fleet, a new site will be needed for an APM depot to accommodate maintenance, storage and other needs in the future. The recommendation is to locate it underground and to the immediate east of the reconfigured/expanded T2 for convenient access to all APM lines. Access to the depot from an above-grade road would also be required for ongoing addition/replacement of APM cars.

Baggage Handling System

5.42 A new baggage handling system (BHS) for T2 passengers will be needed to handle projected passenger volume. This will be built within the reconfigured/expanded T2.

Passenger Terminal Area Road Network

5.43 The existing elevated road network around T2 is proposed to be extensively realigned, with the departure kerb for T2 relocated to the east of the terminal building, similar to T1, and an elevated exit road circling the existing North Commercial District (NCD) before rejoining the Airport Road south of T2. The elevated road will be provided with ramps to and from the at-grade road network in the NCD, and also with elevated road links from T1 and T2 to the HKBCF (see Figures 5. 24 and 5.25).

Figure 5.24 : Proposed Road Network in the T2 Area

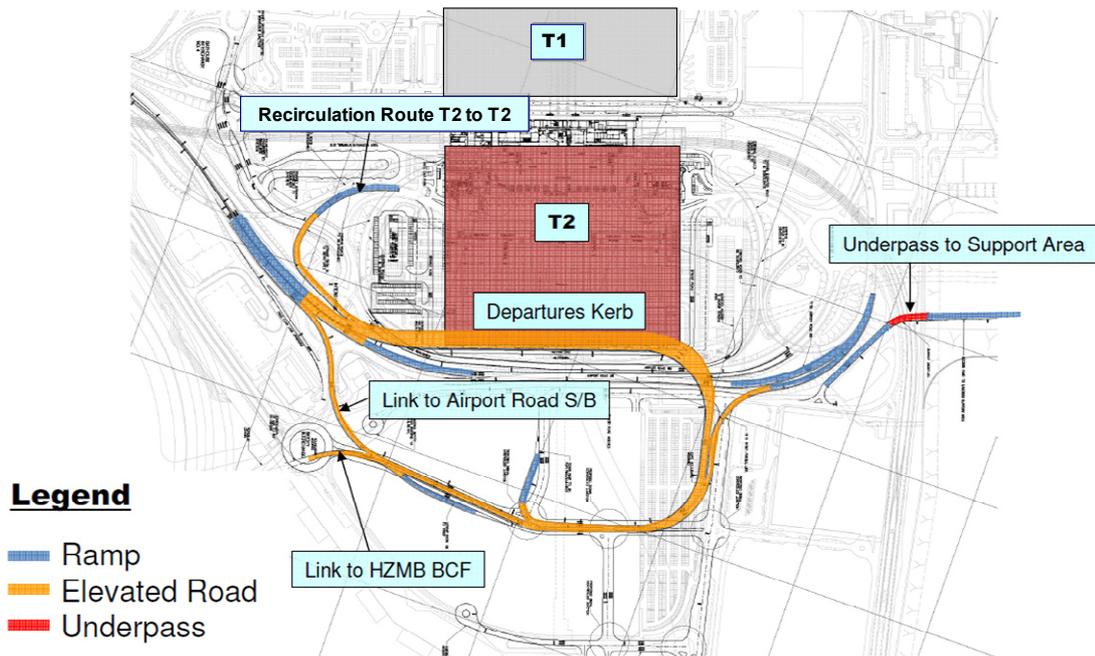
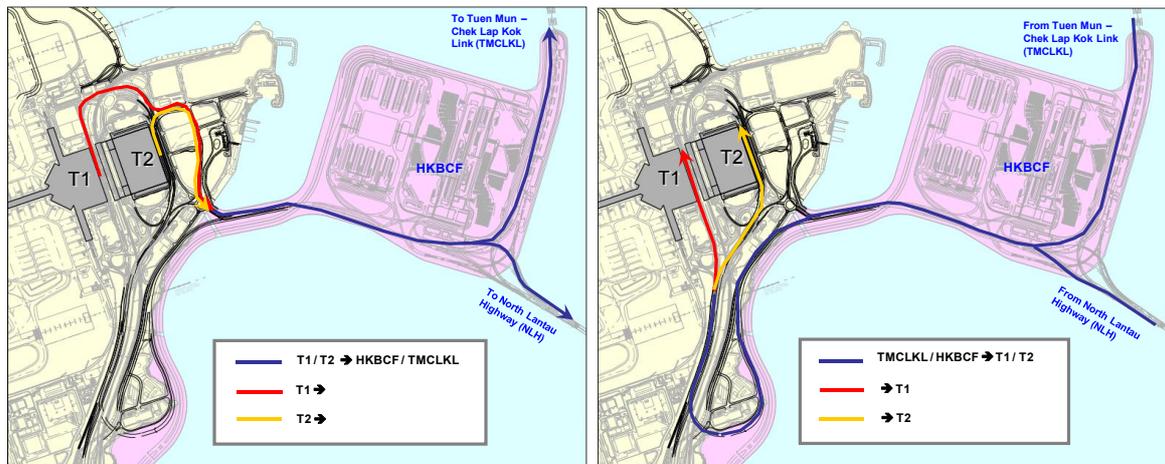


Figure 5.25 : Road Connection to and from the Airport via HKBCF/TMCLKL for Three-Runway Option



5.44 Similarly, the at-grade road network will be reworked around the reconfigured/expanded T2 as well as to the south, with major car parks and vehicle staging areas moved to the NCD (see Figure 4.27 for NCD location), the existing franchised bus terminus expanded close to the existing terminus, and an additional hotel vehicle pick-up facility located south of T2.

Transportation Facilities/Services**5.45 Buses, Coaches, Limousines and Taxis**

The existing private car and hotel vehicle pick-up area south of T1 will be maintained, and a new one provided south of the reconfigured/expanded T2. The taxi station, taxi staging area and franchised bus terminus will remain at the same location, serving both T1 and T2. In addition, an area immediately to the east of the existing bus terminus has been identified as an expansion area for the franchised bus terminus. The existing coach station in T2 will also be expanded.

5.46 Car Parking

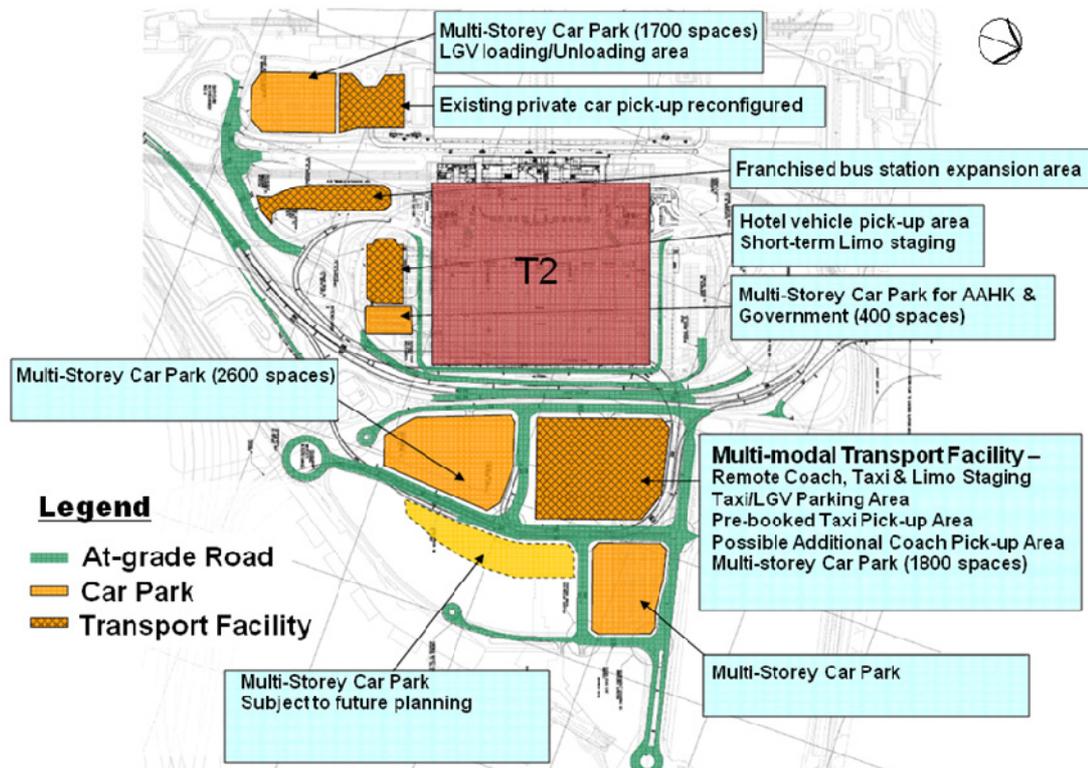
A doubling of passenger throughput by 2030 would require doubling the number of car park spaces to maintain existing service levels. It is estimated that around 6,500 new car park spaces are required, including the re-provisioning of around 1,500 existing public, government and staff car park spaces adjacent to T2 due to the terminal's expansion as well as 1,000 spaces for the existing Sky City car park because of the expansion of the passenger terminal access/exit roads. This estimate is based solely on airport usage and excludes any further parking requirements that may arise for other airport-related uses. These requirements can be met by the provision of four multi-storey car parks south of T1 and adjacent to reconfigured/expanded T2.

5.47 Coach Staging

By 2030, it is estimated that approximately 260 coach staging spaces will be needed. The existing coach staging area at T2 provides about 150 spaces. This facility will be retained and designated for future use as a short-stay coach staging area. An additional 110 spaces will be provided in the area to the east of the reconfigured/expanded T2 and immediately to the south of Airport Expo Boulevard. This staging area will be allocated for longer stay and overflow coach parking. It will also be used as a taxi and limousine staging area, taxi/light goods vehicle parking area and pre-booked taxi pick-up area. Allowance has been made for about 200 spaces.

5.48 Figure 5.26 provides an overall view of the proposed locations for future car parking facilities.

Figure 5.26 : Proposed Locations of Future Transportation Facilities

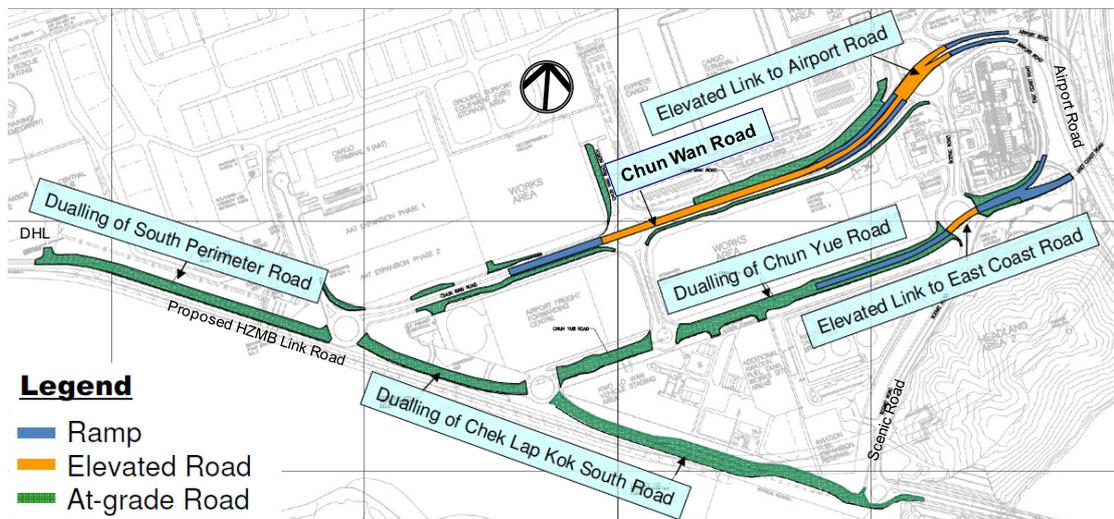


Aviation Support Facilities

5.49 Cargo Terminal Precinct and Road Network

The area reserved for the potential new cargo terminal and the required road network enhancements in the Southern Cargo Precinct will be similar to that planned for expansion for the two-runway system. The additional road improvement works would include the widening of Chun Yue Road to dual two-lane standard, local widening of eastbound carriageway of Chun Wan Road to four lanes, and widening of South Perimeter Road (between DHL and Chun Ping Road) (See Figure 5.27).

Figure 5.27 : Proposed Road Improvements in the Southern Cargo Precinct



5.50 Aviation Fuel Facilities

The Permanent Aviation Fuel Facility (PAFF) located in Tuen Mun has reserved space for the installation of four additional aviation fuel storage tanks in Phase 2 of its development. The airport onsite fuel storage facility of 223,000 cubic metres, together with PAFF’s Phases 1 and 2, will provide a combined capacity of 611,000 cubic metres. This easily exceeds the mandatory 11-day fuel storage requirement (i.e. 400,000 cubic metres based on 2030 forecast aircraft movements).

Airport Related Development

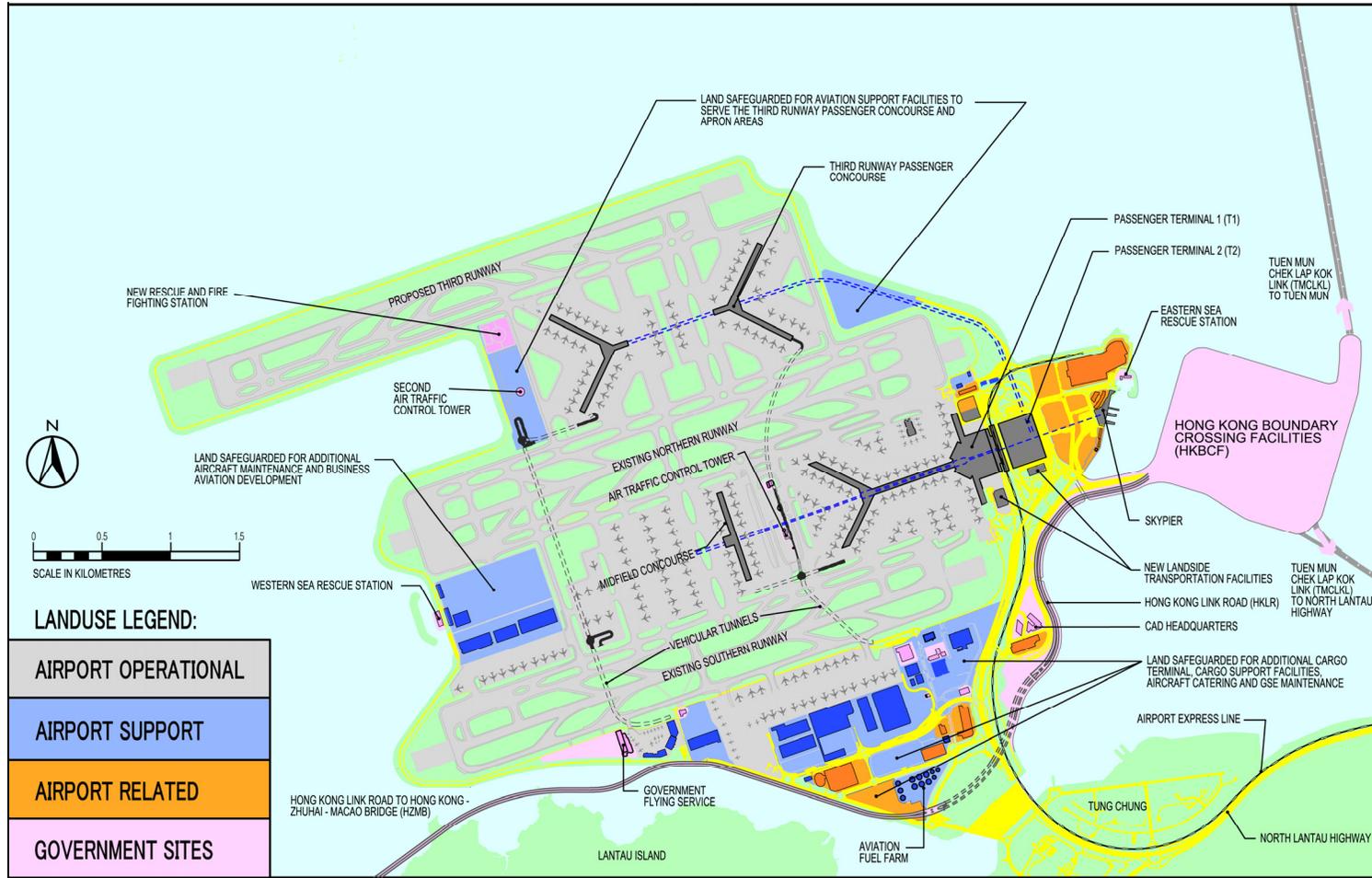
5.51 Because of the need for additional airport operation and support facilities, there will be less space available for airport related development in the North Commercial District compared to Option 1 but the area reserved in Kwo Lo Wan remains.

Airport Layout Plan in 2030

5.52 Option 2 proposes expanding the airport island northward, based on the preferred alignment of the Third Runway and the development strategies for operations, support and other ancillary airport functions. It also provides synergy with the HKBCF, TMCLKL and potential WEL project (see Figure 5.28).

- 5.53** Only the conceptual design has been explored thus far involving preliminary qualitative assessments of potential environmental impacts and challenges. For example, it is estimated that around 650 hectares of reclamation to the north of the existing airport island will be required. Preliminary engineering and environmental considerations attempted to maximise the use of land on the existing airport island, thereby keeping new land reclamation requirements to a minimum.
- 5.54** When compared to major airports on the Mainland and other hub airports in the region, the existing and planned future area of HKIA is relatively small, particularly when taking into consideration the aircraft movements handled and the planned future handling capacity (see Figure 5.29 and Figure 5.30).

Figure 5.28 : Option 2 (Three-Runway System) – Airport Layout Plan in 2030



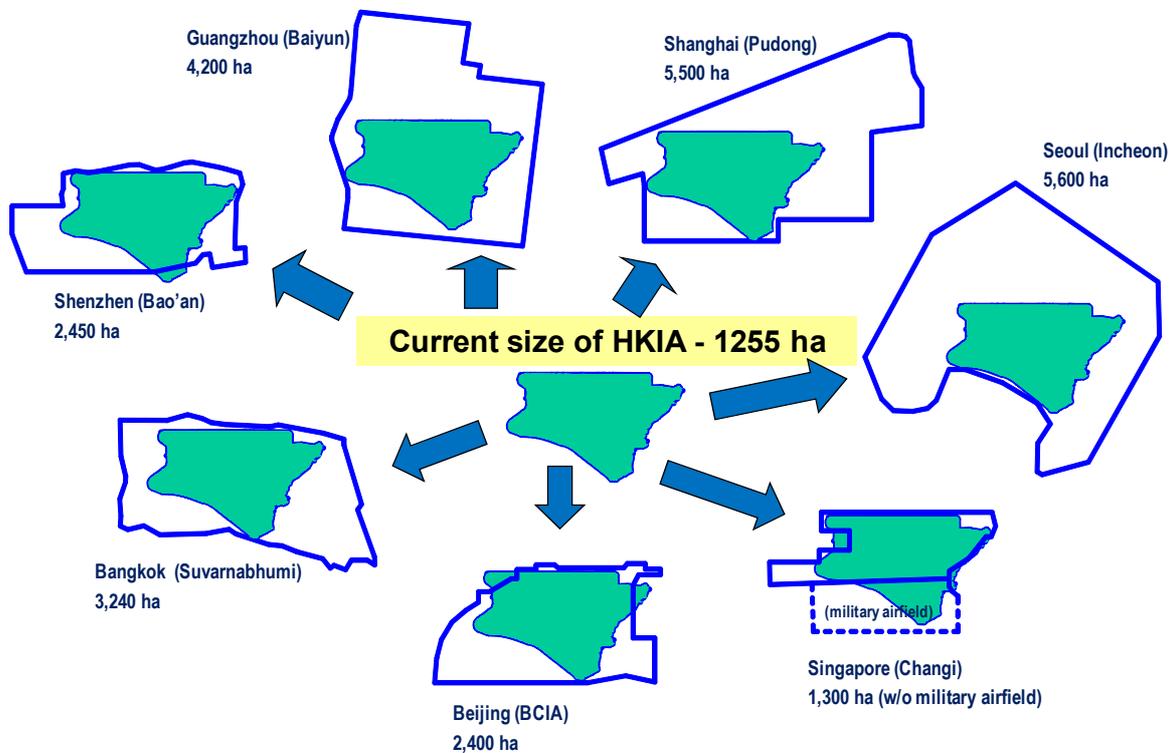
Definitions:

- 1) Airport Operational Development (AOD) refers to operational facilities such as runways, taxiways, parking aprons, passenger processing terminals and passenger concourses, ground transportation centre and vehicle parking spaces, etc.
- 2) Airport Support Development (ASD) refers to support facilities such as cargo terminals, aircraft maintenance and engineering, aircraft catering, ground services equipment maintenance, aircraft fuelling, etc.
- 3) Airport Related Development (ARD) refers to commercial facilities such as freight forwarding, hotels, offices, retail and exhibition centre, etc.
- 4) Government Sites refer to Government facilities such as the Government Flying Service (GFS), the Headquarters Building of the Civil Aviation Department and the Air Mail Centre, etc.

Figure 5.29 : Development of HKIA compared to Mainland Airports

Airport	Existing Number of Runways	Existing Area (ha)	Air Traffic Movements Handled in 2008	Future Area Planned (ha)	Future Total Number of Runways Planned	Future Air Traffic Capacity Planned (Per Annum)
Hong Kong International Airport	2	1,255	301,000	~1,900	3	620,000 (3 runways)
Shanghai (Pudong)	3	4,500	265,735	5,500	Space reserved for expansion to 5	653,000 (5 runways)
Guangzhou (Baiyun)	2	1,500	280,392	4,200	3 under planning, with space reserved for expansion to 5	620,000 (3 runways)
Beijing Capital	3	2,400	429,646	Planning to build a second international airport.		
Shenzhen (Bao'an)	1	1,100	187,942	2,450 (by 2011)	2 by 2011, with space reserved for expansion to 3	450,000 (2 runways)

Figure 5.30 : Comparison of HKIA's Size with Other Hub Airports in the Region



Preliminary Engineering Feasibility

- 5.55** Preliminary assessment on the engineering feasibility for each key component of the airport development scheme has been conducted, including land formation, airfield facilities, passenger terminals/concourses, apron facilities, automated people mover (APM), baggage handling system (BHS), access infrastructure and airport utilities. The requirements of the existing facilities and operational areas have been considered while developing the passenger processing terminal, concourse, apron and aircraft parking stand area. The construction techniques considered for the land formation areas seek to minimise potential environmental impact while optimising reclamation phasing.

Traffic Impact Assessment (TIA)

- 5.56** A preliminary traffic impact assessment (TIA) was undertaken to test the capacity of the existing airport road network and to propose appropriate road improvements/enhancements to accommodate the forecast air passenger and cargo traffic up to 2030. A detailed traffic impact assessment will be undertaken nearer the proposed implementation timeframe of these road network improvement works/upgrades whose detailed design needs to be reviewed and approved by the Transport Department.

Marine Impact Assessment (MIA)

- 5.57** A preliminary marine impact assessment (MIA) was undertaken, which highlighted the reduction in channel width north of the airport and suggested that appropriate separation measures be introduced to mitigate marine safety risks. The assessment has also identified, in consultation with the Civil Aviation Department (CAD), the possible reconfiguration of the "Hong Kong International Airport Approach Areas (HKIAAA)"⁵⁸ of the expanded airport platform to facilitate marine vessels' north-south movement in the west of the Hong Kong waters, while adhering to airport height restrictions to safeguard the operations of the Third Runway. A further detailed marine impact assessment will be carried out in consultation with stakeholders and the Marine Department if and when the formal EIA study is carried out for the Third Runway.

Land Formation

- 5.58** A series of possible alternative land formation methods has been investigated on a preliminary basis. The key objective is to find a robust solution to the project requirements within the required timeframe.

5.59 **Geotechnical Assessment**

A geotechnical assessment of the proposed land formation work has been conducted based on the available ground investigation records in the vicinity, including recent investigation of the contaminated mud pits and an extrapolation of the comprehensive geological model of the existing platform.

⁵⁸ The Shipping and Port Control Regulations (Cap 313A) specify the boundary of the HKIAAA where vessels are prohibited from entering and conditions under which vessels are permitted to enter as well as the penalties for contravention.

5.60 Geologically, the site is underlain by a descending sequence of marine deposits (between 10m and 20m thick) and alluvium (20m to 25m thick), which is in turn underlain by decomposed rock and granitic bedrock. Around 320ha of the site is located in the old marine borrowing areas, which have been and continue to be used for the deposit of contaminated mud of mixed content from around the territory. Based on the ground investigation carried out recently at these contaminated mud pits and the available bathymetric survey records, these pits could be up to 27m deep within the site.

Figure 5.31 : Airport Layout with Contaminated Mud Pits



5.61 Using available relevant laboratory results and the land formation experience of the existing airport platform, engineering properties have been investigated and the parameters for the preliminary design of the land formation work established. Since only limited site-specific data is available on the extent and properties of the major geotechnical units, marine deposits and alluvium, the engineering parameters will need to be carefully reviewed and verified at the next design stage through a comprehensive testing programme.

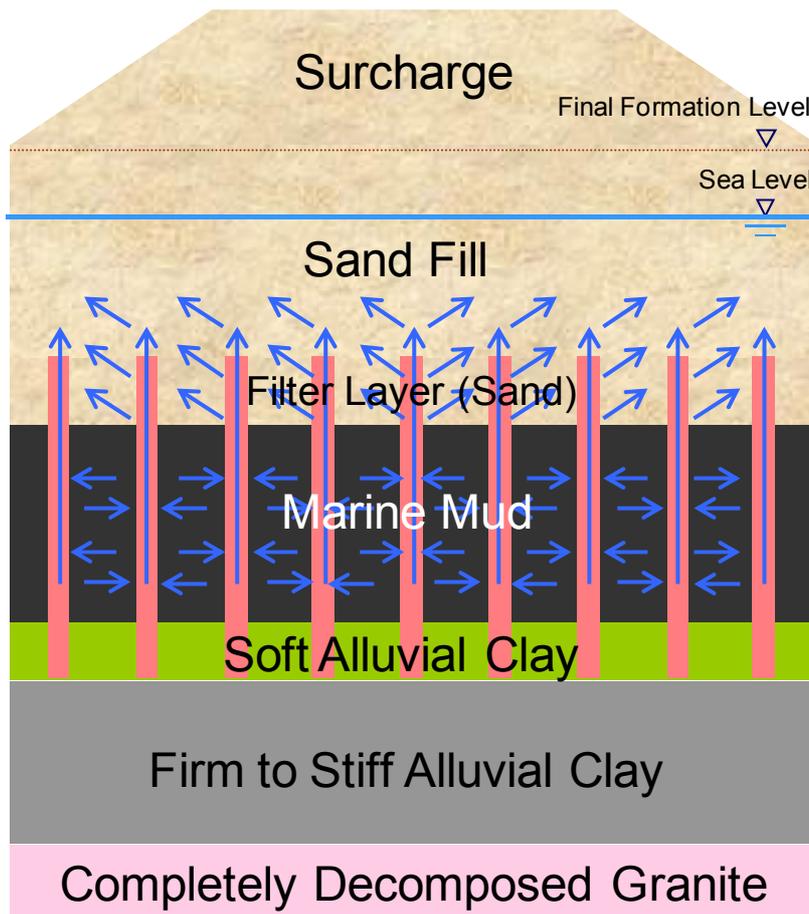
5.62 Preliminary Reclamation Design

Dredged reclamation was adopted for construction of the existing airport platform and less than 2m of soft marine sediments were left in place. Other ground treatment options are proposed in the preliminary design of the new platform to minimise the removal of the existing soft marine sediments where possible. It is intended that all contaminated marine mud contained in the mud pits will be retained in situ.

5.63 Most areas of reclamation tend to adopt a drained reclamation solution, which is a locally well established method which avoids dredging of soft marine sediments. In this method, the reclamation fill is placed over the un-dredged marine mud, which is then consolidated

by installing vertical wick drains to accelerate release of retained pore water in the marine mud.

Figure 5.32 : Land Formation by Un-dredged Method with Vertical Drains

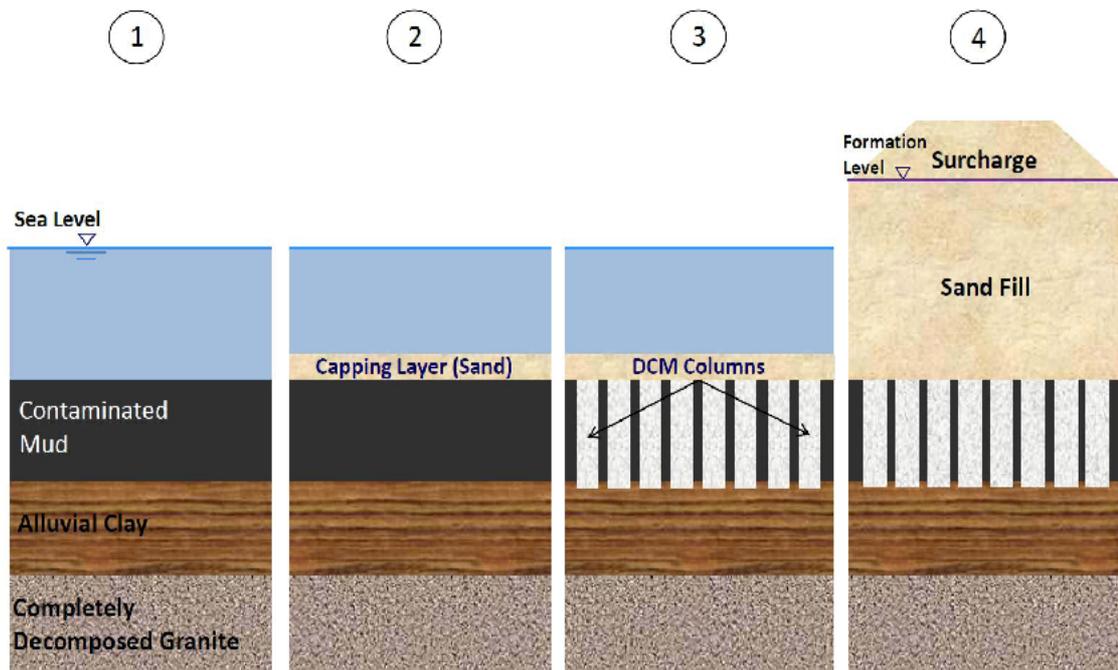


- 5.64** For reclamation above the mud pits, conventional drained reclamation is infeasible due to the considerable time required for the primary consolidation of these softer materials and the potential leaching of contaminated water out from the mud pits through the installed vertical drains. Therefore, in areas above the mud pits, treating and leaving the material in place is recommended. This can be done by increasing the strength and stiffness of the soft mud through a technique called Deep Cement Mixing (DCM). The DCM method, while widely used in Japan has not previously been implemented in Hong Kong. Therefore, site trials would have to be conducted to study and confirm its engineering and environmental feasibility and acceptability before large-scale implementation. For areas of reclamation outside the mud pits but beneath the proposed runway, the marine sediment will be treated with DCM in order to meet the more stringent performance criterion.

Figure 5.33 : Deep Cement Mixing Rigs



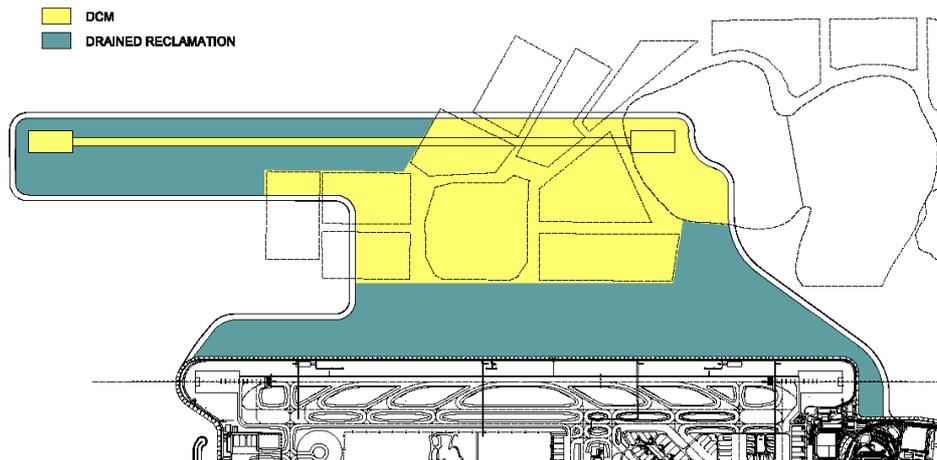
Figure 5.34 : Land Formation by Deep Cement Mixing (DCM) Method



5.65 Sand fill compacted by vibro-compaction is proposed as the key fill material for the reclamation. In all areas, surcharge preloading is proposed to control the anticipated settlement during the service life of the landfill. The duration of surcharge preloading will depend on the results of instrumentation monitoring throughout construction but is anticipated to be in the range of 4 to 12 months.

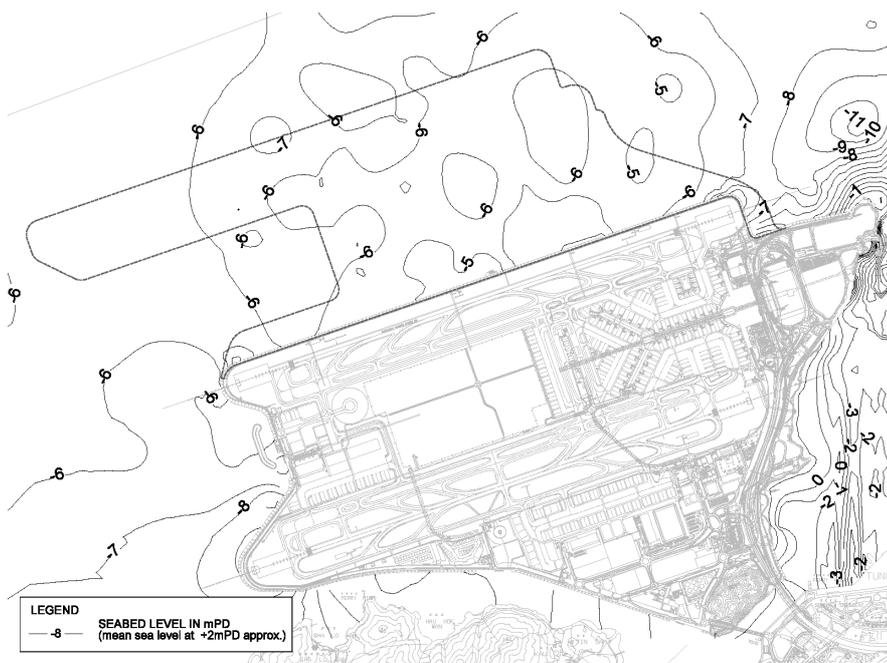
5.66 It is proposed to erect sloping seawalls on a non-dredged formation or over DCM-treated contaminated mud. The seawall armour is designed so as to allow recycling of old armour from the existing seawall which will effectively be relocated to the new sea wall location. The operations of seawall relocation and construction will be coordinated to ensure that the new seawall is in place and provides protection to the section of seawall to be relocated.

Figure 5.35 : Plan of Proposed Reclamation Methods



5.67 The approximate seabed level in the reclamation area is at -6 mPD⁵⁹ (see Figure 5.36). Assuming mean sea level at +2 mPD, the average water depth in the reclamation area will be 8m.

Figure 5.36 : Seabed Contour



⁵⁹ Note: mPD means metre above principal datum.

5.68 Fill Acquisition

Based on the preliminary design, various types of fill will need to be imported for the land formation work. The estimated quantities of fill required are:

- Quantity of Marine Sand: ~80 million cubic metres
- Quantity of Rock Fill and Rock Armour: ~15 million cubic metres

5.69 In view of the impact to the environment and the limited sources available within Hong Kong waters, marine sand and rockfill have to be obtained from the Mainland. This requires assistance from the HKSAR Government for liaison with the Mainland government. However, time has to be allowed for the liaison work and environmental impact assessment.

5.70 Public fill (i.e. construction and demolition material (CDM)) could also be used as reclamation material instead of marine sand. However, the importation rate of public fill is slow and the total quantity of public fill that the fill bank can store is much smaller than that needed. Nevertheless, the Public Fill Committee (PFC) of HKSAR Government welcomes usage of public fill, which can be collected at the fill bank free of charge. Direct procurement of CDM from contemporary projects involving excavation, such as MTR tunnelling work, should also be considered during the detailed design stage.

5.71 The outcome of the preliminary engineering feasibility assessment suggests that a combination of land formation methods including conventional drained reclamation, deep cement mixing and surcharging could address the critical technical issues and environmental concerns to a large extent. Relevant engineering and environmental trials will be needed subsequently to confirm the land formation methodology for the three-runway option.

Airfield and Apron Works

5.72 Preliminary designs have been prepared for the airfield and apron which cover pavement construction, drainage, utilities, firefighting systems, aviation fuel system, airfield ground lighting, apron systems, airside roads, and CAD and Hong Kong Observatory (HKO) airfield facilities.

5.73 The grading of the new airfield and apron will meet CAD and International Civil Aviation Organisation (ICAO) requirements and can match the existing airport. It is proposed to use flexible pavement construction for the runway, taxiways and taxilanes and rigid pavement for the aircraft parking stands.

5.74 The preferred concave profile for the runway will be maintained and paved surfaces will be above a 6.5mPD flood level. The tributary stormwater drainage and oil separation systems will be similar to the existing system at the airport.

- 5.75** The new runway lighting system, developed in accordance with the system currently used and installed, is based around a CAT IIIA⁶⁰ approach on the proposed Runway 25R, as per the existing 25R. Similarly, a CAT II system will be installed on the proposed Runway 07L in line with the existing runway. Two additional sub-stations will be needed to provide power to the new Airfield Ground Lighting system, associated aprons and taxiway equipment.
- 5.76** The airside road system has been planned and designed in accordance with relevant design criteria. The new head-of-stand road is a three-lane road with two 5-metre lanes separated by a 6-metre dividing lane that can either be designated as two 3-metre through lanes or one 6-metre turning/manoeuvring lane. The new concourse will be connected to the existing airport by means of two road tunnels of four lanes (each lane being 5m wide). These will connect to an east/west road tunnel allowing traffic to reach either end of the new concourse without causing congestion on the head-of-stand road system.
- 5.77** Preliminary design has taken into account the CAD and HKO facilities' requirements for the new runway and airport expansion area. Further airfield layout refinement will be required to accommodate existing CAD and HKO facilities.

Passenger Processing Terminal and Concourse Remodelling

5.78 Terminal 2

The preliminary design assumes that Terminal 2 (T2) will be extensively remodelled to include arrival facilities whilst retaining much of the existing building including the tour coach station, building structure and foundations. It will be bounded by Airport Road to the east, the Ground Transportation Centre (GTC) to the west, and the existing road infrastructure to the north and south. The two office towers will remain in continuous operation, as will the Automated People Mover (APM) from T1 to SkyPier running under the site. Two bands north and south of the terminal have been safeguarded as future expansion areas.

- 5.79** Several terminal planning options for T2 have been considered with alternate various key facilities such as the departures road, check-in, baggage claim, Meet and Greet hall and car parks. The aim is to emulate the terminal layout and hence the passenger experience of T1 as far as possible. Despite key differences in location of the Airport Express Line (AEL) departures platform relative to check-in and the APM station leading to the new concourse vis-à-vis the main processing areas, there will be an overall equal Level of Service (LOS) between T1 and the remodelled T2.
- 5.80** Landside retail and food and beverage facilities are provided in a way that offers easy visibility and access from both the arrivals and departures levels. Customs/immigration/quarantine (CIQ) processing areas are largely stacked above each other, allowing potential for sharing between arrivals and departures.

⁶⁰ CAT I, II or III (A, B and C) refer to categorisation of the type of approach/runway lighting and ILS system performance required for a precision approach (instrument) runway in order to facilitate aircraft operations during low visibility conditions that may be caused by fog, heavy rain, etc.

5.81 For reasons of construction efficiency, T2 will be remodelled in phases with early phases requiring only some modification of the existing structure. There is potential to build the new T2 baggage hall and the APM Interchange Station serving the new Third Runway passenger concourse, Hong Kong Boundary-Crossing Facilities (HKBCF)/Hong Kong-Shenzhen Western Express Line (this project is under feasibility study by the Government) flows and connectivity to T1 and SkyPier eastwards, outside T2's existing footprint.

5.82 Third Runway Passenger Concourse

The Third Runway passenger concourse (TRPC) is an airside concourse that will serve mostly passengers using T2, to which it is connected via an underground APM. The size and shape of the Third Runway passenger concourse will be similar to the T1 concourse with equivalent provisions for APM stations, BHS, retail, transfer facilities, CIP lounges, gate lounges, boarding and queuing areas, toilets, and mechanical and electrical plant rooms. Development of the final configuration of the concourse will require further assessment to ensure that its footprint and shape satisfy efficiency and phasing parameters. For planning and programme considerations, the concourse and apron areas are based upon existing T1 designs, which are proven to satisfy a known passenger throughput.

Automated People Mover

5.83 The following areas had been looked into in the preliminary assessment for the APM system for the three-runway option:

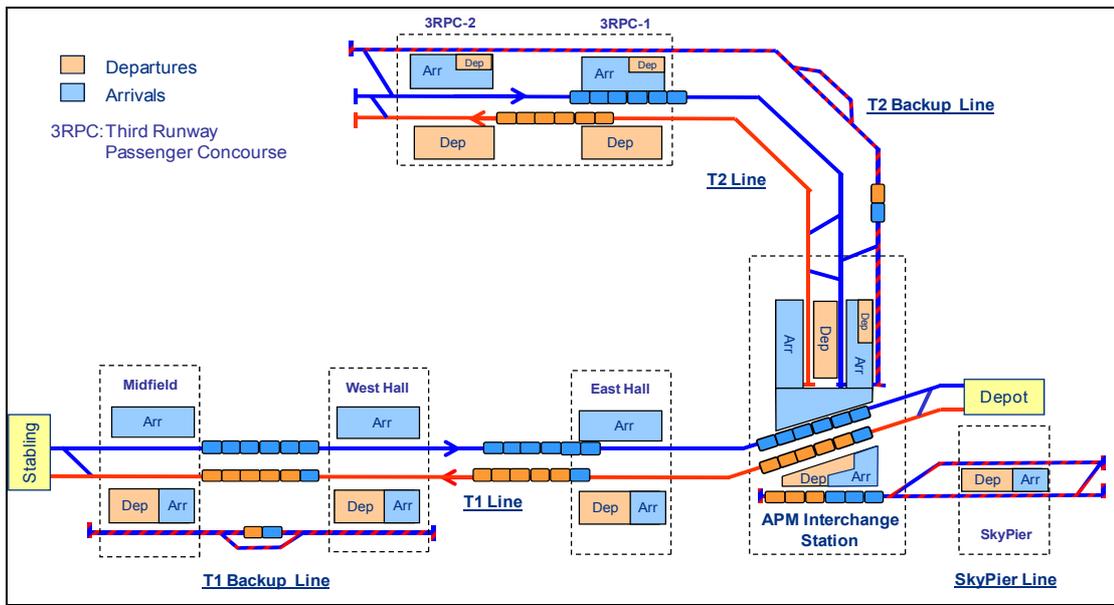
- To develop a concept design for the future APM system serving between T2 and the TRPC;
- To facilitate transfer of passengers between T1, T2 and SkyPier by incorporating an APM Interchange Station at T2;
- To ensure that the APM system is able to cope with the expected airport demand; and
- To study the location and sizing requirement for the APM depot.

5.84 The proposed APM system for the three-runway option will have the following features (see Figure 5.37):

- A separate pinched loop line between T2 and TRPC (T2 Line) to provide a direct service between T2 and TRPC. Separate island platforms for arrivals and departures are provided for the T2 line to improve efficiency;
- A bypass loop between T2 and TRPC (T2 Backup Line) for mixed car trains to allow a double shuttle mode of operation (for backup and route recovery purposes);
- Two APM stations at TRPC;
- Extension of the T1 APM pinched loop line serving the T1 East Hall, T1 West Hall and the Midfield Concourse stations in the two-runway option further eastward to serve the new APM Interchange Station at T2, so as to cater for transfer passengers making flight connections between T1 and T2 in future;
- Security screening for all transfer passengers between T1/Midfield Concourse and TRPC at the T2 APM Interchange Station. The eastbound line of the T1 APM pinched loop will retain the current operational mode carrying only non-secure arrival passengers;

- Upgrading the existing shuttle mode SkyPier Line to pinch loop to provide additional APM capacity. Intermodal T1/T2 Transfer Passengers will be connected to and from SkyPier via the APM Interchange Station at T2 using the SkyPier Line; and
- An APM depot will be located below the existing Golf Course Area close to the T2 APM Interchange Station for maximum efficiency of APM operations.

Figure 5.37 : Proposed APM System Network for the Three-Runway Option



5.85 HKIA needs an APM fleet size of 110 cars to bring its annual handling capacity to 100 million passengers by 2030. It is recommended that the existing APM depot underneath T2 be relocated underground east of T2. This will be sized to accommodate the ultimate APM network capacity but can be constructed in stages.

Baggage Handling System

5.86 The feasibility assessment of the BHS and facilities is based on BHS schematics and estimates of system space requirements. These, in turn, are based on the layout of critical operational areas and interfaces that are the principal drivers of facility size, such as loading docks and make-up areas. Capacity and demand analysis has been used to determine the overall baggage flows and the resulting capacity requirements under a range of planning scenarios.

5.87 Different systems including Destination Coded Vehicle (DCV), high-speed belt conveyor and vehicle based systems were also assessed. The key findings were:

- The DCV system arrangement is the most extensive type of baggage handling system in terms of size of facilities and extent of equipment;
- A vehicle-based arrivals system has several advantages over arrivals by DCV or high-speed conveyor such as: reduced DCV system requirements between T2 and the Third Runway passenger concourse, reduced size of baggage basements and a decrease in the overall requirement for DCV transport system equipment.

DCV high-speed baggage transport vehicles achieve very similar arrivals baggage delivery time performance; and

- High-speed belt systems are currently unproven at very high speed (10m/s) but offer benefits such as a simpler control strategy and potential space-saving, removal of risk from supplier tie-in on matters of software, and simpler maintenance regimes. However this option will require further study and supplier product development.

5.88 T2 will provide the check-in and reclaim functions for the new Third Runway passenger concourse. Check-in provision is based on the T1 facility and comprises a similar arrangement with redundant transport routes to the T2 baggage hall. Security screening is provided for departing bags in T2 and the bags are then loaded onto a high-speed belt conveyor system for point-to-point transport between the terminal buildings. Each terminal building will contain a high-capacity multi-way sorting switch e.g. tilt-tray sorters, as required for the principal routing functions. The T2 system will be a simpler process in terms of sorting, but transport redundancy must be provided for while selecting routing equipment.

5.89 The baggage handling system and operational space requirements in the Third Runway passenger concourse were assessed on the basis of phased baggage facilities. The baggage facility could be located either within the possibly constrained footprint of the concourse or in a single consolidated baggage facility in a building separate to the main concourse buildings. The stand-alone baggage facility has significant advantages for the design of the concourse buildings. The removal of the baggage basements enables the APM to be at a shallower depth, giving shorter transport times and lower construction costs. Additionally, construction phasing is improved with the complex baggage handling system being commissioned and built independently of the concourse buildings.

5.90 Inter-terminal baggage transfer remains a challenge and requires further investigation of facilities and baggage handling strategies.

Vehicular and APM/Baggage Tunnels

5.91 Vehicular, APM and baggage tunnels will be employed to link the existing airport and the Third Runway passenger concourse. Extensions of the Western and Eastern Vehicular Tunnels will pass under the existing North Runway and taxiways linking the Midfield area with the Third Runway passenger concourse. The horizontal alignment of the Eastern Vehicular Tunnel and the vertical alignment of the Western Vehicular Tunnel need to avoid clashing with the existing drainage box culverts. The construction of the vehicular tunnels by cut and cover method will result in temporary closure of the taxiways and/or the North Runway.

Airport Access

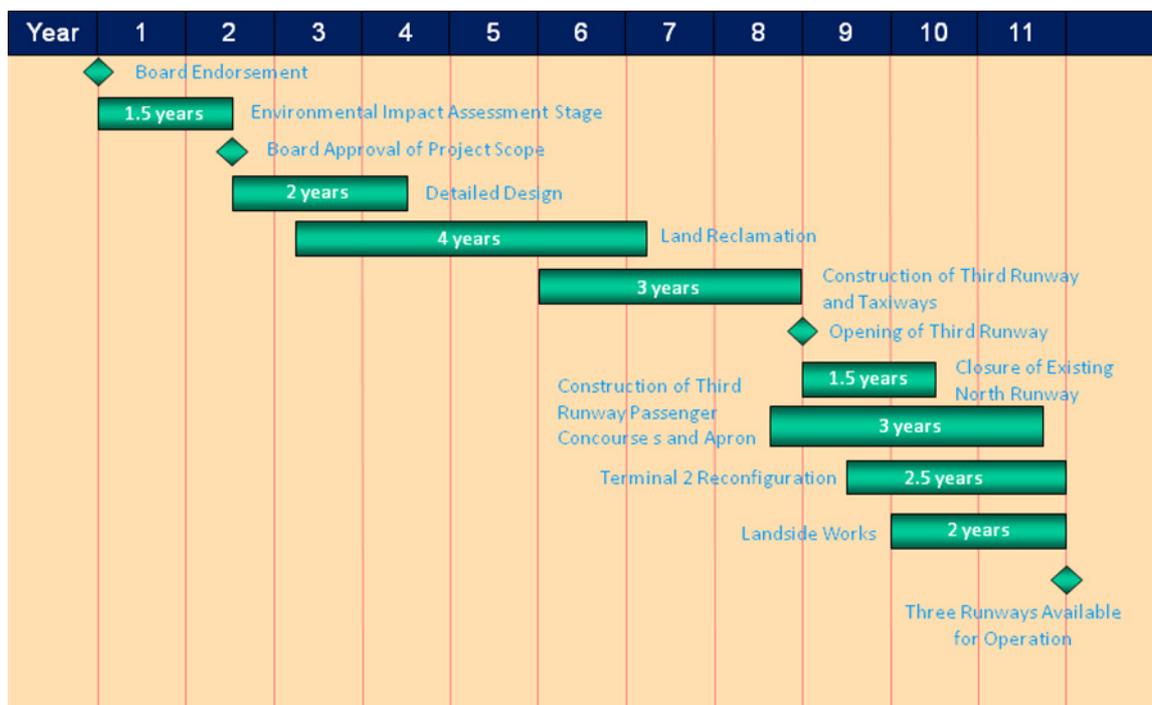
5.92 The Airport Road and Chek Lap Kok Road are the primary links between Tung Chung and the airport island. Additional links in the form of the Hong Kong-Zhuhai-Macao Bridge (HZMB), HZMB-Hong Kong Link Road, and the Tuen Mun-Chek Lap Kok Link (TMCLKL) are proposed for the near future and the additional capacity provided by these links should be sufficient for the forecast 2030 traffic demand.

5.93 Modification plans for the road system have been drawn up in line with the expected increase in origin/destination passenger throughput. (See paragraphs 5.43 and 5.44).

Indicative Third Runway and Associated Infrastructure/Facilities Development Phasing Plan

5.94 Implementing the Third Runway project entails a series of critical activities including undertaking the Environmental Impact Assessment (EIA), reclamation, early completion of the Third Runway and the associated taxiways and the Air Traffic Control tower. The early commission of the Third Runway and closure of the Second Runway will enable the construction of cut and cover airfield tunnels to eliminate the operational risk of tunnel construction under a live runway. The Third Runway project requires a construction lead time of about 10 years (see Figure 5.38), but this may change at the detailed design stage to optimise the programme.

Figure 5.38 : Estimated Implementation Programme of the Third Runway



5.95 The development will be done in incremental stages in line with air traffic demand over the next 20 years to rationalise capital investment. From a long-term growth sustainability perspective, development beyond 2030 has been considered in the context of how much area is needed to accommodate the ultimate capacity of the three-runway system. Based on current assumptions of future PRD airspace arrangements and aviation technology advancements, the three-runway system can be estimated to support a potential capacity of 102 movements per hour.

5.96 Figure 5.39 indicates the development required under each phase.

Figure 5.39 : Indicative Infrastructure/Facility Development Phasing for the Three-Runway System

	Unconstrained Development				
	Phase 1 (2015)	Phase 2 (2020)	Phase 3 (2025)	Phase 4 (2030)	Total
Midfield and Third Runway Aprons Development:					
Additional Number of Airbridge-served and Remote [#] Aircraft Parking Stands	20	44	25	25	114
Passenger Processing Terminal and Concourse Development:					
Reconfiguration and Expansion of Terminal 2 (T2) to Increase Annual Handling Capacity to:	-	15 million passengers	23 million passengers	30 million passengers	
New Passenger Concourse at the Midfield	1st phase of "I" shaped Concourse completed	2nd phase of "I" shaped Concourse completed	-	-	
Third Runway Passenger Concourse	-	East Concourse completed	Southwest Concourse completed	Northwest Concourse completed	

Note: # Remote aircraft parking stands can be used by both passenger aircraft and freighter.

5.97 Areas have been safeguarded for development beyond 2030 to increase the number of aircraft parking stands at the Third Runway passenger concourse area and the Midfield to cater for 120 million passengers and 10 million tonnes of cargo per annum, subject to market demand and the future development of aircraft navigation technology and improvements in airspace and air traffic management which could potentially stretch the runway capacity further.

Brief descriptions of each development phase are given in the following paragraphs.

Indicative Infrastructure/Facility Development Phase 1 (completion by 2015)

5.98 As explained in Chapter 3, a commitment has already been made for Phase 1 of the development programme to ensure that there are sufficient facilities to serve the demand forecast for 2015. In other words, this Phase 1 programme does not in any way pre-empt the final choice of Option 1 (Two-Runway System) or Option 2 (Three-Runway System) for which development plans start to diverge beyond year 2015. To recap, the Phase 1 programme includes:

- The construction of a Midfield concourse with 11 airbridge-served stands and 9 remote parking stands;
- An additional cross-field taxiway to serve the stands on the west side of the Midfield concourse;
- An extension of the APM line and APM tunnel from T1 West Hall to connect with the Midfield concourse, with a back up system in case of APM breakdown or for route recovery;
- Minor enhancement to the BHS; and
- An additional ramp providing access to Midfield concourse from the existing eastern tunnel roundabout, with a tunnel extended west under the new taxiway.

Indicative Infrastructure/Facility Development Phase 2 (completion by 2020)

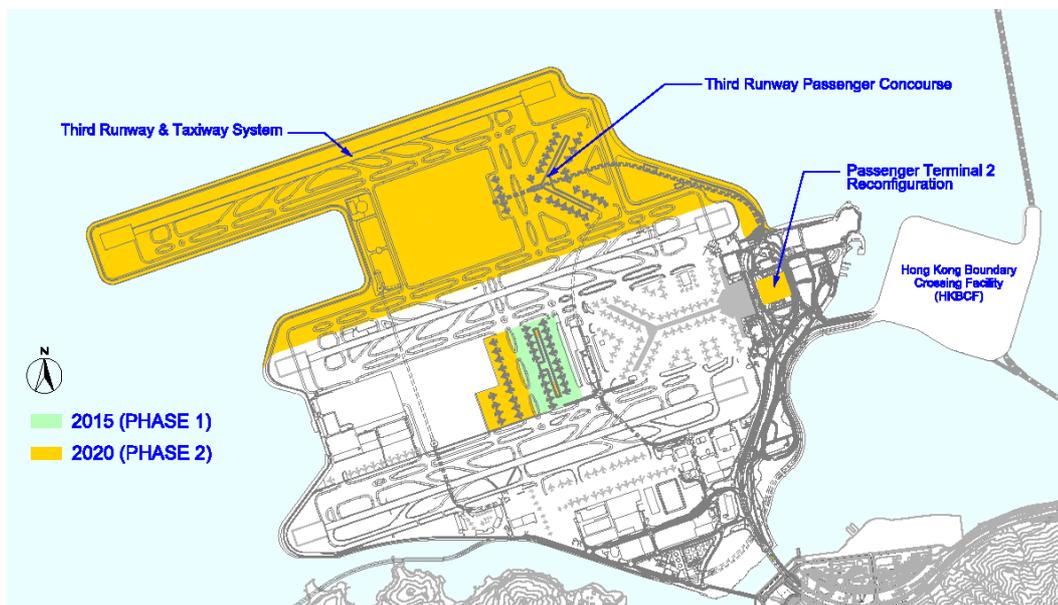
5.99 The development programme (see Figure 5.40) under Phase 2 will include:

- *Completion of land reclamation:* Fulfilling the airport's expansion requirements up to the design capacity of the three-runway layout, with the surcharge completed for Phase 2 portion of the reclamation and completion of infrastructure connecting the new reclamation to landside access roads and utility services;
- *Implementation of the three-runway system:* Putting in place all key elements such as, Third Runway and associated taxiways and apron system, new Air Traffic Control Tower, associated navigational aids, rescue and fire fighting stations within the airport restricted area, necessary utilities stations and operations-related facilities in the new apron;
- The two taxiways connecting the Third Runway and the future Second Runway (existing North Runway) to become operational;
- Reconfiguration of T2 to handle the initial passenger capacity (approximately 15 million passengers per annum); provision of roads and landside transportation facilities connecting to T2;
- Completion of the first phase of Third Runway passenger concourse and aircraft stand development with 30 passenger aircraft stands, as well as connecting taxilanes along the eastern section of the reclaimed apron;
- APM east station and BHS serving the first phase of the Third Runway passenger concourse as it becomes operational; opening of a new APM maintenance depot underneath the existing North Commercial District;
- Opening of the extension of the eastern vehicular tunnel to the Third Runway passenger concourse; construction of the box structure of the Western Vehicular Tunnel underneath the existing North Runway (access to the west end of the new apron, including the new Air Traffic Control Tower and rescue and fire

fighting stations within the airport restricted area, will be via at-grade airside roads and the Eastern Vehicular Tunnel);

- Further expansion of the Midfield concourse with conversion of the 9 remote parking stands built in Phase 1 into airbridge-served stands, along with an additional 14 remote parking stands to the west of the Midfield concourse for common use by passenger and freighter aircraft;
- Construction of a second cross-field taxiway to serve the additional remote parking stands to the west of the Midfield concourse;
- Increasing APM capacity to six cars per train; and
- Addition of two multi-storey car parks.

Figure 5.40 : Indicative Infrastructure/Facility Development Phases 1 & 2



Indicative Infrastructure/Facility Development Phase 3 (completion by 2025)

5.100 The development programme under Phase 3 will include:

- A surcharge for the Phase 3 portion of the reclamation so as to enable expansion of the Third Runway passenger concourse;
- Expansion of T2 to the north to meet Phase 3 capacity;
- Completion of the second phase of the Third Runway passenger concourse (southwest concourse) along with 14 additional passenger aircraft stands and connecting taxiways;
- Addition of an APM west station to the Third Runway passenger concourse and the BHS to meet Phase 3 demand, and expansion of the new APM maintenance depot to meet Phase 3 operational needs;
- An additional 11 cargo stands in the Midfield together with the required taxiways and taxiway;
- Opening and extension of the Western Vehicular Tunnel to the new apron to serve both the Midfield area and the western end of Third Runway passenger concourse; and
- Addition of one multi-storey car park.

Indicative Infrastructure/Facility Development Phase 4 (completion by 2030)

5.101 The development programme under Phase 4 will include:

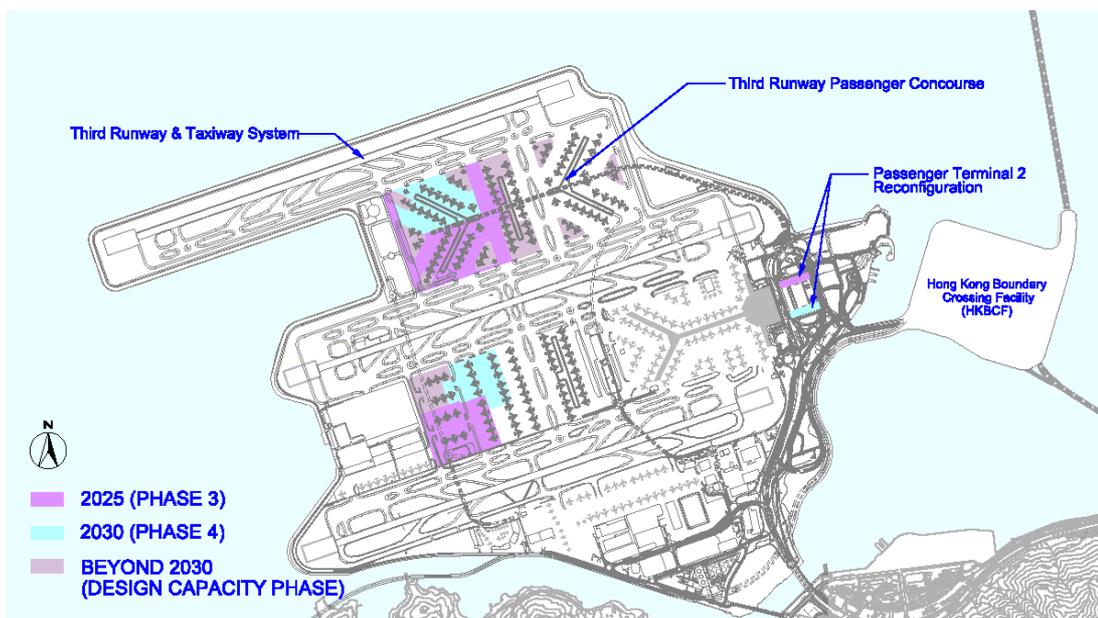
- A surcharge for the Phase 4 portion of the reclamation to enable expansion of the Third Runway passenger concourse;
- Expansion of T2 to the south to meet Phase 4 capacity;
- Completion of the third phase of the Third Runway passenger concourse (northwest concourse) along with an additional 14 passenger aircraft stands and connecting taxilanes;
- Expansion of the BHS and the APM system to meet Phase 4 operational needs;
- An additional 11 cargo stands in the Midfield together with required taxilanes and taxiway; and
- Addition of one multi-storey car park.

Potential Infrastructure/Facility Development Beyond 2030

5.102 The current infrastructure/facility plan embodies further expansion potential which would achieve the full projected capacity of the airport under a three-runway layout. This is possible by way of the following:

- Laying of a surcharge for the remaining portion of the reclamation to enable expansion of the Third Runway passenger concourse;
- Expansion of the Third Runway passenger concourse (central concourse) and apron development so as to increase annual handling capacity to 120 million passengers eventually;
- Expansion of the cargo apron at the Midfield to its full size for optimum utilisation; and
- Enhancement of the APM system and the BHS to full design capacity.

Figure 5.41 : Indicative Infrastructure/Facility Development Phases 3 and 4 and Earmarked Areas for Development Beyond 2030



Estimated Construction Costs

- 5.103** A preliminary assessment has been carried out to consider the engineering feasibility of each of the key components of the airport expansion scheme such as land formation, airfield facilities, apron facilities, passenger terminals and concourses, automated people mover system, baggage handling system, access infrastructure, and other supporting facilities and utilities.
- 5.104** The assessment outcome has generated a preliminary cost estimate for each development phase up to 2030 (see Figure 5.42).

Figure 5.42 : Preliminary Phased Development Cost Estimates for a Three-Runway System

Unconstrained Development Phases	Construction Cost HK\$ Billion	Design & Project Management HK\$ Billion	Contingency HK\$ Billion	Total Cost Estimate HK\$ Billion
Phase 1 (by 2015)	7.9	0.6	0.8	9.3
Phase 2 (by 2020)	50.2	5.0	10.1	65.3
Phase 3 (by 2025)	10.1	1.0	2.0	13.1
Phase 4 (by 2030)	6.0	0.6	1.2	7.8
Total (Phases 2 – 4)				86.2

 Committed

Estimating Approach & Development

- 5.105** The indicative capital construction cost estimate for the Preferred Airport Layout Plan in 2030 is based on the following parameters. The rates used in computing these estimates are fixed-price competitive tender rates prevailing in the Fourth Quarter of 2010 subject to future inflation adjustment. The rates used in the cost estimates were compared wherever possible with the relevant government contract rates for similar types of civil works. The preliminary cost estimate was based on the best information available at the master planning stage. These estimates also include contingency, design fees and project management fees. Phase 1 development which is already committed, is at Money-of-the-day (MOD) prices. The three-runway option’s development phases from 2016 up to 2030 are estimated to cost HK\$86.2 billion in 2010 dollars or HK\$136.2 billion at MOD prices.
- 5.106** Where practical, approximate quantities of work have been measured, corresponding to the level of design details available, applying costs per unit of construction floor area from other similar projects where relevant. Lump sum budget allowances have been inserted for items of uncertain scope. For airport specialist systems such as BHS and

APM, quotations from specialist manufacturers were obtained and supplemented through reference to existing airport project benchmarks.

Environmental Considerations

HKIA's Environmental Commitments

5.107 As mentioned in Chapter 4, a voluntary Environmental Impact Assessment (EIA) was conducted as an integral part of the New Airport Master plan published in 1992, to evaluate potential environmental impacts associated with airport development and operations, resulting in a range of commitments designed to ensure that environmental impacts would be mitigated to acceptable levels and effectively managed.

5.108 In addition to fulfilling the commitments from the EIA, HKIA's environmental programme also addresses the many other challenges inevitably associated with operating a major international airport, focusing on initiatives that prevent or minimise pollution and maximise energy and natural resource use efficiency, by following the principle of continuous performance improvement. Some of its ongoing programmes are outlined below:

5.109 Carbon and Air Emission Management

HKIA is running numerous initiatives to reduce local air emissions and carbon emissions as well as to improve energy and resource efficiencies including the following:

- AAHK is a signatory to the Environmental Protection Department's Carbon Reduction Charter and the Aviation Industry Commitment to Action on Climate Change;
- AAHK has undertaken carbon audits since 2008 and is actively working with its business partners on HKIA-wide carbon auditing and reduction;
- To reduce both air pollutant and greenhouse gas emissions, AAHK promotes the use of electric, hybrid and liquefied petroleum gas-powered vehicles at HKIA. The airport has one of Hong Kong's largest fleets of electric vehicles and ground service equipment, and all AAHK's diesel vehicles use B5 biodiesel, a mixture of 95% conventional diesel and 5% biodiesel made from used cooking oil;
- A wide range of measures has been introduced to improve the efficiency of airport lighting, ventilation, air conditioning and hydraulic systems, cumulatively contributing to significant carbon emissions reduction. HKIA has recently pledged as an airport community to reduce airport carbon emissions by 25% per Work Load Unit⁶¹ by 2015 based on 2008 emissions levels;
- AAHK has teamed with other airport community members to enlarge the existing 200-strong fleet of electric vehicles, including the provision of charging infrastructure; and
- AAHK is working to improve the efficiency of the fixed ground power and pre-conditioned air systems used by aircraft during stopovers, so as to further reduce local air pollutant emissions.

⁶¹ A Work Load Unit is equal to 1 passenger or 100kg of cargo

5.110 HKIA Air Quality Monitoring Programme and Data Interpretation

AAHK is committed to understanding and managing airport generated air emissions.

- AAHK has three air quality monitoring stations at and near HKIA to measure real-time data on air quality at and north of HKIA. Continual real-time data is collected and can be analysed in conjunction with meteorological information. The data is interpreted on an ongoing basis by an independent team of air quality and atmospheric experts from the Hong Kong University of Science and Technology (HKUST). Their analysis facilitates a better understanding of the effect that HKIA-generated air emissions have on regional air quality, based on airport operations and the real-time air quality and meteorological situation.
- Experts have identified that HKIA's most significant air pollutant, Nitrogen Oxide (NO_x), has not been a key contributor to significant episodes of poor air quality in Tung Chung (i.e. on days when the Tung Chung Air Pollution Index is particularly high). The key contributor there was respirable suspended particulates. From the air quality monitoring dataset and meteorological information, HKUST has shown that when the API is high in Tung Chung the high levels are mainly caused by air pollutants with primary sources to the north and northwest of HKIA.

5.111 Waste Minimisation and Recycling

Increasing waste separation at source across the airport and achieving good recycling rates remain key focus areas for AAHK. AAHK is also working closely with the airport community to minimise waste.

- HKIA has striven to continually reduce waste going to Hong Kong's scarce landfills and to increase recycling percentages. During the five years to March 2010, 4,600 tonnes of waste have been recycled, with enhanced efforts to increase recyclables separation achieving a 50% improvement by volume within 2010.
- AAHK is implementing a programme of actively partnering with tenants to drive up waste separation and recycling by providing complimentary bags and bins to tenants to aid separate recyclables and food waste collection from airport restaurants and retail outlets.
- HKIA's wastewater treatment plant, a commitment from the 1991 EIA, has processed 6.4 million cubic metres of wastewater from aircraft catering facilities, aircraft washing bays, passenger terminal restaurants and restroom sinks over the 5 years to March 2010. About 12% of the treated water is used to irrigate the airport's landscaping.

5.112 Local Biodiversity

AAHK has an ongoing commitment to the conservation of local, flora and fauna as well as important local habitats.

- AAHK has funded the management of the Sha Chau and Lung Kwu Chau Marine Park. It has also supported research into Chinese White Dolphins, the development of an artificial reef programme in North Lantau waters and a conservation plan for the Romer's Tree Frog, which is native to Hong Kong.
- HKIA has a green area of over 3 million square metres on the airport island and has contributed to substantial off-airport tree and inter-tidal mangrove planting.

Preliminary Environment Assessment for The Expansion of HKIA

5.113 The three-runway development plan represents a significant change from the two-runway layout that was assessed in 1991. Under the EIA Ordinance enacted in 1998, a Third Runway with its supporting infrastructure qualifies as an "environmentally significant material change" to the 1991 scheme, necessitating an Environmental Permit before work can proceed. Obtaining the permit requires that a statutory EIA is completed in accordance with criteria and stipulations detailed in Hong Kong's EIA Ordinance and "Technical Memorandum on EIA Process" (TM).

5.114 The preliminary environmental considerations have been a vital part of the preliminary planning and initial engineering assessments for airport expansion. This initial assessment has helped define the scope of the potential impacts and facilitated a preliminary qualitative comparison of the expansion options. It has included:

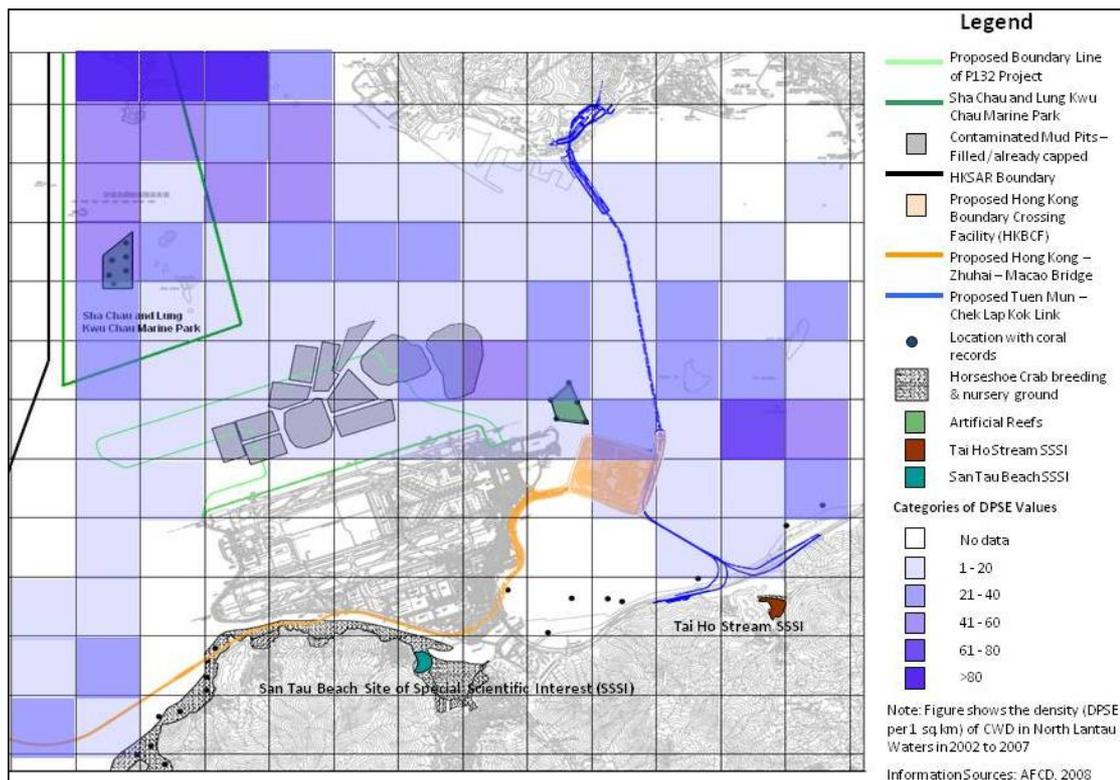
- A review of available and relevant information and data;
- An initial scoping of environmental aspects and issues expected to require formal assessment in the statutory EIA process;
- Early liaison with the Environmental Protection Department, Agriculture, Fisheries and Conservation Department, and other relevant Government departments and bureaux to ascertain key areas and issues of concern;
- Identification of key "differentiating" environmental issues that may arise during the construction and operational phases; and
- A qualitative comparison of the available expansion options.

5.115 The preliminary environmental assessment and comparison exercise were designed to inform the option selection process in this Master Plan, as environmental aspects are important factors in the evaluation and selection of three-runway airport layout options. A number of 'broad brush' differentiators of environmental factors were used in comparing each of the viable three-runway layout options. This part of the options comparison is detailed in Appendix 3.

5.116 *Environmental Review and Issues Scoping*

All available information has been reviewed including academic research papers, statutory EIA reports and non-statutory studies relevant to north Lantau and the natural environment around HKIA. Figure 5.43 identifies ecological and other resources and constraints near HKIA that have a bearing on future airport expansion.

Figure 5.43 : Environmental Resources near HKIA



5.117 It is recognised that the scoping of environmental aspects and the preliminary assessments do not replace the statutory EIA process prescribed in the EIA Ordinance. Should HKIA proceed with the three-runway development plan, a formal EIA will be completed in accordance with the criteria and stipulations detailed in the statutory process. At that point a Project Profile will be submitted to the Director of Environmental Protection (DEP) to start the process, who will carry out a series of formal public consultations. In addition, AAHK will explain the project to stakeholders and seek inputs from interested parties as the Master Plan consultation progresses, to ensure that all environmental and community issues of public concern are addressed adequately in later assessments.

5.118 A key objective of AAHK is to assess and carefully consider the potential environmental impact of reclamation, large infrastructure construction, and the environmental and community impact associated with expanded airport operations. Figure 5.44 provides a summary of the environmental aspects covered by the EIA Ordinance, along with the key issues to be assessed at the construction and operational stages for each aspect.

Figure 5.44 : Summary of Environmental Aspects

Aspect	Issues for Environmental Assessment
Air Quality	<p><i>Construction Phase:</i></p> <ul style="list-style-type: none"> ▪ Cumulative impact from land formation and construction dust, as well as from concurrent projects on Air Sensitive Receivers (ASRs) <p><i>Operational Phase:</i></p> <ul style="list-style-type: none"> ▪ Potential increase in air emissions from phased increase in aircraft movements and airport operations under the three-runway option. The potential cumulative emissions from nearby infrastructure projects will also be considered ▪ Projections to recognise Air Quality Objectives (AQOs) prevailing by 2030
Marine Cultural Heritage	<p><i>Construction and Operational Phases:</i></p> <ul style="list-style-type: none"> ▪ As the area has already been disturbed, substantial archaeological remnants are not expected
Fisheries	<p><i>Construction Phase:</i></p> <ul style="list-style-type: none"> ▪ Disturbance to fisheries production ▪ Disturbance to fishing operations ▪ Loss in fisheries value due to construction <p><i>Operational Phase:</i></p> <ul style="list-style-type: none"> ▪ Permanent loss in fisheries production ▪ Habitat loss ▪ Potential impact on fishing operations ▪ Potential impact on fisheries value ▪ Potential impact on fisheries operations in Marine Exclusion Zone (MEZ)
Hazard to Life	<p><i>Construction and Operational Phases</i></p> <ul style="list-style-type: none"> ▪ No significant issues are expected according to Hong Kong risk guidelines
Landscape and Visual	<p><i>Construction and Operational Phases:</i></p> <ul style="list-style-type: none"> ▪ Potential disturbance to Visual Sensitive Receivers (VSRs) in Sha Lo Wan, Tung Chung and northwest New Territories
Marine Ecology	<p><i>Construction Phase:</i></p> <ul style="list-style-type: none"> ▪ Potential disturbance to marine ecology and habitats near works areas, including known horseshoe crab nursery grounds, coral and sea-grass habitat near the proposed airport expansion footprint ▪ Potential impact from increased Suspended Solid (SS) concentration on marine Ecologically Sensitive Receivers <p><i>Operational Phase:</i></p> <ul style="list-style-type: none"> ▪ Permanent loss of 650 hectares of sea bed and marine habitat, including about 260 hectares already occupied by Contaminated Mud Pits (CMPs) ▪ Potential impact on intertidal habitat, soft-bottom habitats and coral communities <p><i>[Note: A significant part of the sea bed in the proposed new land area has been subject to substantial disturbance in the past as a result of CMPs as well as other major developments.]</i></p>
Chinese White Dolphins (CWD)	<p><i>Construction Phase:</i></p> <ul style="list-style-type: none"> ▪ Disturbance to CWD (noise/water quality/feeding grounds); ▪ Disturbance to dolphin calves <p><i>Operational Phase:</i></p> <ul style="list-style-type: none"> ▪ Habitat loss ▪ Permanent loss of feeding grounds ▪ Potential encroachment into CWD travelling “corridors” between known areas of higher dolphin abundance ▪ Proximity to southern boundary of Sha Chau and Lung Kwu Chau Marine Park

Aspect	Issues for Environmental Assessment
Noise	<p><i>Construction Phase:</i></p> <ul style="list-style-type: none"> ▪ Potential impacts of land formation and construction on Noise Sensitive Receivers (NSRs) in north Lantau (e.g. residential) <p><i>Operational Phase:</i></p> <ul style="list-style-type: none"> ▪ Potential impact on noise sensitive land uses with updated Aircraft Noise Exposure Forecasts (NEFs)
Waste	<p><i>Construction Phase:</i></p> <ul style="list-style-type: none"> ▪ Quantity of dredged mud for disposal (e.g. under seawall and runway alignment)
Water Quality and Hydrodynamics	<p><i>Construction Phase:</i></p> <ul style="list-style-type: none"> ▪ Increase in Suspended Solid concentration at Water Sensitive Receivers near reclamation ▪ Potential release of sediment fines from mud dredging; methodologies for stabilising CMPs to ensure contained pollutants or interstitial water will not be released to the surrounding areas <p><i>Operational Phase:</i></p> <ul style="list-style-type: none"> ▪ Loss of marine area ▪ Potential change in hydrodynamics and tidal flows ▪ Potential change in flushing capacity of existing airport sea channel and water quality in east Tung Chung embayment

5.119 Should the Third Runway option be pursued, each of the above aspects would be assessed fully in accordance with the assessment requirements of the EIA Ordinance.

5.120 The review and scoping exercise helped identify several environmental aspects that are expected to be significant during the statutory assessment process given the expected scale and nature of works required for airport expansion and the increase in airport operations thereafter. Preliminary environmental assessments have been carried out on some of these key aspects at this early stage, which include:

- Potential operational impact on air quality;
- Potential impact from new land formation on marine ecology—in particular on Chinese White Dolphins;
- Potential aircraft noise impact on residential communities near the airport and along the flight paths; and
- Potential water quality impact of new land formation over an area of Contaminated Mud Pits (CMPs) north of HKIA and from any soft mud removal from sea bed areas outside the CMPs. It is worth noting that when the preliminary environmental assessments on the potential impacts of new land formation were carried out, it was assumed that dredging would be undertaken, which represents a worst-case scenario. It was subsequently proposed that only un-dredged methods, namely drained reclamation and DCM, would be used, so as to avoid dredging. Please refer to paragraphs 5.62 to 5.67 for the preliminary reclamation design proposed.

5.121 Quantitative assessments have been done to estimate early levels of operational air quality and aircraft noise impact from expanded airport operations on the surrounding communities. Additional qualitative assessments have also been carried out making use of the existing and comprehensive Chinese White Dolphin abundance database for North Lantau waters, with early work done on identifying a reclamation methodology that will facilitate reclamation over CMPs without disturbing the contained material within.

Preliminary Assessment on Air Quality

5.122 AAHK shares the community’s concerns about Hong Kong’s air quality and recognises that fresh air is an essential part of a quality living environment. As identified in Figure 5.44, there could be potential impact on air quality at both the construction and operational stages and both will be considered in full in subsequent studies. The potential impact during the operational stage at or on approaching three-runway capacity has warranted further preliminary assessment at this stage to give an early indication on how expected increases in ATMs and airport supporting activities may impact future air quality at local air sensitive receivers (ASRs), such as residential areas near HKIA. The current air quality legislative framework and requirements relating to air quality assessment in Hong Kong is outlined below.

5.123 Current Air Quality Legislative Framework

The Air Pollution Control Ordinance (APCO, Cap 311) is the principal law for managing air quality in Hong Kong. Under APCO, there is a set of Air Quality Objectives (AQOs) stipulating limits on seven main air pollutants, namely, Sulphur Dioxide (SO₂), Total Suspended Particulates (TSP), Respirable Suspended Particulates (RSP), Nitrogen Dioxide (NO₂), Carbon Monoxide (CO), photochemical oxidants, and Lead (Pb) (see Figure 5.45). The APCO requires the Government to aim to achieve AQOs and the Government, in turn, requires compliance with the AQOs as a pre-requisite; for example, for the issue of permits under the APCO for specified processes (such as for power generation) or for the issue of environmental permits under the Environmental Impact Assessment Ordinance.

Figure 5.45 : Hong Kong Air Quality Objectives

Pollutant	Concentration in micrograms per cubic metre ^[1] (Parts per million, ppm in brackets)				
	1 Hour ^[2]	8 Hours ^[3]	24 Hours ^[3]	3 Months ^[4]	1 Year ^[4]
Sulphur Dioxide	800 (0.3)		350 (0.13)		80 (0.03)
Total Suspended Particulates			260		80
Respirable Suspended Particulates ^[5]			180		55
Carbon Monoxide	30,000 (26.2)	10,000 (8.7)			
Nitrogen Dioxide	300 (0.16)		150 (0.08)		80 (0.04)
Photochemical Oxidants (as ozone) ^[6]	240				
Lead				1.5	

Notes:

- 1) Measured at 298°K and 101.325 kPa.
- 2) Not to be exceeded more than three times per year.
- 3) Not to be exceeded more than once a year.
- 4) Arithmetic mean.
- 5) Respirable suspended particulates means suspended particulates in the air with a nominal aerodynamic diameter of 10 micrometres or smaller.
- 6) Photochemical oxidants are determined by measurement of ozone only.

5.124 EIAs for Designated Projects are required to demonstrate compliance with AQOs at Air Sensitive Receivers (ASRs) near any development at both the construction and operational stages before the project proponent can commence development. ASRs are defined (per Annex 12 of the EIA Ordinance Technical Memorandum) as “any domestic premises, hotel, hostel, hospital, clinic, nursery, temporary housing accommodation, school, educational institution, office, factory, shop, shopping centre, place of public worship, library, court of law, sports stadium or performing arts centre.”

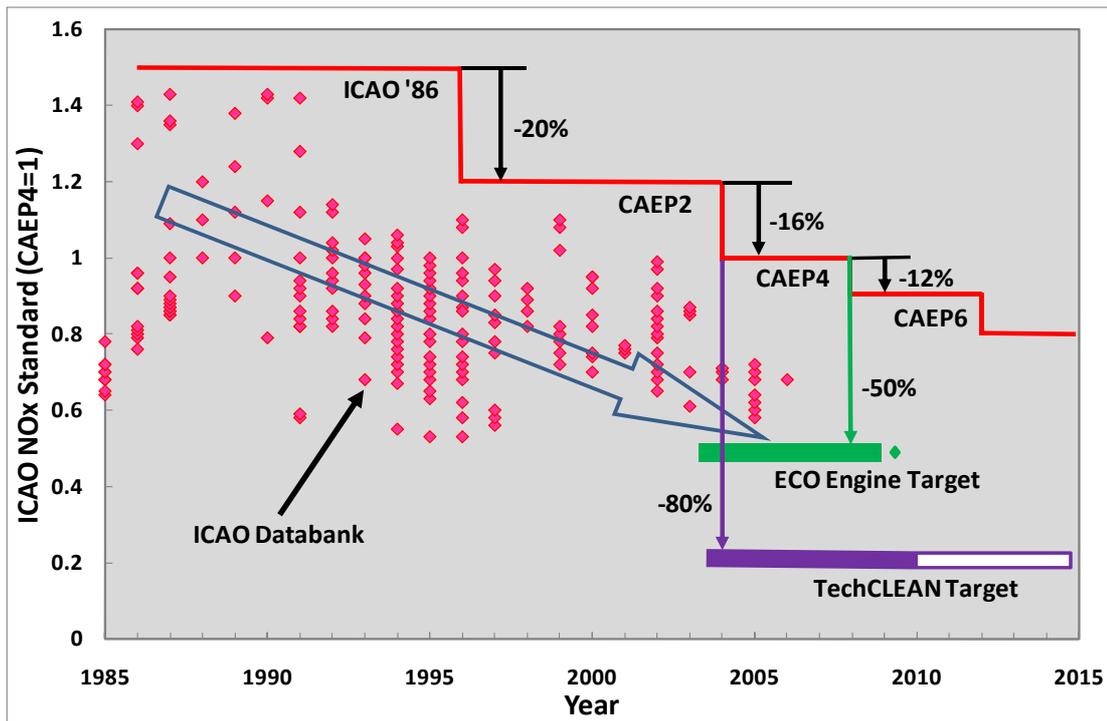
5.125 Airport-generated Emissions

Airport activities and operations such as air traffic movements, ground support equipment (GSE), motor vehicles, maintenance and catering activities etc, all generate air pollutant emissions.

5.126 Airport-generated air pollutants are very similar in nature to pollutants generated in urban areas, which include Carbon Monoxide (CO), Nitrogen Oxide (NO_x), Sulphur Oxide (SO_x), hydrocarbons (HCs) or Volatile Organic Compounds (VOCs) and particulate matter (particulates). According to an Airports Council International (ACI) 2009 Study, aircraft engines are usually the biggest source of both NO_x and other air pollutant emissions at an airport, with airport vehicles next. Off-airport emissions sources in the case of HKIA include nearby roads such as the North Lantau Highway, power stations, marine traffic and broader regional inputs from the PRD region.

5.127 The major air pollutant generated by airports is NO_x emissions from aircraft during landing and take-off (including climb-out, final approach and taxiing modes). All aircraft produced today are required to meet engine certification standards adopted by ICAO. The first standards for NO_x were adopted in 1981 and made more stringent in 1993, 1999 and 2004. Based on the reviewing work of the Organisation’s Committee on Aviation Environmental Protection, the medium and long-term technology goals for NO_x are developed. Relative to midterm goals (2016), the group estimated a 45% reduction from the current standards set in 2004. As for the long term goal (2026), it estimated that a reduction of some 60% would be attainable under specific pressure ratio conditions. Figure 5.46 illustrates historical and expected future improvements in aircraft NO_x emission standards.

Figure 5.46 : ICAO NO_x Criteria Including Target Values for Research and Development



Note: ICAO – International Civil Aviation Organization
 CAEP – Committee on Aviation Environmental Protection
 NO_x – A generic term for Nitric Oxide and Nitrogen Dioxide
 Source: Japan Aerospace Exploration Agency, 2008

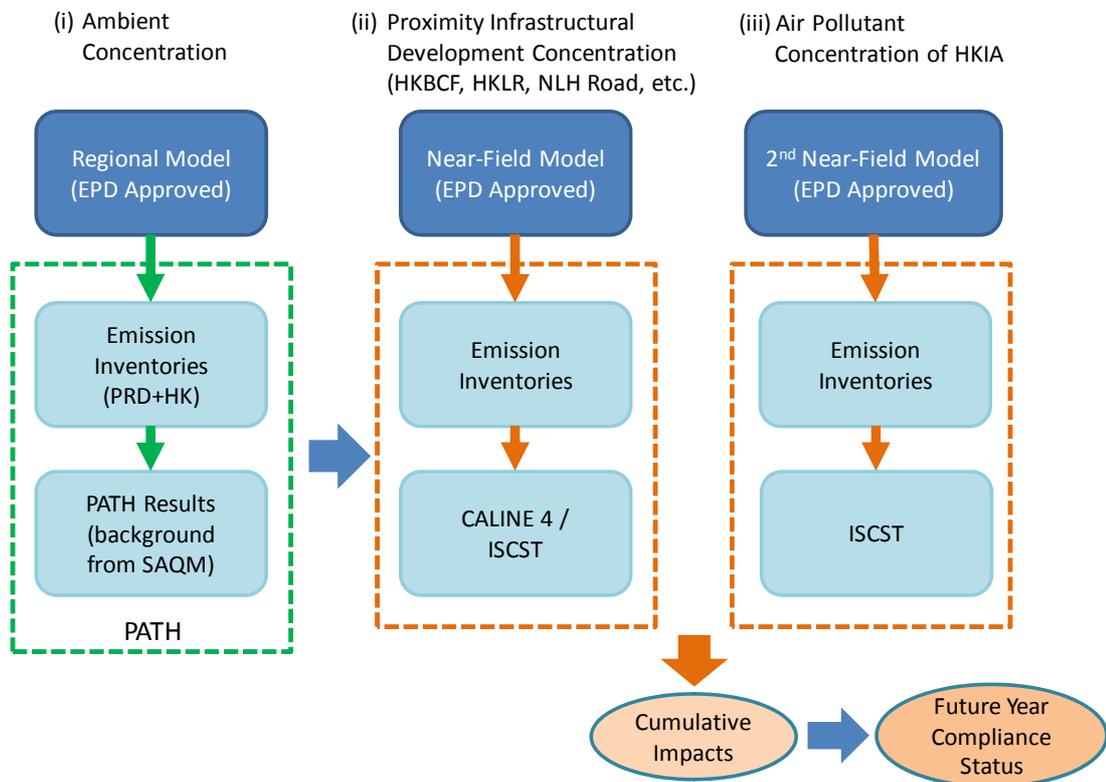
Approach used to assess air quality impact of HKIA

5.128 EPD provides clear guidance on acceptable methodologies and modelling tools for completing air emissions inventories and dispersion models. The principles of these have been adopted in this preliminary work and in the context of the interim review have allowed:

- Estimation of ambient pollutant concentrations from local emissions sources including power plant emissions, vehicular emissions and regional sources from PRD which are determined by using a regional air quality prediction model developed by EPD – the “Pollutants in the Atmosphere and their Transport over Hong Kong” (PATH) model.
- Estimation of proximity infrastructural development pollutant concentrations from vehicular emissions sources from North Lantau Highway (NLH), Hong Kong Boundary Crossing Facilities (HKBCF, Hong Kong Link Road (HKLR), Tuen Mun – Chek Lap Kok Link (TMCLKL) and local roads inside Tung Chung and the airport island which are determined by using a near field model accepted by EPD – the “California Line Source Dispersion Model Version 4” (CALINE 4) model.
- Estimation of project pollutant concentrations of emissions sources related to airport operators including landing and take-off ratios, and emissions from ground support equipment, auxiliary power units (APU), car parks, engine testing, fuel tanks, fire training, catering and helicopters established by a near field model also accepted by EPD – the “Industrial Source Complex Dispersion Model IV Short Term” (ISCST) model.

5.129 The way in which these modelling components combine to give a cumulative impact based on different input criteria is illustrated in Figure 5.47 below.

Figure 5.47 : Cumulative Impact based on Different Input Criteria



Source: SAQM stands for "Multi-species photochemical air quality model" – used for Pollutants Transport & Chemistry Modelling

5.130 The preliminary analysis has referred to the assumptions and methodologies in the recent EIA reports of HKSAR government’s infrastructural projects near HKIA, but with air traffic movements scaled up to 620,000 ATMs per year to roughly simulate airport emissions from a three-runway system at design capacity. This is intended to give an early indication of how future “scaled up” airport emissions may affect nearby Air Sensitive Receivers (ASRs).

5.131 Results and Compliance Status

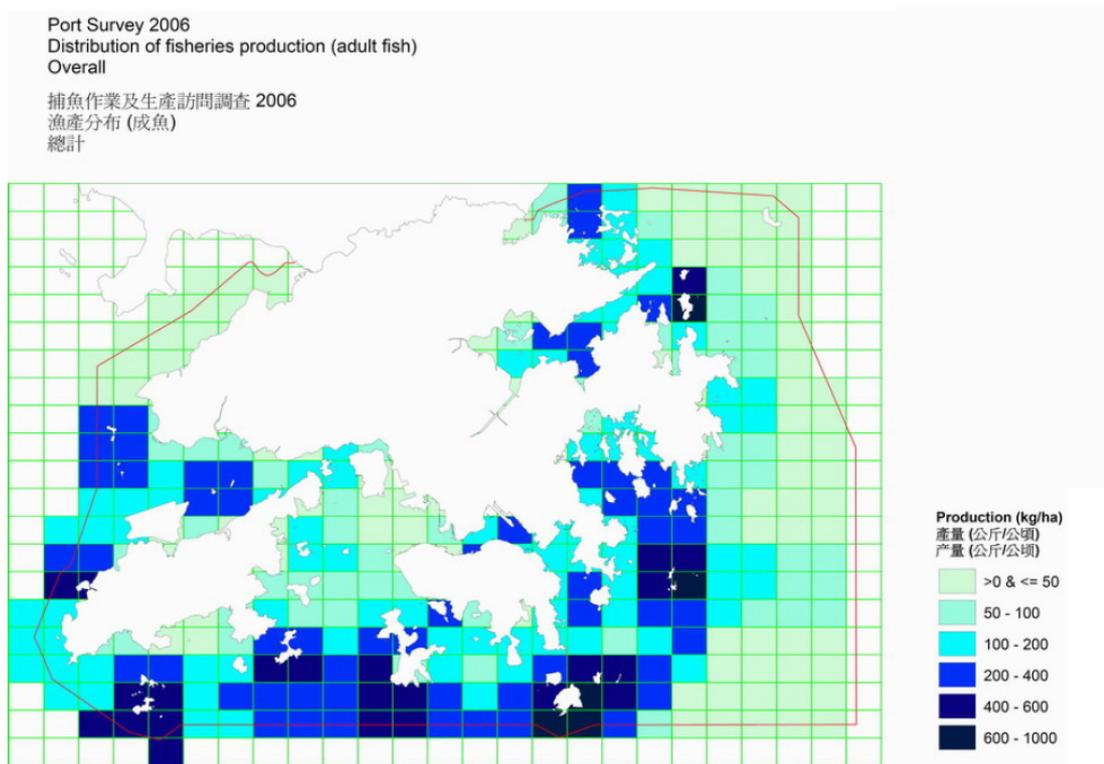
The preliminary analysis predicted that only the Midfield area on the airport island would experience concentration of NO₂ exceeding the limits (24-Hour NO₂ and/or Annual NO₂) in 2030, according to the current AQO criteria. However, as the ASRs locating in the Midfield area would all be commercial buildings, their air conditioning and mechanical ventilation designs are expected to be able to include appropriate gas filters to satisfy indoor air quality requirements for the buildings’ occupied interior spaces. The projected cases where NO₂ exceeded the allowable limits at on-airport commercial buildings are not of major significance under the Air Pollution Control Ordinance. The preliminary

analysis did not predict any breach of the current AQOs at the off-airport ASRs representing residential areas.

- 5.132** If Option 2 (three-runway system) is to be taken forward to the EIA stage, the airport emissions inventory and dispersion modelling exercise to be conducted for the three-runway airport layout at maximum operating conditions will adhere fully to the clear EPD guidance on acceptable methodologies and modelling tools for completing air emissions inventories and dispersion models. Future assessments will also make use of the best available information and assumptions for potential emissions reductions. It will also project the worst-case air pollutant levels at nearby ASRs against the prevailing AQOs that are expected to be in effect by 2030.

Preliminary Assessment on Fisheries

- 5.133** The scoping exercise identifies issues requiring a thorough assessment at both the construction and operations stages. Reclamation and permanent loss of marine area may affect fisheries' resources and fishing operations within the project area and in adjacent waters. The assessment was conducted by reviewing existing information related to culture and capture fisheries (such as the Ma Wan Fish Culture Zone) and capture fisheries (in the North Western Water Control Zone). For example, the 2006 Port Survey (AFCD, 2006), which identified levels of fisheries production and fishing activity within Hong Kong waters, found that the waters north and north-west of HKIA support a 'medium' value of fisheries production (medium-low fisheries production and fishing activities) within the survey grids affected by the Option 2 new land area (see Figure 5.48). The permanent loss in fisheries production is preliminarily estimated to be around 0.08% of Hong Kong's yearly production (58,700-117,400 kg loss).
- 5.134** If Option 2 is taken forward, the impact on fisheries will be considered in full accordance with statutory requirements in subsequent studies, including appropriate measures to reduce impact on fisheries to acceptable levels. Means for formalising compensation for capture and culture fisheries that may be impacted by new reclamation and/or construction works are clearly prescribed and these are likely to be applicable.

Figure 5.48 : Distribution of Fisheries Production (adult fish)

Source: Agriculture, Fisheries and Conservation Department, 2006

Preliminary Assessment on Marine Ecology

- 5.135** The scoping exercise identified likely impact on marine ecology, principally from marine work required for new land formation at the construction stage and from the permanent loss of sea bed and marine habitat thereafter.
- 5.136** The areas examined included the North Western Water Control Zone (WCZ), North Western Supplementary WCZ, Deep Bay WCZ and Western Buffer WCZ as designated under the Water Pollution Control Ordinance (WPCO). Sensitive areas that could be impacted by the project include coral sites within the WCZs, the Sha Chau and Lung Kwu Chau Marine Park, intertidal habitat zones of horseshoe crabs, coastal seagrass beds and the artificial reefs deployed in the Airport Marine Exclusion Zone (MEZ). A desktop literature review has established the conditions of the physical environment and the general ecological profile for impact assessment. In the desktop study process, no significant information gap was identified for a focused quantitative assessment at this preliminary stage.
- 5.137** It should be noted that much of the footprint of the proposed reclamation has been subject to substantial human disturbance in the past and is not known to be of particularly significant ecological value.

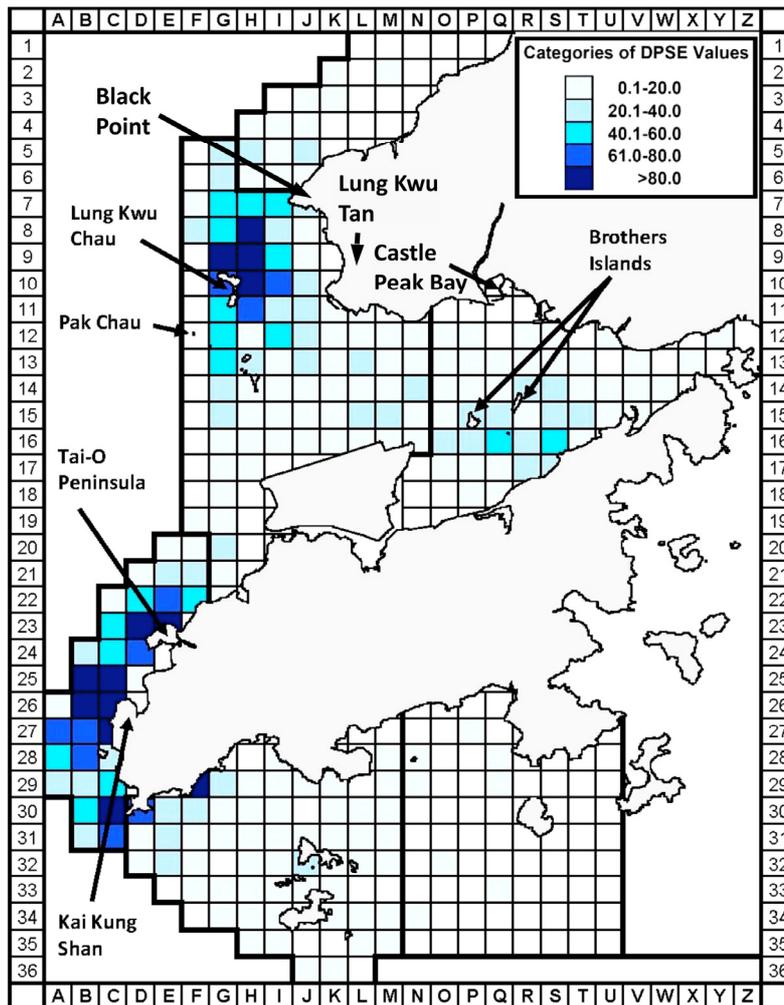
Preliminary Assessment on Chinese White Dolphins

- 5.138** Chinese White Dolphins (CWD), or Indo-Pacific Humpback dolphins (*Sousa chinensis*), can be found from southern China and northern Australia in the east to South Africa in the west. The local population size in Hong Kong waters is estimated to be about 100-200 individuals depending on the time of year⁶², with CWDs in Hong Kong being largely located within north and west Lantau waters. In the wider Pearl River Estuary, it is estimated that there are at least 2,500 CWDs⁶³.
- 5.139** The potential impact on CWDs includes the reduction of habitat, disruption of breeding and calving areas, and disturbance of CWD activities including feeding and socialising. These disturbances could be generated during both the construction and operational phases. Potential impact can be alleviated by minimising the extent and duration of disturbance and by avoiding or minimising direct impact on known important dolphin habitat areas – identified through long-term analysis of CWD distribution and abundance patterns.
- 5.140** The Agriculture, Fisheries and Conservation Department's (AFCD) current database on CWDs in north Lantau waters and in the Pearl River Delta has been reviewed, particularly the distribution range and abundance in the proposed area of airport expansion. With over 13 years of monitoring, dolphin behaviour, seasonal use and abundance in north Lantau waters is relatively well understood. This preliminary work has referred to the database in considering the risks posed to CWDs from both the marine work required for reclamation – in particular the short-term elevation in suspended solid concentrations from reclamation activities and potential impact from actual construction activities – as well as from permanent loss of habitat as a result of new land formation.
- 5.141** The CWD distribution and abundance surveys have identified that CWDs are widely distributed throughout northwest, northeast, west and southwest Lantau, while they are rarely observed in the Deep Bay, southeast Lantau and Lamma areas. CWD sightings (and the areas of highest abundance) are common in the waters east of Lung Kwu Chau, between Lung Kwu Chau and Black Point, near Pak Chau, around the Brothers Islands and throughout the west Lantau area. Abundance is especially high along the stretch of waters between the Tai O Peninsula and Kai Kung Shan. CWDs are much less frequently observed in waters off Castle Peak Bay, Lung Kwu Tan, north of the HKIA platform and in northeast Lantau waters. Specifically around the existing airport platform, moderate to low abundance is evident extending several kilometres to the north and northwest, with slightly higher abundance noticed off the northeast corner of the airport platform (see Figure 5.49).

⁶² Agriculture, Fisheries and Conservation Department 2007 Study

⁶³ Chen, T., S.K. Hung, Y.S. Qiu, X.P. Jia, and T.A. Jefferson. 2010 Distribution, abundance, and individual movements of Indo-Pacific humpback dolphins (*Sousa chinensis*) in the Pearl River Estuary, China. *Mammalia* 74: 117-125.

Figure 5.49 : Chinese White Dolphins Sightings



Note: Density of Chinese white dolphins with corrected survey effort per square kilometres in waters around Lantau Island, using data collected during 2002-2009. DPSE = no. of dolphins per 100 units of survey effort.

Source: Agriculture, Fisheries and Conservation Department

5.142 In recent years, studies have identified that the period between April to August is more important for calving, and mother-calf pairings may be more sensitive when they are subject to environmental stress such as underwater noise, increased marine activities and marine-based construction activities. Surveys show that areas in west Lantau have the highest number of newborn calf sightings. Specific areas identified as having higher densities of newborn calves include areas east and west of Lung Kwu Chau, near Tai O, Peaked Hill and around the tip of Fan Lau⁶⁴.

5.143 In broad terms, the overall impacts of airport expansion on CWDs depend on both the total size of the reclamation and its proximity to areas of known importance to CWDs. This preliminary work has considered only the existing database of CWD information, without conducting additional survey work. A thorough assessment of the overall

⁶⁴ Hung, S. K. (2008). Monitoring of marine mammals in Hong Kong waters – data collection. Final report submitted to the Agriculture, Fisheries and Conservation Department, Hong Kong.

environmental acceptability of Option 2 (three-runway layout) will be completed in subsequent studies.

5.144 Formation of new land will result in the permanent loss of CWD habitat. Airport expansion to the north would overlay a marine area of known low CWD abundance; nonetheless, land formation activities would require mitigation. Over time, numerous measures have been developed to minimise the immediate effects of marine construction activities on CWDs. With the proposed scale of reclamation required, there is also likely to be a need to compensate for the permanent loss of marine habitat or to find other ways to mitigate this loss. An important aspect to consider is that the Third Runway layout, while in an area of relatively low CWD abundance, may have the effect of interfering with CWD travelling “corridors”. These are the routes that CWDs are thought to take when passing between areas of very high abundance, for example, between the Tai O Peninsula and Kai Kung Shan and the Lung Kwu Chau and Black Point high use areas. Further comprehensive assessments on such aspects will be completed in subsequent studies.

5.145 Mitigation Measures

There are a number of well-established mitigation measures, adjusted methodologies and working controls in Hong Kong to mitigate the impact of construction on dolphins. All options for minimising the impact of significant reclamation on CWDs and all other possible mitigation measures will be explored and developed, should the three-runway option be taken forward to the EIA stage after the public consultation.

5.146 An initial summary of measures that have often been recommended and deployed to minimise impact on marine mammals during marine works in Hong Kong is outlined below:

- Mitigation Principles

In considering the application of mitigation measures intended to offset environmental impact, the principles of “avoid, minimise, mitigate and compensate” are of particular relevance.

Avoidance

Every effort should be taken to avoid, as far as possible, any impact at all.

Minimisation

Every effort should be taken to minimise impact where possible, for example by minimising reclamation size or reducing the duration of work.

- Mitigation Measures

There are a range of effective mitigation measures in relatively standard use in marine based projects in Hong Kong and these include:

- Bubble Curtains

Piling is not recommended as the construction method for land formation as it would generate underwater noise with high energy at frequencies which CWDs are sensitive to. Preliminary engineering feasibility assessments have identified that marine piling is not required for any of the options put forward. In case piling work is ultimately required, a bubble curtain is recommended to reduce underwater noise. Bubble curtains anchored to the sea bottom around piles could effectively absorb sound generated from pile driving.

- Dolphin Exclusion Zone

A monitored exclusion zone of up to several hundred metres in size could be set up around dredging sites to reduce the chances of any adverse impact on CWDs. The work site is generally closely monitored for at least 30 minutes prior to the start of dredging, and if dolphins are sighted, dredging is delayed until CWDs have left the exclusion zone.

- Silt Curtains

To avoid the spread of suspended solids which are re-suspended back into the water column during dredging and filling operations, silt curtains could be used around work areas wherever feasible. Regular inspection of the effectiveness of silt curtains would be required. A water quality monitoring programme, usually implemented in association with such marine work, would help to ensure that water quality in the vicinity of the work site meets the required standards.

- Dolphin Monitoring

Monitoring the density and behaviour of CWDs before, during and after the period of construction work is likely to be recommended through the EIA process. This would help check if the other mitigation measures employed have been effective in reducing disturbance to CWDs and will also spot any longer-term change in behaviour.

It is recommended that CWDs be monitored in three phases: pre-disturbance (i.e. baseline phase), disturbance (i.e. construction phase), and post-disturbance (i.e. operational phase). Survey techniques should be held constant from phase to phase with survey equipment and personnel ideally being the same as well. Any apparent differences in density between survey phases should be statistically analysed for trends.

Compensation

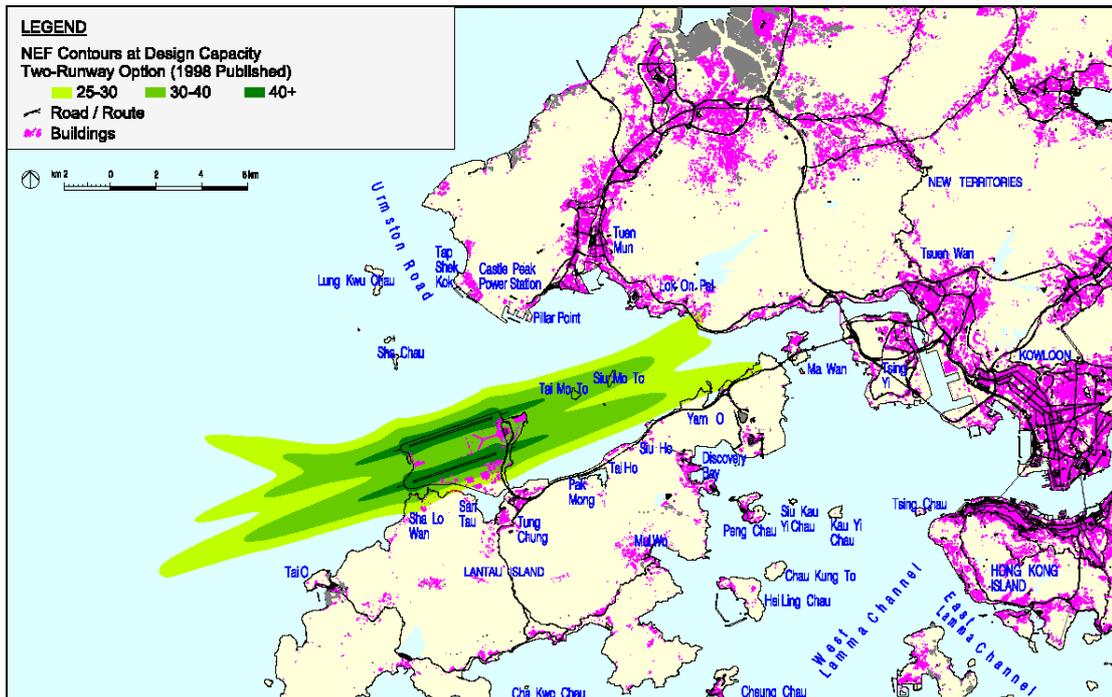
From a CWD conservation point of view, establishing designated Marine Park areas has historically been pursued as further compensation, generally as part of a suite of mitigation measures for any project.

5.147 As these measures have been identified from the review of current studies only, their relevance and applicability to the current project will be further evaluated, taking into account the design of the project and findings of the detailed EIAs to be undertaken in subsequent studies after the public consultation.

Preliminary Assessment on Noise

- 5.148** Although construction noise is expected to arise from land formation activities, it is not expected to be a major issue as the reclamation area is distant from nearby Noise Sensitive Receivers. This aspect will be studied in line with statutory requirements during subsequent studies.
- 5.149** Residential communities near the airport and its flight paths are subject to varying degrees of aircraft noise. Because operation of the Third Runway is likely to require new and amended arrival and departure flight paths, preliminary assessments of aircraft noise have been completed to determine its likely impact.
- 5.150** Moving HKIA from Kai Tak to Chek Lap Kok in 1998 had the major benefit of removing intrusive aircraft noise from over 350,000 residents living under or near Kai Tak's flight paths. Flight paths of HKIA's two-runway operation are mainly over water, creating less impact on residents and enabling 24-hour airport operation.
- 5.151** In Hong Kong, aircraft noise evaluation is conducted in accordance with guidelines established by the International Civil Aviation Organisation (ICAO) and the US Federal Aviation Administration (FAA). The FAA's Integrated Noise Model (INM) is an internationally accepted tool for assessing airport noise exposure, which is used to generate Noise Exposure Forecast (NEF) contours around the airport and its flight paths.
- 5.152** The INM combines accepted mathematical methods for the calculation of aircraft noise with an extensive database of aircraft acoustic and performance information. It estimates noise exposure by factoring in the duration of flyovers, peak noise levels, tonal characteristics, and the number of aircraft movements during both daytime and night-time periods. It penalises night-time flights; one night-time flight is equivalent to 16 daytime flights (of the same aircraft type). Based on these factors, a NEF — a composite index figure representing the cumulative aircraft noise exposure level per day (averaged over a year) — can be calculated.
- 5.153** NEF is a tool for land use planning, primarily used to define areas where the construction of certain types of building is "acceptable" or "unacceptable". Contours are defined for 25, 30 and 40 NEF levels. According to the Hong Kong Planning Standards and Guidelines (HKPSG), all land uses are considered acceptable if they fall outside the 25 NEF contour. It is noteworthy that these standards apply to buildings that rely on open-window ventilation. Land uses that do not rely on open-window ventilation—for example, those that utilise air conditioning — are permitted to be developed within the 25 NEF contour.
- 5.154** The most recent NEF contours for HKIA (see Figure 5.50) were published in 1998. These NEF contours represent a projection of the existing two-runway airport layout at design capacity.

Figure 5.50 : Projection of Two-Runway NEF Contours for HKIA at Design Capacity
(Published in 1998)

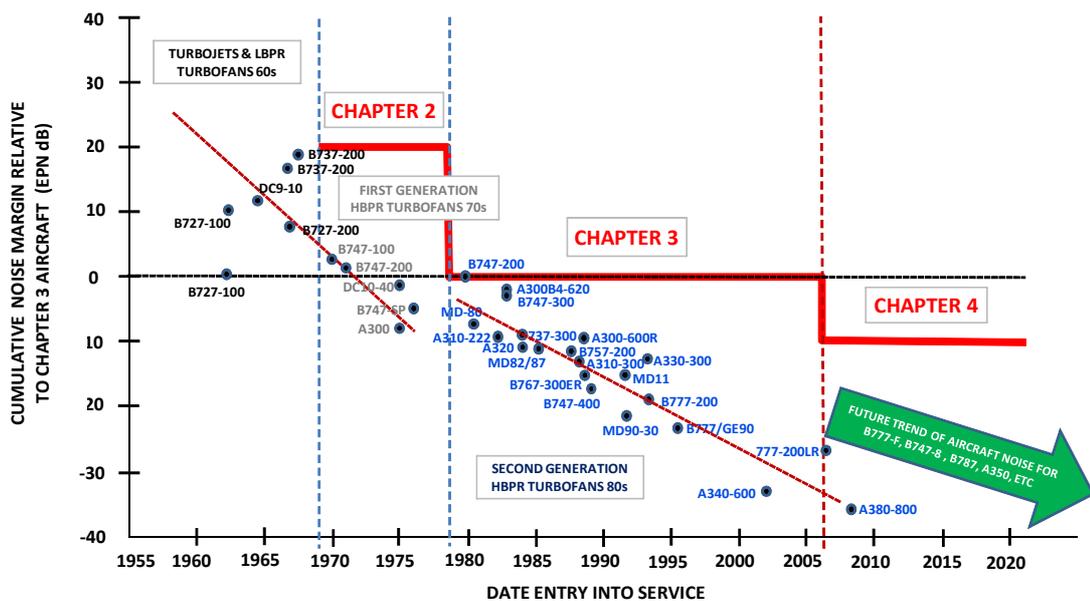


- 5.155 The NEF forecast will be formally updated as part of the future EIA based on updated flight path design, aircraft operational forecast, runway utilisation plan and practical assumptions of night-time noise mitigation measures for a three-runway system.
- 5.156 Due to the importance of the impact of aircraft noise, projections of preliminary noise contours have been completed. More information on the preliminary NEF contour forecast is in Appendix 4. The assessment has proportionally increased existing flight operating patterns to the projected annual aircraft movements of 620,000 at the design capacity of the three-runway system (see Figure 5.51).

This is the result of:

- a) Improvements in aircraft and engine technology over the past decades, resulting in quieter, more efficient aircraft engines and airframes have reduced aircraft noise dramatically over time, and this trend is expected to continue. Figure 5.53 indicates the noise levels of commercial aircraft coming into operation over the last 50 years. The red line in Figure 5.53 shows the stepped ICAO aircraft noise certification requirements that have resulted in aircraft noise reduction over time. The Chapter 2 aircraft noise standard was introduced in 1969, but most Chapter 2 aircraft have now been phased out. All aircraft operating into Hong Kong are at least Chapter 3 compliant, and the ICAO requires all new aircraft types applying for type certification (from 1 January 2006 onwards) to be Chapter 4 compliant. Chapter 4 compliant aircraft are at least 10 decibels quieter than Chapter 3 – compliant ones, based on a cumulative measurement over the three phases of flight (approach, takeoff under full power, and overflight) tested at certification. Accepted acoustic standards are that a 10 decibel reduction is perceived as a roughly 50% decrease in noise volume. It is worth noting that many certified Chapter 3 aircraft comply with the Chapter 4 aircraft noise standard.

Figure 5.53 : Quieter Aircraft Entering Service over Time



Source: Pratt & Whitney & ICAO

- b) The airline industry consensus is that all Chapter 3 noise standard-certified aircraft will be phased out in 20 years' time. By 2030, all night-time flight operations at HKIA will utilise new-generation aircraft (for example, B787, A350, B747-8F and B777F), which are expected to be at least as quiet if not significantly quieter than the most stringent current Chapter 4-certified aircraft noise level standard. New aircraft such as the B777 and A380 have already achieved this standard.

- c) Changes to current night-time arrival and departure procedures, along with the development of new arrival flight paths:
- Under current noise abatement procedures implemented by the Civil Aviation Department (CAD) since October 1998, about 90% of night-time flight operations (between 0000 – 0700 hours) are required to use Runway 07 direction for both arrivals and departures (i.e. landings from the southwest and takeoffs to the northeast, with north-easterly departures turning south via the West Lamma Channel). This arrangement avoids night-time flights over Sha Tin, Tsuen Wan and Sham Tseng;
 - CAD indicates that under the three-runway option, alternate runway direction usage (between Runway 07 direction, west to east, and Runway 25 direction, east to west) will be possible from an ATC operations point of view. As departures are noisier than arrivals, this will allow more departures to leave to the west during periods with more departures and vice versa when there are more arrivals; and
 - To continue minimising night-time flights over Sha Tin, Tsuen Wan and Sham Tseng. CAD has indicated that since alternate runway direction usage will allow increased arrivals from the east, new arrival flight paths (via the West Lamma Channel) can be explored for night-time flight operations that will allow the majority of night-time departures and suitably equipped arriving aircraft to take place over water, hence minimising flights over populated areas.
- d) The South Runway will be assigned to standby mode where possible during the night-time period from 23:00 to 06:59 in order to minimise the aircraft noise impact along North Lantau shoreline. This assumption is made on the basis of significant tapering of forecast demand during 23:00-08:00 which could be adequately met by the remaining two runways during 23:00-00:59 and even by a single runway in mixed mode during 01:00-08:00 when routine maintenance of the three runways will be carried out in turn. The increase of HKIA's runways to three will provide the flexibility to minimise the use of the First Runway during 23:00-08:00, crucial to reducing aircraft noise impact along the North Lantau shoreline. This would be impossible under the two-runway option.

Preliminary Assessment on Water Quality and Hydrodynamics

5.158 The scale of the reclamation proposed in Option 2 – 650 hectares – has the potential to significantly impact water quality during the several years required for land formation work. During the operational phase, an aspect of significance is the potential change to the hydrodynamics and water flow patterns around any new land mass. Should tidal flows and water circulation be reduced, there could be implications on water quality, for example due to inadequate flushing of pollutants from embayed areas. The significant size of the new land area can potentially influence broader water flow patterns in Hong Kong waters.

5.159 Water Flow Patterns

Preliminary work has included some early assessment based on hydrodynamic and water quality models, both to give an indication of the overall acceptability of any changes to tidal flows and hydrodynamics caused by the new land area, and to assist in the qualitative environmental comparison of the three-runway layout options. 3-D hydrodynamics models (Delft Hydraulics) have been used in the preliminary assessment of options, covering both wet and dry seasons with 10 vertical model layers using a grid size of 200m x 200m.

5.160 Modelling results suggest that the reclamation proposed in Option 2 will not significantly impact large-scale tidal flows, although some local scale changes were identified around the individual footprints (for example, small increases in flow speed at the western end of the Third Runway). Flushing capacity in major flow channels such as Urmston Road to Ma Wan Channel, was not shown to change significantly and impact on the airport channel was low. No substantive impact on broader Hong Kong waters was shown. These vital parameters will be assessed fully in accordance with statutory requirements in subsequent studies.

5.161 Water Quality

Dredging and filling phases of marine construction may adversely impact on water quality by resulting in increased Suspended Solid (SS) concentrations in the water column, which can directly influence marine ecology. SS re-deposition can affect ecologically sensitive receivers (i.e. corals, sea grasses and certain other marine flora and fauna).

5.162 Preliminary water quality modelling work has been undertaken using a Delft3D-WAQ model, focusing on SS suspension and sediment plumes that could be expected from dredging work associated with land formation. This represents a worst-case scenario in terms of the number and types of dredging equipment that could be anticipated and based on time series plots covering complete spring-neap cycles focusing on selected water sensitive receivers (WSRs), such as the Sha Chau and Lung Kwu Chau Marine Park and coastal areas near Tai Ho Wan and Sha Lo Wan.

5.163 The early water quality modelling indicated that the Option 2 preferred layout would have the least impact on WSRs. It is projected that SS levels are marginally exceeded at certain WSRs but these can probably be reduced to acceptable levels with the adoption of well-trying and tested mitigation measures. This preliminary analysis will be reviewed and assessed fully in accordance with statutory requirements in subsequent studies.

5.164 Dredging of Soft Sediment

During the construction of HKIA, a “dredged reclamation” approach was adopted requiring the removal and disposal of soft marine mud layers prior to infilling with firmer reclamation material on the underlying firm sand of the deeper sea bed. The preliminary water quality monitoring work summarised above has estimated sediment plumes based on the assumption of a dredged reclamation approach as a worst-case. However, because of the environmental impact of soft sediment dredging, the preferred

reclamation approach now practised in Hong Kong is “drained reclamation”, a methodology that leaves the soft sediment of the surface layers in place. A surcharge/de-watering method to stabilise the *in-situ* softer material above the deeper firm sandy layer is implemented to stabilise and firm the soft surface layers prior to reclaiming above the stabilised seabed material.

5.165 Contaminated Mud Pits

A further potential challenge arises when land reclamation is considered over the area of contaminated mud pits (CMPs) to the north of the existing airport island (see Figure 5.31). These CMPs are managed by the Civil Engineering and Development Department (CEDD), and began operation in late 1992. They are the Government’s permanent solution for the disposal of contaminated soft marine mud. The marine mud was taken from the inner harbour and other areas to make way for earlier reclamations in Hong Kong. The CMPs hold contaminated material that is contained (“capped”) under a layer (about two metres) of clean material at seabed level. In considering the viability of forming new land over the CMPs, the presumption is that the contained contaminated material must remain in place because these facilities are a permanent solution and removing materials prior to building over the pits is not a realistic option.

5.166 If interface or encroachment into the CMPs is required, the contaminated material and water from the CMPs must be contained during the process of land formation. The drained reclamation approach now preferred in Hong Kong would not be possible, mainly because the surcharge/dewatering methodology, by its nature, squeezes interstitial water from the soft material as an integral part of the consolidation process – this is not acceptable given the nature of the material contained in the CMPs. The preliminary engineering feasibility for airport development has therefore investigated various ground stabilisation and construction methodologies that are able to:

- Sufficiently firm the soft material in the CMPs in-situ, and
- Ensure there is no leaching of material or interstitial water from contained material within the CMPs to surrounding waters.

5.167 One methodology that appears capable of achieving this after detailed consideration of several possible alternatives is Deep Cement Mixing (DCM).

5.168 Areas of reclamation outside of the CMPs are expected to use the drained reclamation approach wherever possible, so as to minimise the extent of soft sediment dredging prior to land formation. For areas outside the CMPs but beneath the runway, the marine sediment will be treated with DCM in order to meet the more stringent performance criterion. Sloping seawalls are proposed to be erected on a non-dredged formation or over DCM treated CMPs. The engineering method for land formation will be further studied during the EIA phase.

5.169 Future engineering and environmental trials of DCM will be done to quantify the potential for additional water quality impact from the methodology, and to determine its acceptability for firming the area of CMPs falling within the Option 2 airport footprint. Should DCM be used above CMPs, it is expected to provide an effective and permanent cap for the contained contaminated material once reclamation is completed.

Other Environmental Aspects

5.170 It is recognised that some of the environmental aspects identified in Figure 5.44 have not been elaborated upon in this section, although most were considered in the qualitative comparison of available expansion options (see Appendix 3 for details). All the aspects identified and associated potential impacts will be considered fully in accordance with statutory requirements in subsequent studies.

Statutory Environmental Impact Assessment Process

5.171 It is recognised that the scoping of environmental aspects and the preliminary assessments being carried out do not replace the statutory EIA process prescribed in the EIA Ordinance. Should HKIA move forward with the three-runway development plan, a formal EIA will be completed in accordance with the criteria and stipulations detailed in the statutory process.

CHAPTER 6 ECONOMIC IMPACT ASSESSMENT

- 6.1** HKIA serves as much more than just an airport that meets people’s travelling needs. It has become an international aviation hub that creates enormous economic value for Hong Kong. Based on a Study by Enright, Scott & Associates (ESA), **the direct, indirect and induced contributions of HKIA to Hong Kong’s economy in 2008 accrue to HK\$78 billion⁶⁵ in value added, which is 4.6% of Hong Kong’s GDP— provide employment to 185,000 people, about 5.3% of Hong Kong’s working population.** As the Hong Kong economy continues to develop and HKIA traffic demand continues to grow, the economic contribution of HKIA will also keep increasing over time. For detailed methodology and assumptions used in the assessment of HKIA’s economic contributions, please refer to Appendix 5.
- 6.2** Experience overseas has demonstrated that airports have a significantly higher impact on the local economy⁶⁶ than other transport infrastructure and that investing in them provides very handsome economic returns. ESA has conducted analyses to assess the potential impact of the investments made in HKIA’s expansion on Hong Kong’s economy.
- 6.3** In general, an investment’s economic impact is measured by its direct, indirect, and induced contributions⁶⁷ to the economy, usually expressed in terms of “value added” (VA)⁶⁸ and percentage contribution to GDP in a certain year. In the context of HKIA, the terms used above can be elaborated as follows:
- (a) “Direct” contribution refers to employment and income generated by the aviation sector in Hong Kong including the direct operation of the airport, comprising organisations such as the Airport Authority (AAHK), airlines, air cargo terminal operators, catering operators, aircraft maintenance and services operators, etc., as well as non-aviation businesses at HKIA, including retail, food and beverage, hotels, and conventions and exhibitions;
 - (b) “Indirect” contribution refers to employment and income generated by the suppliers of goods and services to the direct activities of the aviation sector in Hong Kong and non-aviation businesses at HKIA, such as utilities suppliers, fuel suppliers, construction and cleaning companies, suppliers of food and retail goods, etc.; and
 - (c) “Induced” contribution refers to the employment and income generated by the spending of income by the direct and indirect employees on local goods and services, such as spending of AAHK employees, airline employees, utilities supplier employees, etc.
- 6.4** In estimating the relevant economic contribution components of airport investment, ESA has quantified both the direct and indirect value added (VA) impact of airport-related

⁶⁵ Throughout this chapter all figures in 2008 are in 2008 HK dollars. Other figures are in 2009 HK dollars unless otherwise stated.

⁶⁶ According to Economic Impacts of Hub Airports, a report commissioned by British Chambers of Commerce in July 2009, the wider economic benefits of hub airports can be 2 to 5 times that of rail.

⁶⁷ Many analyses also include estimates of catalytic benefits such as the impact on tourism, trade, productivity and business environment. The numbers reported in this document do not include such benefits.

⁶⁸ “Value added” is defined as the value of gross output less the value of intermediate consumption (the value of goods and services used up in the course of production) and includes direct, indirect and induced contribution.

activities. ESA has also adopted a set of VA “multipliers”⁶⁹ for selected sectors related to the airport in its calculations and estimated the VA generated from additional spending due to the income projected from the direct and indirect impacts mentioned above.

- 6.5** To ascertain whether investment in HKIA is worthwhile, the study has conducted analyses based on two widely used investment analysis tools: Economic Net Present Value (ENPV)⁷⁰ and Economic Internal Rate of Return (EIRR). However, the two options presented for analysis are widely divergent. One involves leveraging existing assets to serve additional demand, and the other involves heavy investment in building up new assets to serve additional demand. Given the significant difference in investment profiles and the well-recognised shortcoming of EIRR (it tends to favour projects with short-term paybacks at the expense of projects with longer paybacks regardless of the overall value generated by the project), ESA has recommended against conducting investment evaluation based on EIRR and has instead used ENPV.

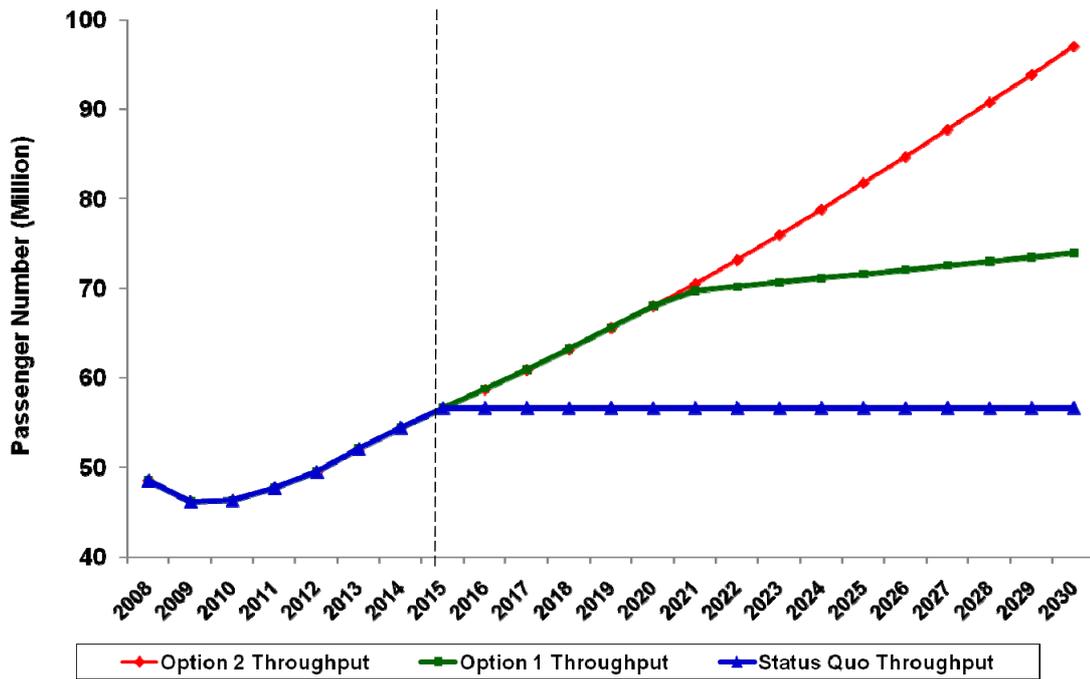
Economic Impact of Option 1 and Option 2

- 6.6** Future projections of the quantifiable economic impact of HKIA were generated for the two main investment options and were referenced to a “Status Quo” benchmark wherein already approved capital investments continue until 2014 but no further investment is made in capacity growth. In “Option 1”, capital investment is made to expand capacity in a two-runway configuration beyond 2015. In “Option 2”, capital investment is made to expand capacity of the two runways and also to construct a new Third Runway, with the first investment being made in 2012. For consistency, the investment evaluation period for both options is 50 years (2012-2061). In order to “stress test” the base analysis, pessimistic cases for Options 1 and 2 were developed by incorporating arbitrary assumptions versus main scenarios of 15% lower demand, 50% higher investment costs, and a declining value added to revenue ratio for aviation businesses.
- 6.7** The traffic forecast assumptions were based on the Master Plan consultant inputs presented in previous chapters of this report. Passenger and cargo throughput figures used for the analyses are illustrated in Figures 6.1 and 6.2.

⁶⁹ The VA multipliers comprise the sectors’ own ability to generate VA and the spillover effect to other sectors. The multipliers relating direct plus indirect value added to gross output or business receipts were provided by the Economic Analysis and Business Facilitation Unit of the Hong Kong SAR Government as broad working assumptions for the current economic impact analysis. These are produced based on the observed linkages between sectors and the resultant pattern of intermediate consumption, import leakages of the various economic activities, gross margin of external trade, the ratios of VA to gross-output and business receipts for the affected sectors in recent years. As these impact estimates are largely judgmental, they should only be taken as working assumptions for the current economic impact analysis, and should not be regarded as “official estimates” of the Government.

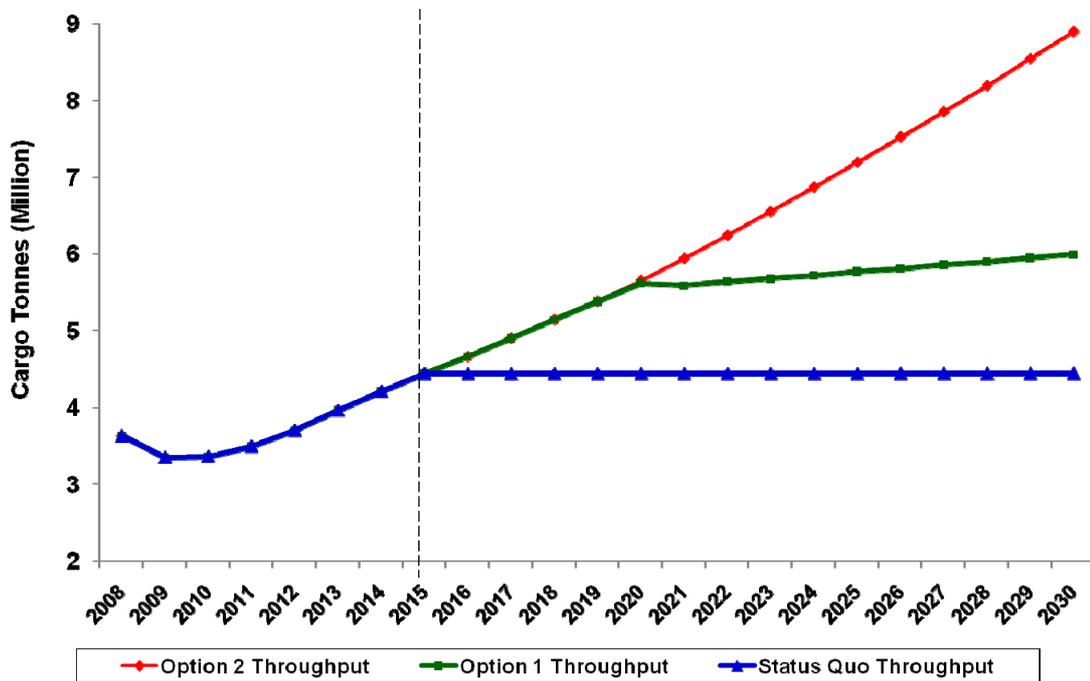
⁷⁰ For details on ENPV projection conducted, please refer to Appendix 6.

Figure 6.1 : HKIA Passenger Throughput



Source: Airport Authority Hong Kong, IATA Consulting

Figure 6.2 : HKIA Cargo Throughput



Source: Airport Authority Hong Kong, IATA Consulting

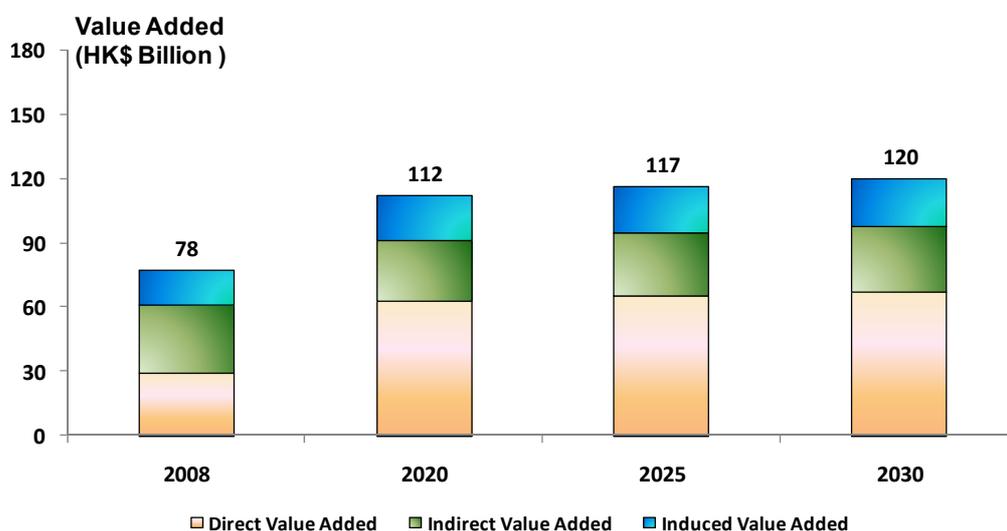
Economic Impact of Option 1 (Two-Runway System)

6.8 ESA estimated that the direct, indirect and induced contribution of HKIA to Hong Kong’s GDP in 2030 under this option will be HK\$120 billion, equivalent to around 3.3% of the HKSAR’s GDP forecast for 2030 (compared to 4.6% in 2008). Direct employment associated with HKIA would increase from 62,000 in 2008 to 101,000 in 2030. Indirect/induced employment would increase from 124,000 in 2008 to 143,000 in 2030⁷¹ (see Figure 6.3).

6.9 Based on an additional capital investment of HK\$23 billion⁷² under this option, and the corresponding stream of additional traffic up to 2061 (a 50-year life span is assumed for infrastructure), the ENPV⁷³ is estimated to be HK\$432 billion.

Figure 6.3 : HKIA’s Economic Contribution under Option 1

% HK GDP	4.6%	4.3%	3.7%	3.3%
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Employment* (Persons)	185,000	229,000	238,000	244,000
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Note: *Include estimated direct, indirect and induced employment.

Construction period economic impact excluded.

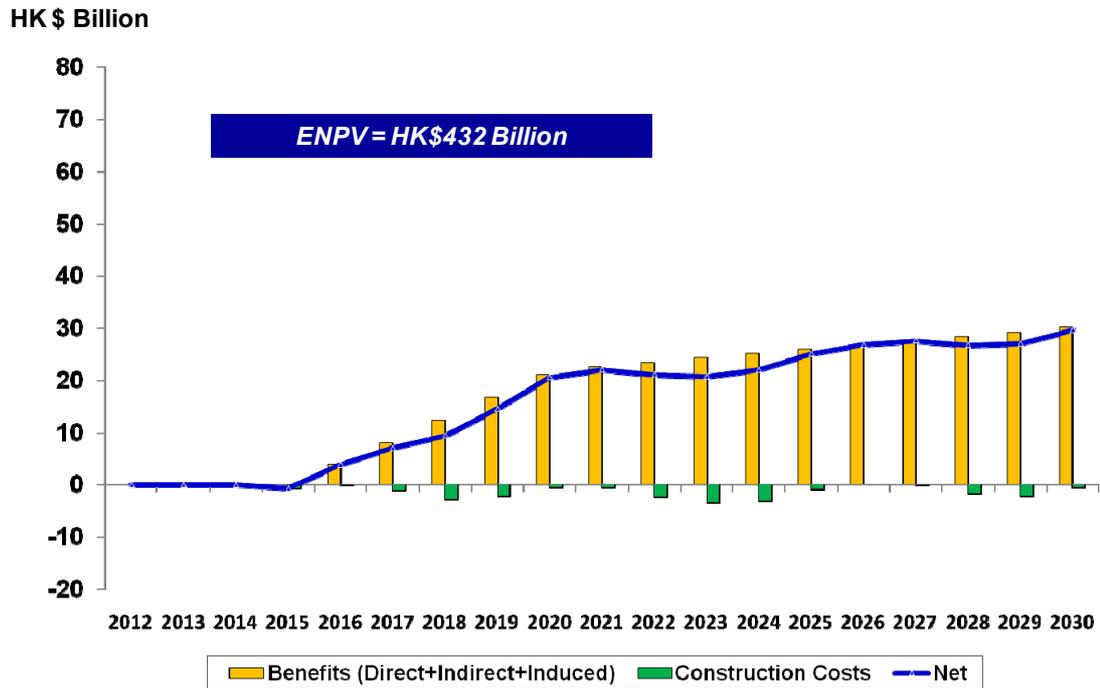
Source: Enright, Scott & Associates Ltd

⁷¹ Figures are rounded.

⁷² Capital investment of HK\$23 billion in 2009 dollars was used in the evaluation of economic impact to align with other information sources.

⁷³ The ENPV was calculated based on a discount rate of 4% for a 50 year return beginning 2012. The 4% discount rate is commonly used to assess the economic benefits of Hong Kong Government funded projects.

Figure 6.4 : Cost and Benefit Flows of Option 1



Note: ENPV is calculated based on 50-year return (till 2061) and discount rate of 4% which is used generally for Government infrastructure projects. Benefits are measured in value added. For simplicity, graph illustrates cash flow up to 2030 only.

Source: Enright, Scott & Associates Ltd

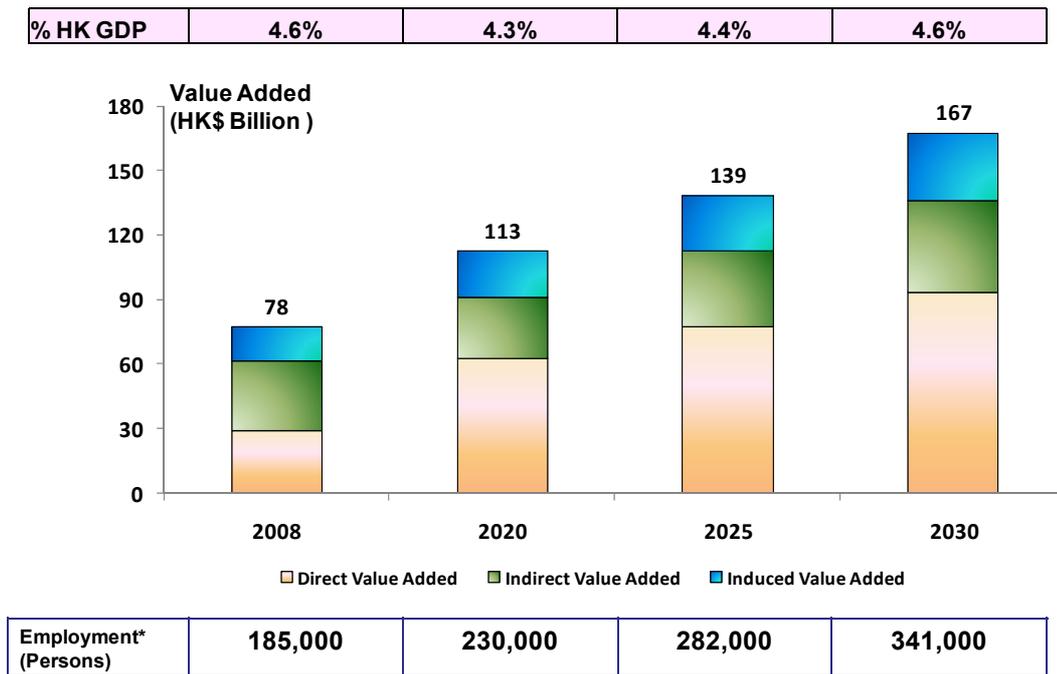
Economic Impact of Option 2 (Three-Runway System)

6.10 ESA estimated that with a capital investment of HK\$80 billion⁷⁴ under this option, the direct, indirect and induced contribution of HKIA to Hong Kong's GDP in 2030 will be HK\$167 billion, equivalent to around 4.6% of the HKSAR's GDP forecast for 2030 (compared to a contribution of HK\$78 billion, 4.6% in 2008). Direct employment associated with HKIA would reach 141,000 and indirect/induced employment would be about 199,000⁷⁵ (see Figure 6.5).

⁷⁴ Capital investment of HK\$80 billion in 2009 dollars was used in the evaluation of economic impact to align with other information sources.

⁷⁵ Figures are rounded

Figure 6.5 : HKIA’s Economic Contribution under Option 2

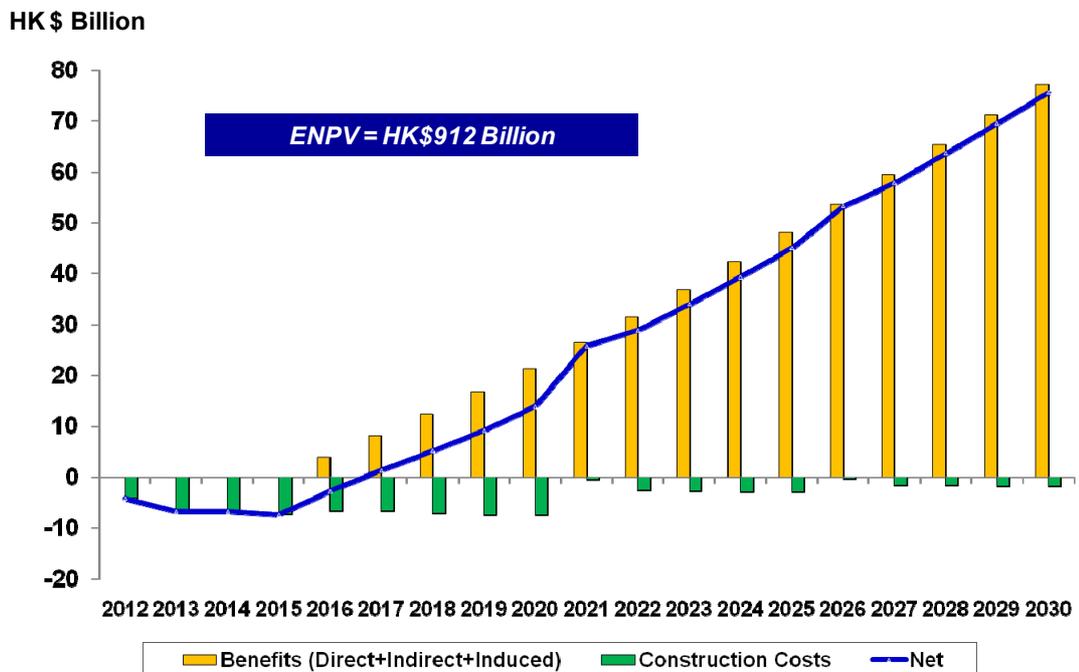


Note: *Include estimated direct, indirect and induced employment. Note: Construction period economic impact excluded.

Source: Enright, Scott & Associates Ltd

6.11 The ENPV up to 2061 under Option 2 is estimated to be HK\$912 billion.

Figure 6.6 : Cost and Benefit Flows of Option 2



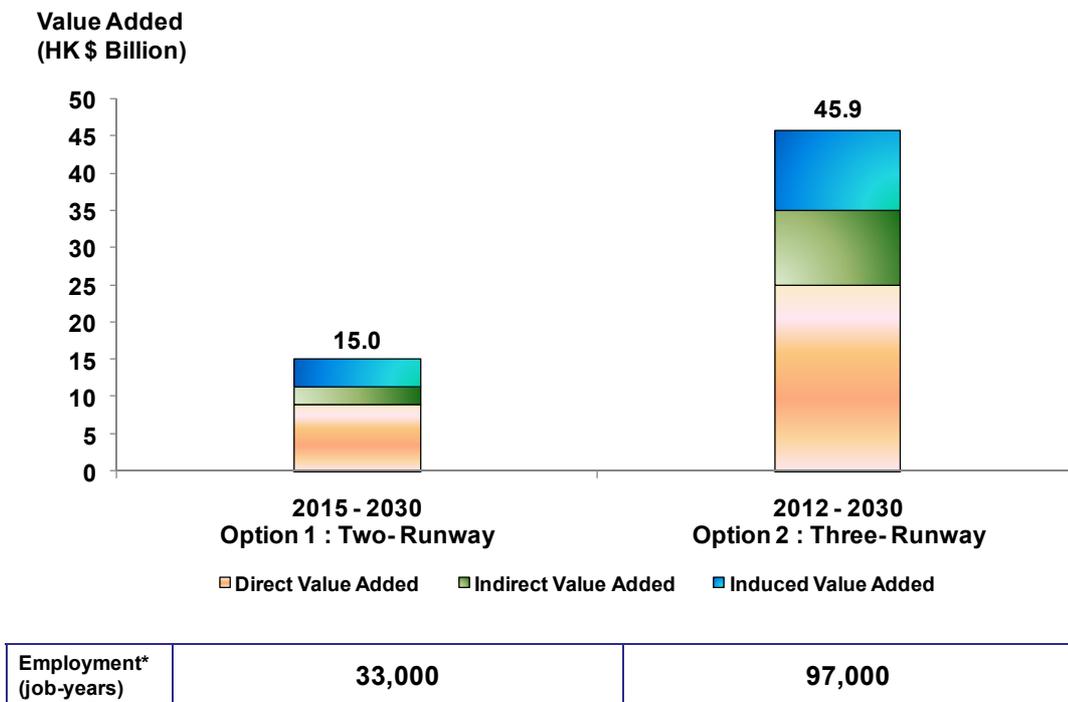
Note: ENPV is calculated based on 50-year return (till 2061) and discount rate of 4% which is used generally for Government infrastructure projects. Benefits are measured in value added. For simplicity, graph illustrates cash flow up to 2030 only.

Source: Enright, Scott & Associates Ltd

Economic Contribution during Construction Period

6.12 ESA estimated that during the construction period for both Options 1 and 2, there will be an economic impact as well as employment generated by the related construction and engineering activities. These impacts have not been factored into the economic benefit calculations (ENPV) in the present Study. The total estimated direct, indirect and induced value added contribution of construction under Option 1 during 2015-2030 is **HK\$15 billion**, with **approximately 33,000 job-years⁷⁶** generated, mainly related to construction and engineering activities. The total estimated direct, indirect and induced value added contribution of construction under Option 2 during 2012-2030 is **HK\$46 billion**, with **approximately 97,000 job-years** generated, again related mainly to construction and engineering activities.

Figure 6.7 : Estimated Economic Contribution due to Construction at HKIA Options 1 and 2



Note: *Includes estimated direct, indirect and induced employment
 Source: Enright, Scott & Associates Ltd

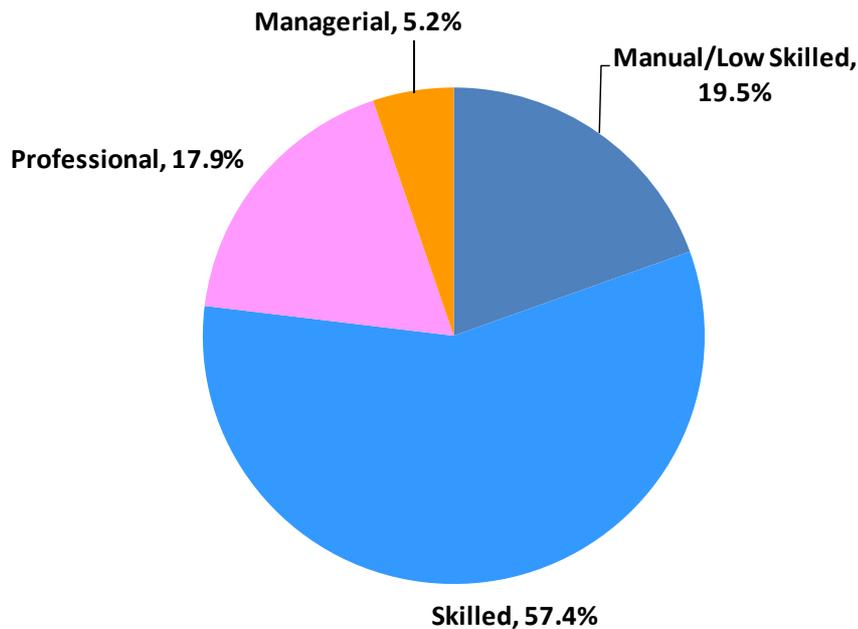
Potential Employment Creation

6.13 Based on ESA’s analysis, under Option 1, 244,000 jobs will be generated by HKIA in 2030 whereas under Option 2, the corresponding figure is estimated to be higher at 341,000 (compared with 185,000 in 2008). Excluding indirect/induced employment, **direct employment associated with HKIA in 2030 is estimated to be 101,000 under Option 1 and 141,000 under Option 2** (compared with 62,000 in 2008).

⁷⁶ A "job-year" is defined as one person employed full time for one year.

6.14 Further to the ESA Study, AAHK has surveyed nearly 400 different companies and organisations operating on the airport island in 2010. Of the 65,000 people employed, around 20% of the employees perform manual/low-skilled jobs. Returns from the survey indicate an expectation that about 50% of new jobs created under both Options 1 and 2 would be to the manual/low-skilled category. Hong Kong is currently in need of employment opportunities for manual/low-skilled labour and the expansion of HKIA would contribute towards filling this gap.

Figure 6.8 : Airport Island Employment Split in 2010



Source: HKIA Workforce Survey 2010

Definitions: Manual/Low Skilled: Jobs involving simple and routine tasks carried out often with some physical effort and help of hand-held tools. Skilled: Jobs requiring special knowledge and skills acquired through training in order to perform well. Professional: Jobs requiring qualifications and knowledge of a specialised field. Managerial: Jobs which are responsible for the management of a section, department, division or a company in the achievement of organisation objectives.

Hypothetical “Pessimistic” Cases

6.15 In order to test the robustness of the potential economic return to the airport expansion investments, hypothetical “pessimistic” cases were produced where it was assumed that:

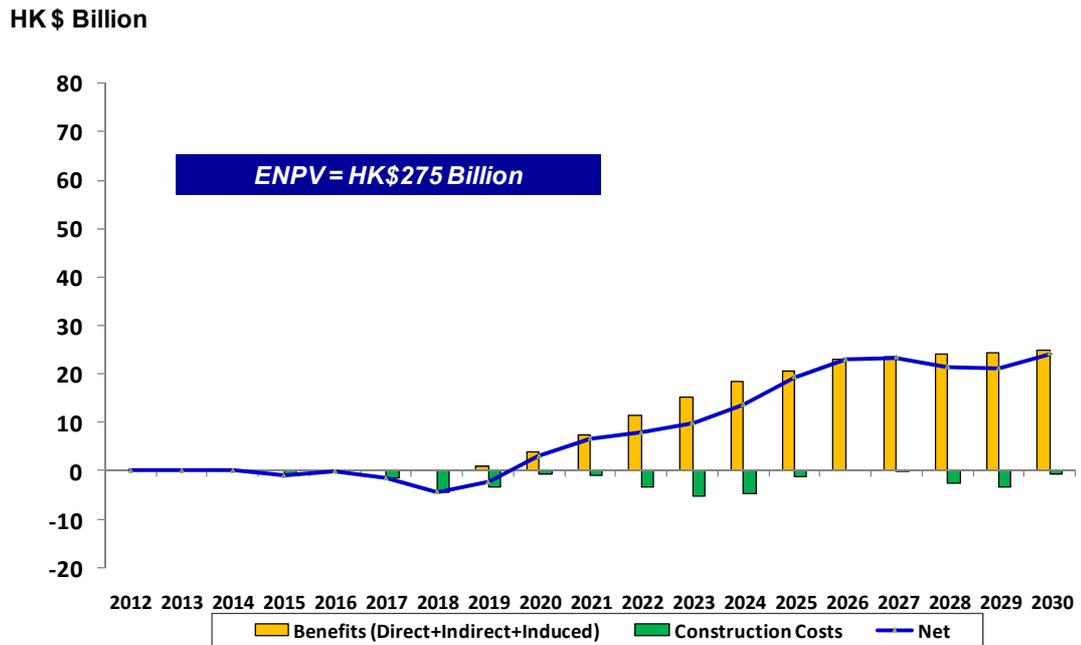
- a) Demand would be 15% lower than the base case forecast;
- b) Construction costs would be 50% higher than the high range cost estimate; and
- c) Value-added to revenue ratio in the aviation sector would decline over time instead of remaining constant.

These analyses are merely for stress testing the potential economic returns, and the assumptions used are not based on the recommendations or projections of any independent MP2030 Consultant Studies.

6.16 Option 1 (Two-Runway System)

Based on the Option 1 “Pessimistic” case results, the ENPV up to 2061 is estimated to be HK\$275 billion (see Figure 6.9).

Figure 6.9 : Option 1 Pessimistic Case: ENPV Based on Direct, Indirect and Induced Economic Impacts (Value Added)



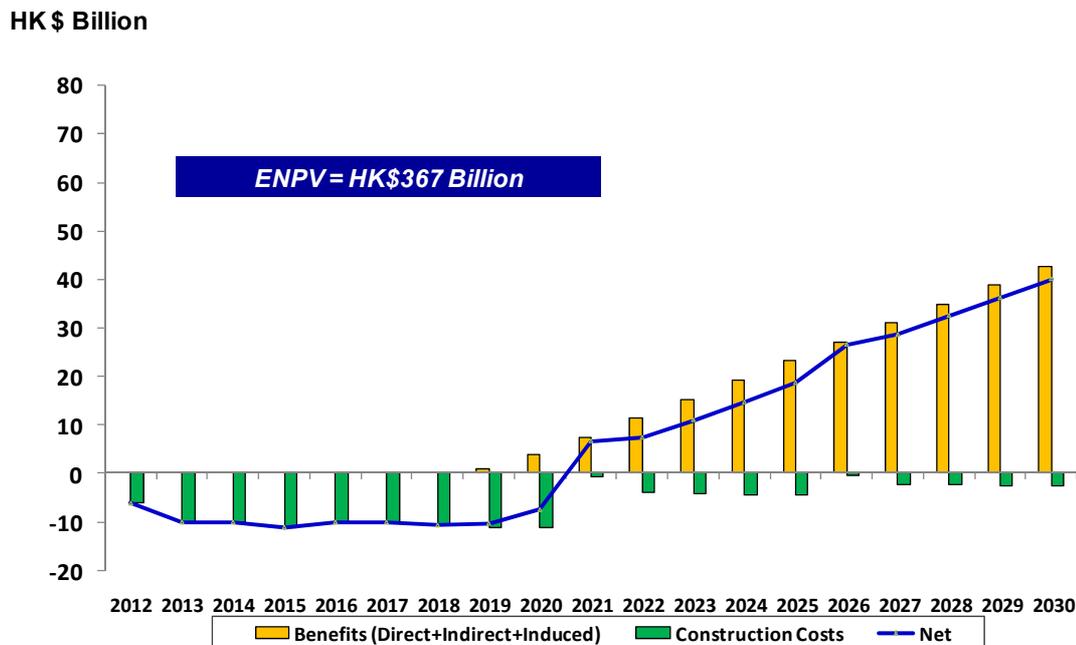
Note: ENPV is calculated based on 50-year return (till 2061) and a discount rate of 4% which is used generally for Government infrastructure projects. Benefits are measured in value added. For simplicity, graph illustrates cash flow up to 2030 only.

Source: Enright, Scott & Associates Ltd

6.17 Option 2 (Three-Runway System)

Based on the Option 2 “Pessimistic” case results, the ENPV up to 2061 is estimated to be HK\$367 billion (see Figure 6.10).

Figure 6.10 : Option 2 Pessimistic Case: ENPV Based on Direct, Indirect and Induced Economic Impacts (Value Added)



Note: ENPV is calculated based on 50-year return (till 2061) and a discount rate of 4% which is used generally for Government infrastructure projects. Benefits are measured in value added. For simplicity, graph illustrates cash flow up to 2030 only.

Source: Enright, Scott & Associates Ltd

6.18 The results of the “Pessimistic” stress tests indicate that both Options 1 and 2 would be highly beneficial to Hong Kong, even with pessimistic assumptions on demand and costs.

Summary

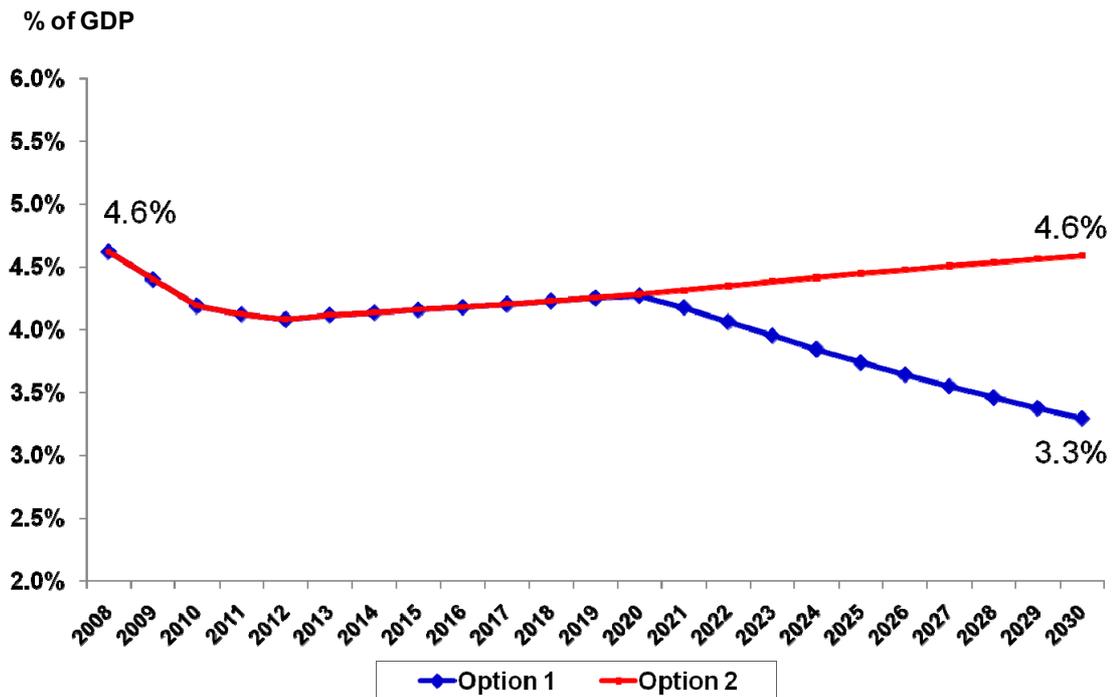
6.19 Option 1 is the less costly option in terms of capital investment. An investment of HK\$23 billion⁷⁷ could increase HKIA’s handling capacity by almost 30% resulting in an ENPV of HK\$432 billion. Option 2, however, has a projected ENPV of HK\$912 billion and is a “front-loaded” investment that will generate a much higher value-added ENPV in the long term.

6.20 Between the two options, Option 2 brings a substantially higher economic contribution in the long term (a difference of HK\$480 billion in ENPV) and provides a significantly greater boost to local employment. One important aspect of the economic analysis that deserves particular attention is the gradual decrease of HKIA’s economic contribution as

⁷⁷ Capital investment of HK\$23 billion in 2009 dollars was used in the evaluation of economic impact to align with other information sources.

a percentage of Hong Kong’s GDP under Option 1 (below the 2008 level) as shown in Figure 6.11. As Hong Kong’s economy continues to grow, it is obvious that Option 1 does not allow HKIA to grow in tandem due to its constrained capacity⁷⁸. In addition, constrained capacity is likely to affect connectivity. Experience in Heathrow bears this out clearly: In 1990, Heathrow ranked second among airports in Europe, after Frankfurt, in the number of destinations served, but as its capacity became constrained, it slipped to seventh in 2010 behind Frankfurt, Paris, Amsterdam, Munich, Rome and Madrid⁷⁹.

Figure 6.11 : GDP Contribution Difference – Option 1 versus Option 2



Note: The contribution includes direct, indirect and induced impacts which are measured in value added.
Source: Enright, Scott & Associates Ltd

- 6.21** Hong Kong could be in danger of losing its international aviation hub status should HKIA run out of capacity. The efficient flow of people and goods made possible by HKIA is vital to Hong Kong’s role as Asia’s financial centre, especially to its four pillar industries – financial services, trading and logistics, tourism, and professional and producer services. These together accounted for approximately 57% of Hong Kong’s GDP and 48%⁸⁰ of Hong Kong’s employment in 2008.
- 6.22** By 2030, with demand outstripping HKIA’s constrained capacity for approximately 10 years, the airport will have been turning away increasing numbers of passengers and cargo due to its fully maximised two-runway system. In this situation, there would be natural tendencies on the part of airlines and cargo carriers to raise prices, promote the operation of larger airplanes, focus on origin-and-destination passengers rather than

⁷⁸ The comparison of the projected economic impact of the two options was made against independently forecast GDP figures. Such figures have not been adjusted to take into account potential slower economic growth in Option 1 than in Option 2.

⁷⁹ “Strategy: Process, Content, Context, An International Perspective By Bob De Wit, Ron Meyer, 4th Edition”

⁸⁰ Based on revised figure released by Census and Statistics Department on 23 Feb 2011.

transfer and transit travellers, focus on major long-haul, regional and the Mainland routes at the expense of other routes, reduce the number of locations with direct services to Hong Kong, and shift freighter traffic to off-peak periods. These natural responses to capacity constraints could negatively impact HKIA's competitiveness and its contribution to Hong Kong's economy.

- 6.23** HKIA could risk losing a significant share of its air cargo and passenger services to other airports if its prices and connectivity fall behind due to capacity constraints. Hong Kong is a global leader in the trade-related services and sourcing sector, whose cornerstone is HKIA. These trade-related services mainly deal with facilitating the supply of consumer products to the world's retailers and industrial products to a wide range of other global businesses. Many retailers consolidate their entire offshore buying activity in Hong Kong because the Mainland is their single largest source of supply, and the remainder of their sourcing from other parts of Asia, South America and Central Europe, is often managed from here as well.
- 6.24** Businesses like trading require excellent connectivity within the Mainland to maintain and develop a large and ever more widely dispersed supplier base across the Mainland. In conjunction they also need excellent connectivity with the other Asian countries that they engage with for sourcing or retailing operations, as well as with their global headquarters. They are thus exceptionally dependent on air travel.
- 6.25** If trading and sourcing activities moved from Hong Kong into the PRD, the loss would ripple through to a range of other industries including financial services, property, trade fairs and exhibitions, freight forwarders (the sales office may be located in Hong Kong to maintain proximity to customers even if the physical logistics are elsewhere), legal services for contract formation and dispute resolution, accounting services, hotels and related services for business travellers engaged in sourcing activities, express carrier services for documents and samples, information technology support services, and other services such as design studios and testing laboratories.

CHAPTER 7 FUNDING ASSESSMENT

- 7.1 Under the Airport Authority Ordinance, AAHK is required to conduct its business according to prudent commercial principles. It has maintained an efficient capital structure in line with comparable commercial entities. Leveraging its strong revenue base and superior credit rating, it operates with a prudent level of borrowings (average year-end debt balances at about HK\$9 billion). This helped it achieve a financial rate of return on equity of 10.7% for the year ending March 2011⁸¹.
- 7.2 To ascertain AAHK's financial capability in undertaking the Master Plan 2030, an independent financial advisor, The Hongkong and Shanghai Banking Corporation Limited, was commissioned to evaluate the financial feasibility of the development options under the Master Plan 2030 within the context of AAHK's financial capability and AAHK's prudent borrowing capacity⁸² based on cashflow projections.
- 7.3 For Option 1, developing the existing Midfield further to add capacity, the capital cost of the works required from 2013 to 2030 is HK\$23.4 billion in 2010 dollars, or HK\$42.5 billion at Money-Of-the-Day (MOD) prices. This assumes a construction cost Tender Price Index (TPI) increase of 5% per annum in 2011-2014, 5.5% per annum in 2015-2020 and 3% per annum thereafter.
- 7.4 For Option 2, constructing a Third Runway along with associated passenger and cargo handling facilities on reclaimed land to the north of the existing site, the capital cost of the works required from 2013 to 2030 is HK\$86.2 billion in 2010 dollars, or HK\$136.2 billion at Money-Of-the-Day (MOD) prices. This assumes a construction cost Tender Price Index (TPI) increase of 5% per annum in 2011-2014, 5.5% per annum in 2015-2020 and 3% per annum thereafter.

Debt Financing for MP2030

- 7.5 In determining AAHK's prudent debt capacity, the financial advisor considered the organisation's financial objectives and analysed its cashflow projections, taking into consideration the key requirements of financing parties, such as bond investors and lenders, as well as the criteria applied by rating agencies. These included:
- Maintaining a high investment grade standalone rating in the single 'A' range so as to ensure a prudent capital structure and continued access to the debt capital markets on reasonable terms;
 - Assessing the prudent debt capacity on the basis of being able to fully repay debt on the terms and conditions typically offered by lenders to this type of project; and
 - Evaluating the robustness of AAHK's overall financial position, including the ability to maintain a standalone investment grade rating, under various stress scenarios.

⁸¹ According to 2010/11 unaudited accounts.

⁸² Please refer to paragraph 7.5 for the detailed methodology of debt sizing.

- 7.6 The results of these different but complementary approaches show that AAHK's prudent debt capacity is approximately HK\$26 billion. Given that AAHK has an average debt balance of about HK\$9 billion, the incremental debt capacity available up to 2030 would be approximately HK\$17 billion.

Major Assumptions in the Cashflow Projections

- 7.7 The cashflow projections under both Options 1 and 2 are prepared on the following assumptions:
- The final construction cost of the capital projects will be increased from the current estimate based on 2010 dollars to MOD amounts, in line with the Tender Price Index (TPI) which is estimated to increase at the rate of 5% per annum from 2011 to 2014, 5.5% per annum from 2015 to 2020 and 3% per annum thereafter;
 - HKIA's operating revenue will increase in line with traffic growth based on IATA Consulting's base case traffic forecast for this period;
 - Airport charges will be adjusted in line with Consumer Price Index (CPI) movements (assuming 3% CPI increase per year up to 2030);
 - The majority of AAHK's profits will be distributed by way of dividends to AAHK's shareholder each year at a similar rate as in previous years; and
 - AAHK will continue to invest in committed capital projects, such as Phase 1 of the Midfield Development, and the routine replacement of fixed assets.

Cashflow Analysis – Option 1

Traffic Forecast

- 7.8 Figure 7.1 details the traffic assumptions for the two-runway option that form the basis of revenue and operating cost forecasts during the period up to 2030.

Figure 7.1 : HKIA Traffic Forecast (Two-Runway Option)

	2015	2020	2025	2030	CAGR * 2008-2030
Passenger Traffic (million trips)	57	68	72	74	1.9%
Cargo Traffic (million tonnes)	4.4	5.6	5.8	6.0	2.3%
Air Traffic Movements ('000)	347	420	420	420	1.5%

Note: * CAGR: Compound Annual Growth Rate

Construction Cost

- 7.9 Under Option 1, the capital expenditure to be incurred would amount to HK\$23.4 billion (2010 dollars) or HK\$42.5 billion at MOD prices between 2013 and 2030. The schedule of development and corresponding cost estimates are outlined in Figure 7.2 and Figure 7.3 respectively. The annual cash outflow of the capital expenditure is shown in Figure 7.4 below.

Figure 7.2 : Indicative Development Phasing Plan for the Two-Runway Option

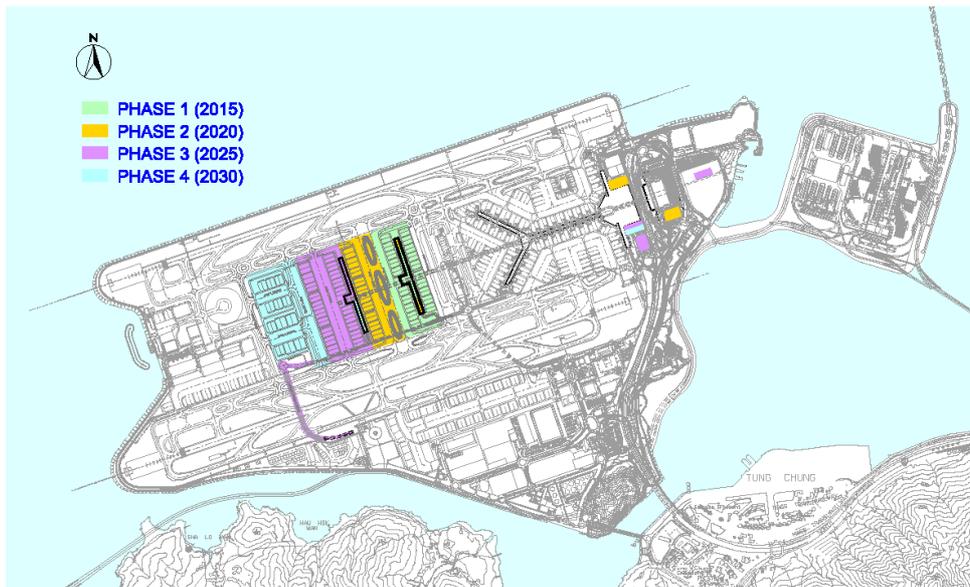
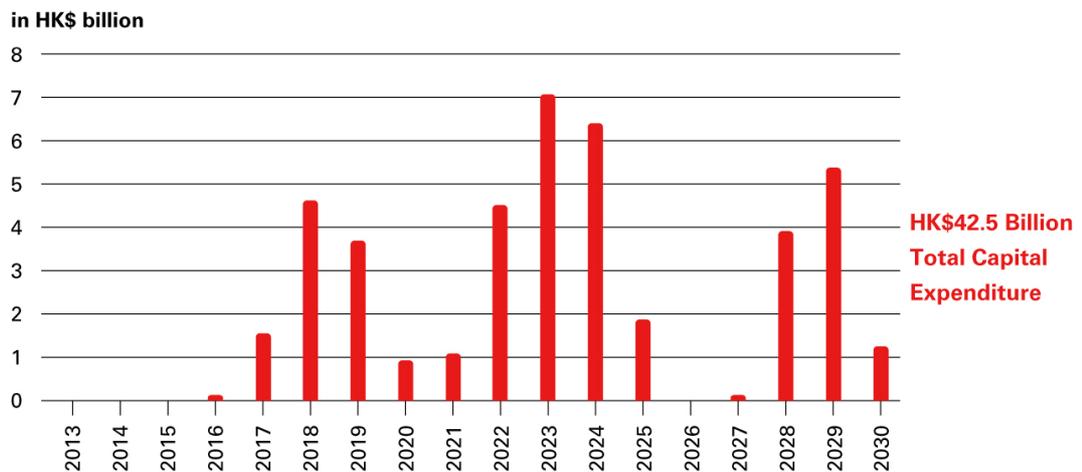


Figure 7.3 : Two-Runway Option Preliminary Phased Development Cost Estimates

HK\$ Billion (2010 dollars)	Phase 1 (By 2015)	Phase 2 (By 2020)	Phase 3 (By 2025)	Phase 4 (By 2030)	Total (Phase 2-4)
Construction Cost		5.4	8.9	3.8	18.1
Design & Project Management		0.5	0.9	0.4	1.8
Contingency		1.0	1.7	0.8	3.5
Total Cost Estimates	9.3*	6.9	11.5	5.0	23.4

Note: *The cost estimate of HK\$9.3 billion is in MOD prices.

Figure 7.4 : Option 1 – Annual Capital Expenditure



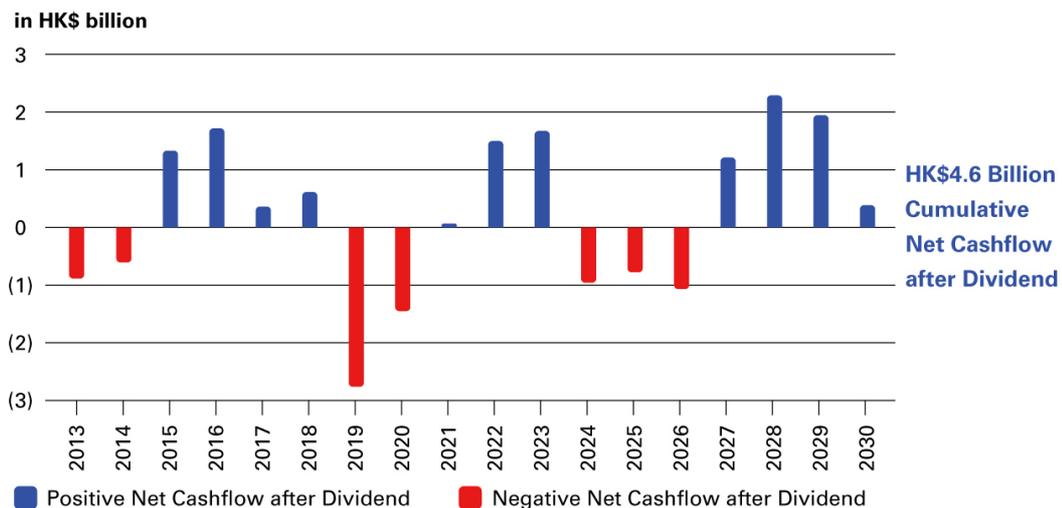
Cashflow Analysis

7.10 The results of each year’s operations based on the assumptions set out in paragraph 7.7 show a trend of rising profits. As depreciation is charged before arriving at the profits, the cashflow generated from the operations is the aggregate of the profits and the depreciation charge but less any increase in AAHK’s working capital. At the same time, expenditure is incurred on the committed capital projects such as Phase 1 of the Midfield Development and routine replacement of fixed assets. Hence, such expenditure should be deducted from the cashflow from operations to arrive at the net cashflow before dividend payments.

7.11 Under the Airport Authority Ordinance, the Financial Secretary has the power to request AAHK to distribute dividend after consultation with the Board. About 80% of profits have been distributed as dividend in past years and the same level of distributions is assumed in the projections.

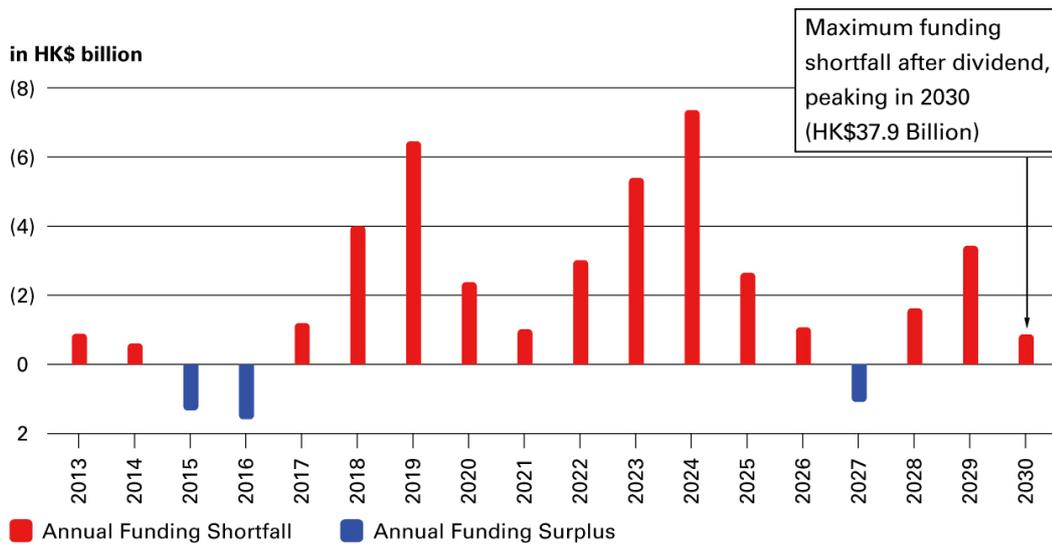
7.12 Based on the foregoing, the forecast profits for the period from 2013 to 2030 under Option 1 will amount to HK\$101.6 billion after depreciation charges of HK\$68.2 billion and a net increase in working capital of HK\$6.1 billion. In the same period, capital expenditure on committed capital projects and routine replacement of fixed assets will amount to HK\$79.5 billion. On the basis of the previous practice of payment of approximately 80% of the preceding year’s profits by way of dividends, which will amount to HK\$79.6 billion, the net cashflow after dividend is forecast to amount to HK\$4.6 billion (representing HK\$101.6 + HK\$68.2 – HK\$6.1 – HK\$79.5 billion – HK\$79.6 billion).

Figure 7.5 : Option 1 – Annual Net Cashflow after Dividend



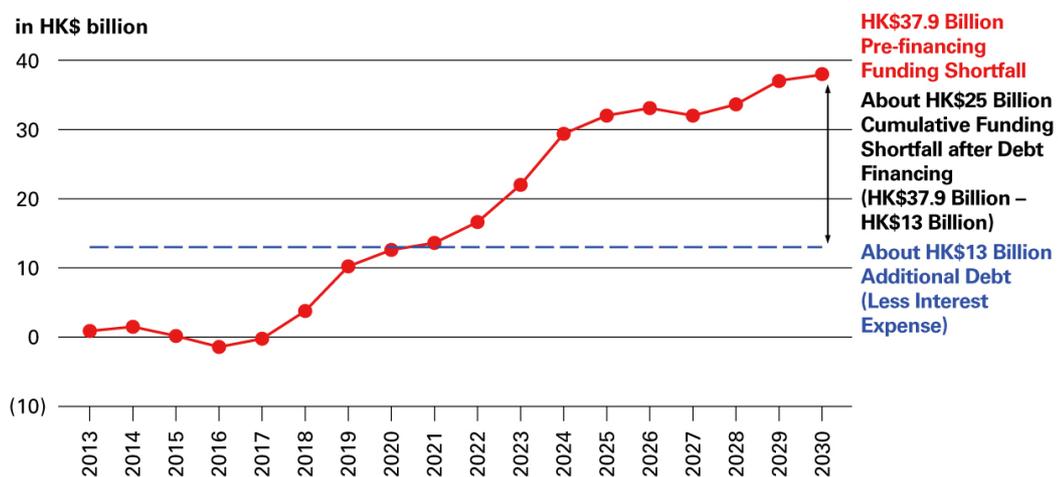
7.13 On comparing the cash outflow required for the capital expenditure with the net cashflow after dividend, it is clear that there would be a funding shortfall for most of the years between 2013 and 2030. The annual funding shortfall is shown in the chart below and the total funding shortfall between 2013 and 2030 is estimated to be HK\$37.9 billion, peaking in 2030 (please see Appendix 7 for details).

Figure 7.6 : Option 1 – Annual Funding Shortfall/Surplus



7.14 As described in paragraph 7.5 above and based on the assumption set out in paragraph 7.7, the financial advisor has assessed AAHK’s prudent borrowing to be approximately HK\$26.0 billion, representing a net additional borrowing capacity of about HK\$17.0 billion over AAHK’s average level of borrowings of about HK\$9.0 billion. As additional interest costs would be incurred on these borrowings, the net incremental cashflow available from borrowings up to 2030 would amount to approximately HK\$13.0 billion under Option 1. This amount would not be sufficient to meet the funding shortfall as shown in the chart below.

Figure 7.7 : Option 1 – Cumulative Funding Shortfall after Debt Financing



Cashflow Analysis – Option 2

Traffic Forecast

7.15 The base case traffic assumptions provided by IATA Consulting are set out in Figure 7.8. They form the basis for the revenue and operating cost forecasts for the period up to 2030.

Figure 7.8 : HKIA Traffic Forecast (Three-Runway Option)

	2015	2020	2025	2030	CAGR 2008-2030
Passenger Traffic (million trips)	57	68	82	97	3.2%
Cargo Traffic (million tonnes)	4.4	5.7	7.2	8.9	4.2%
Air Traffic Movements (‘000)	347	421	509	602	3.2%

Construction Cost

7.16 Under Option 2, capital expenditure to be incurred would amount to HK\$86.2 billion (2010 dollars) or HK\$136.2 billion at MOD prices between 2013 and 2030. The schedule of development and corresponding cost estimates are outlined in Figure 7.9 and Figure 7.10 respectively. The annual cash outflow of the capital expenditure is shown in Figure 7.11 below.

Figure 7.9 : Indicative Development Phasing Plan of the Three-Runway Option

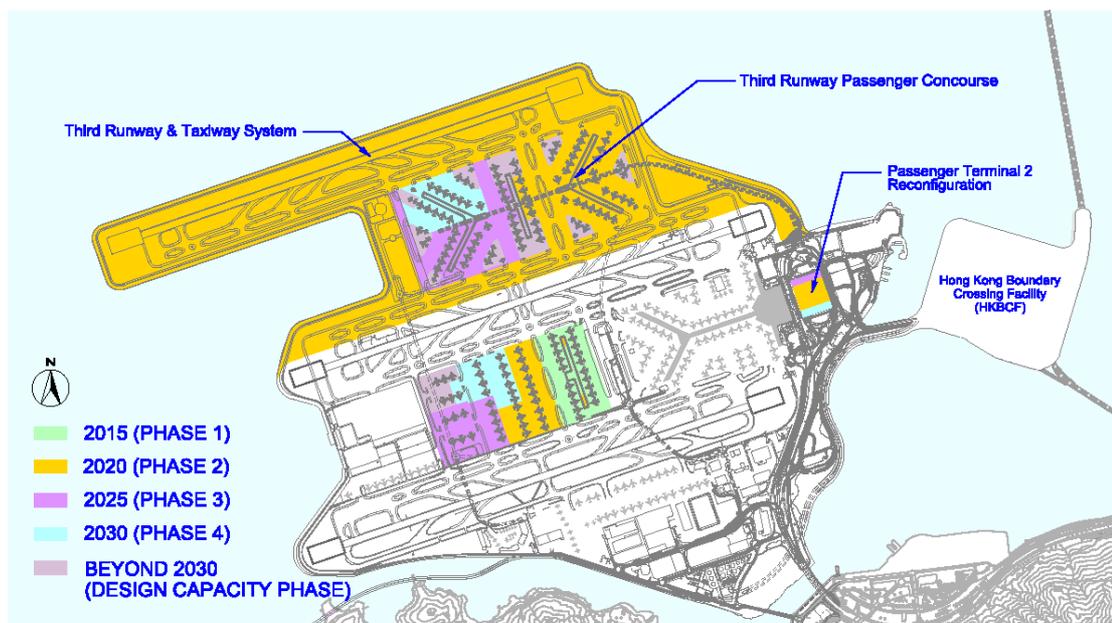
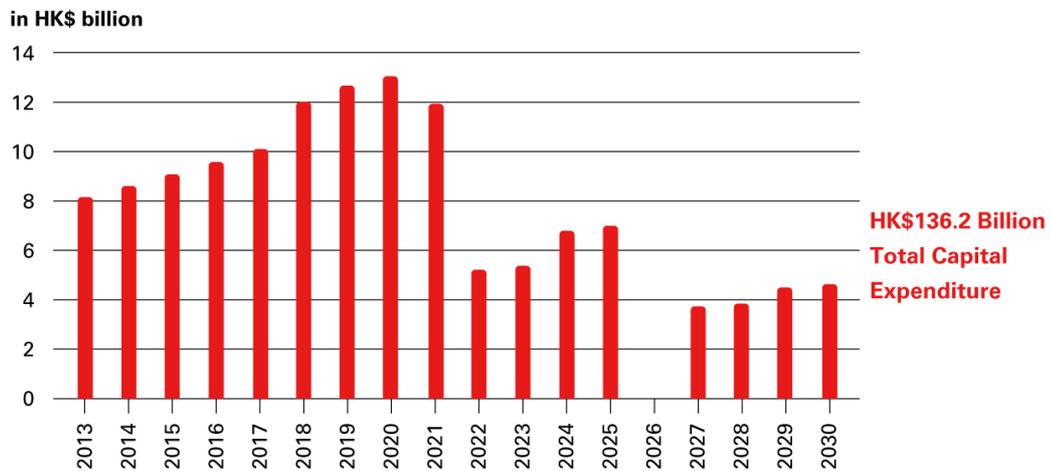


Figure 7.10 : Three-Runway Option Preliminary Phased Development Cost Estimates

HK\$ Billion (2010 dollars)	Phase 1 (By 2015)	Phase 2 (By 2020)	Phase 3 (By 2025)	Phase 4 (By 2030)	Total (Phase 2-4)
Construction Cost	-	50.2	10.1	6.0	66.3
Design & Project Management	-	5.0	1.0	0.6	6.6
Contingency	-	10.1	2.0	1.2	13.3
Preliminary Total Cost Estimates	9.3*	65.3	13.1	7.8	86.2

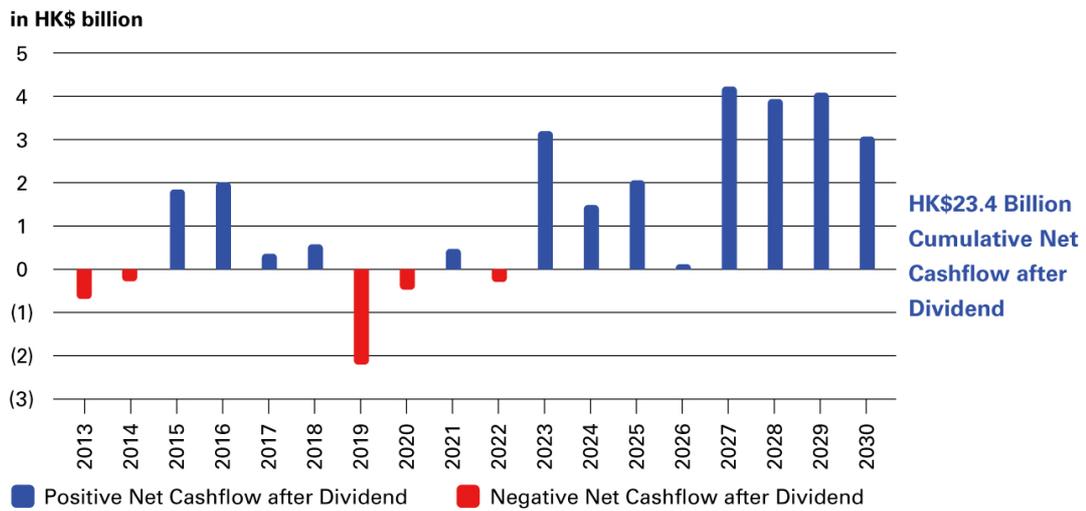
Note: *The cost estimate of HK\$9.3 billion is in MOD prices.

Figure 7.11 : Option 2 – Annual Capital Expenditure



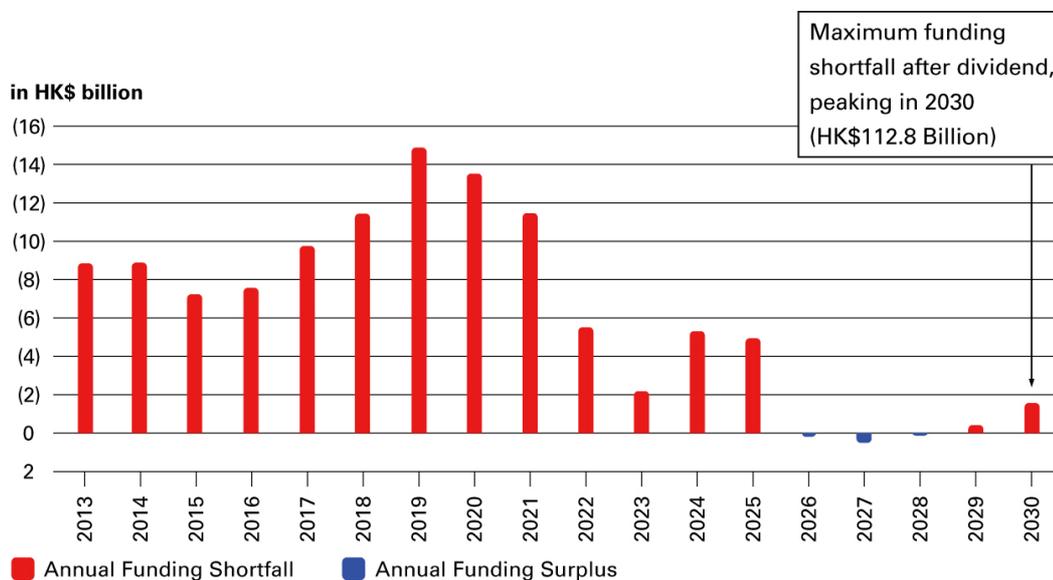
7.17 As described in paragraph 7.10 above, the net cashflow generated from the operations represents the profits, plus depreciation charges and changes in working capital less capital expenditure on committed capital projects and dividends to AAHK’s shareholders. On the assumptions set out in paragraph 7.7 above, the forecast profits for the period from 2013 to 2030 under Option 2 will amount to HK\$102.7 billion after depreciation charges of HK\$87.2 billion and increase in working capital of HK\$4.6 billion. In the same period, capital expenditure on committed capital projects and routine replacement of fixed assets will amount to HK\$83.0 billion. On the basis of the previous practice of payment of approximately 80% of the profits of the preceding years by way of dividends, which will amount to HK\$78.9 billion, the net cashflow after dividend is forecast to amount to HK\$23.4 billion (representing HK\$102.7 + HK\$87.2 – HK\$4.6 – HK\$83.0 – HK\$78.9 billion).

Figure 7.12 : Option 2 – Annual Net Cashflow after Dividend



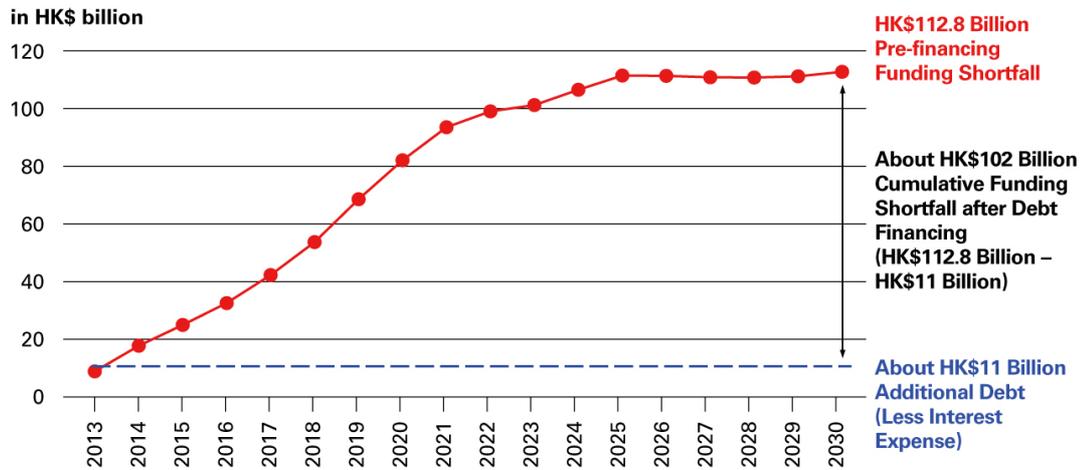
7.18 On comparing the cash outflow required for the capital expenditure with the net cashflow after dividend, it is clear that there would be a funding shortfall for most of the years between 2013 and 2030, with the exception of a few years beyond 2025. The funding shortfall is also much bigger than that of Option 1. The annual funding shortfall is shown in the chart below and the total funding shortfall would peak at HK\$112.8 billion in 2030 (please see Appendix 8 for details).

Figure 7.13 : Option 2 – Annual Funding Shortfall/Surplus



7.19 A similar approach to debt sizing has been adopted in Option 2 as for Option 1, resulting in a net additional borrowing capacity of approximately HK\$17 billion. After allowing for the related interest cost over a slightly longer period, the net incremental cashflow available from borrowings would amount to approximately HK\$11 billion under Option 2. This amount would not be sufficient to meet the funding shortfall as shown in the chart below.

Figure 7.14 : Option 2 – Cumulative Funding Shortfall after Debt Financing



Sensitivity Analyses

Risk Areas Reviewed

7.20 The following risk areas were reviewed to assess the impact of an adverse change in any one of the key assumptions.

7.21 Traffic and passenger revenue

Lower than expected future passenger traffic volumes at HKIA could adversely affect its financial profile. The diminished passenger traffic would result in lesser traffic driven revenue, leading to a lower operating surplus and consequently, a greater funding shortfall. This would lead to even greater financing requirements and a reduced debt-servicing ability.

7.22 Given the 20-year long master planning horizon, there are different degrees of uncertainty around some of the key inputs used to develop the forecasts, such as:

- GDP growth forecast – whilst traffic growth at major airports has historically been closely correlated with real GDP growth, future GDP growth forecasts can be uncertain and may vary according to different viewpoints.
- Competition – As the other major airports and alternative modes of transport in the Pearl River Delta develop rapidly, the overall competitive environment for HKIA will remain dynamic and difficult to predict.

- 7.23** To understand this uncertainty, sensitivity analysis utilising the IATA Consulting's low traffic case was performed (see Figure 7.15).

Figure 7.15 : HKIA Traffic Forecast (Low Case)

	2015	2020	2025	2030	CAGR 2008-2030
Passenger Traffic (million trips)	54	64	76	89	2.8%
Cargo Traffic (million tonnes)	4.2	5.2	6.5	8.0	3.7%
Air Traffic Movements ('000)	332	394	470	552	2.8%

7.24 Airport Charges Adjustment

While the airport charges increase assumption is reasonable in light of HKIA's strong competitive position and high quality service offering and, as confirmed by IATA Consulting, the MP2030 traffic consultant, the relative insensitivity of traffic numbers to modest changes in airport charges, there could be situations when these increases are not implemented. Therefore, a scenario analysis of no airport charges increase is included.

7.25 Construction Cost Overrun

There are risks of cost overruns on all construction projects. To incorporate this, a high construction cost stress test where the investment amount exceeds the base case construction cost (excluding the design fees, project management fees, and contingency) assumption by 20% has been included.

7.26 Construction Cost Inflation

The base case financial assumptions utilise a Tender Price Index (TPI) of 5% per annum in 2011-2014, 5.5% per annum in 2015-2020 and a 3% per annum thereafter. To gauge the impact of a higher TPI, the TPI increase assumed in the base case analysis has been raised by an average of 25% throughout the forecast period. As a result, a TPI adjustment of 6% per annum in 2011-2014, 6.5% per annum in 2015-2020 and 4% per annum thereafter has been used while conducting the stress test.

Sensitivity Analysis for Option 1

- 7.27** Sensitivity analyses are performed to assess the impact that changes in the key parameters of the base case assumptions might have on the pre-financing funding shortfall of MP2030. These are detailed in Figure 7.16.

Figure 7.16 : Option 1 Sensitivity Analysis

FY13/14 - FY30/31	Base Case	High TPI	20% Capex overrun	Low Traffic	No airport charge increase
Traffic Forecast	Base Case	Base Case	Base Case	Low Case	Base Case
CAPEX Estimate (2010 dollars)	23bn	23bn	27bn	23bn	23bn
CAPEX Estimate (MOD prices)	43bn	48bn	49bn	43bn	43bn
TPI	3-5.5%	4-6.5%	3-5.5%	3-5.5%	3-5.5%
Airport charges adjusted in line with CPI increase	3% per annum	3% per annum	3% per annum	3% per annum	none
Pre-financing Funding shortfall (HKD)	38bn	51bn*	43bn	39bn	45bn*

Note: *Figures are the cumulative pre-financing funding shortfall up to FY2030/31.

7.28 The sensitivity analysis indicates that the impact of low traffic is less severe than that observed in other stress test scenarios. The other stress test cases incorporate a significant adverse change to the key assumptions in order to assess the robustness of the analyses, viz.:

- Raising the TPI adjustment factor by an average of about 25% throughout the period up to 2030;
- Building in a 20% cost overrun in addition to the 20% contingency which is already included in the cost estimate; and
- Allowing for a scenario where airport charges will not be raised in the next 20 years, despite the inevitable increase in operating costs and CPI adjustments during that period.

In any event, the results of these stress tests indicate that the funding shortfall of the two-runway option will rise by up to HK\$13 billion, resulting in a material weakening in AAHK's financial profile and a need for additional financial support.

Sensitivity Analysis for Option 2

7.29 Similar to Option 1's sensitivity analysis, the stress tests for Option 2 show that low traffic has a relatively smaller impact on the funding shortfall than changes in other parameters. The other stress test scenarios incorporate significant downside adjustments to key assumptions to assess the robustness of the analyses, viz.:

- Raising the TPI adjustment factor by an average of around 25% throughout the period up to 2030;

- b) Building in a 20% cost overrun in addition to the 20% contingency which is already included in the cost estimates; and
- c) Allowing for a scenario where airport charges will not be adjusted in the next 20 years, despite the inevitable increase in operating costs and CPI adjustments during that period.

The results of these stress tests (see Figure 7.17) indicate that the size of the funding shortfall could increase by up to HK\$20 billion, resulting in a need for additional financial support and review of other financing options.

Figure 7.17 : Option 2 Sensitivity Analysis

FY13/14 - FY30/31	Base Case	High TPI	20% Capex overrun	Low Traffic	No airport charge increase
Traffic Forecast	Base Case	Base Case	Base Case	Low Case	Base Case
CAPEX Estimate (2010 dollars)	86bn	86bn	100bn	86bn	86bn
CAPEX Estimate (MOD prices)	136bn	150bn	157bn	136bn	136bn
TPI	3-5.5%	4-6.5%	3-5.5%	3-5.5%	3-5.5%
Airport charges adjusted in line with CPI increase	3% per annum	3% per annum	3% per annum	3% per annum	none
Pre-financing funding shortfall (HKD)	113bn	133bn	131bn	117bn	122bn

Funding the Two Options

- 7.30** The above analysis is predicated on the base case financial projections of AAHK and MP2030 construction costs. It shows that neither options can be funded through AAHK's internal cashflow and external prudent borrowing capacity. While AAHK may be able to reduce the shortfall by reviewing the existing revenue framework with a view to increasing the revenue, the magnitude of such additional revenue sources would unlikely be material within this time frame. Subject to views gauged on the way forward for the Master Plan 2030, further discussions on how best to bridge the funding gap between AAHK and the Government would be necessary.
- 7.31** In preparation for the discussions, the following financing possibilities will be analysed in detail in conjunction with the financial advisor. The options listed below are not mutually exclusive and can be pursued independently or in combination. The optimal choice will depend on the priorities of AAHK and its shareholders and stakeholders, in addition to

other factors such as credit rating considerations and capital market condition at the time the additional funding is needed.

- ***User Pays Principle***

Under this principle, the user of the facilities and services provided by the HKIA pay for part of the construction costs of MP2030. The Airport Authority Ordinance empowers AAHK to set up and determine the amount of charges and fees. HKIA has historically maintained a very competitive level of airport tariff, but the current level of charges other than airport charges can be reviewed to identify areas for adjustment. While planning, HKIA will take into consideration the possibility that passenger flow at the airport might be diverted to its neighbouring competitors as a result of any tariff adjustments.

- ***Equity funding from the private sector***

Private sector equity capital can be accessed through a partial sale of HKIA to a selected group of investors. This approach however has many issues, including the issue of diluting the HKSAR government's interest in HKIA, and the strategic, operational and pricing implications of reduced control of the business.

- ***Alternative financing instruments***

A wide range of financing options along the debt/equity spectrum can be employed to expand the funding portfolio. They include:

- Debts that cater to demands from specific funding sources, such as retail bonds, Islamic bonds and Renminbi bonds, etc.;
- Hybrid capital and convertible debts; and
- Structured debts in the form of perpetual bonds, preferred equity, etc.

The list above is not exhaustive and more options can be generated based on market conditions and investor demand at the time when the funding is needed. Some of these instruments, however, will not increase the overall debt capacity. Others, such as structured financing instruments, could find their market constrained by lack of liquidity, small investor base and higher costs. Financing instruments with conversion features also present issues of ownership dilution. Nevertheless, in many cases these instruments will benefit AAHK's overall financing capability by enhancing its credit rating, or from accounting and tax considerations.

- ***Government's funding support***

Direct financial support from the HKSAR Government represents a departure from the user pays principle. But given the economic benefits that HKIA's future expansion would bring to the economy of Hong Kong, the case can be made for seeking Government's funding support. This could take many forms, including an injection of additional equity, a reduction in the rate of dividend payout, provision of shareholder's loan(s) and/or guarantees to third party lenders, etc., or a combination of these different methods.

LIST OF ACRONYMS

AAHK	Airport Authority Hong Kong
AACM	Autoridade de Aviacao Civil Macao
ADM	“Arrivals only, Departures only, Mixed” mode of operations
ADS	Approved Destination Status
AEL	Airport Express Line
AFCD	Agriculture, Fisheries and Conservation Department
AIPDUWG	Airport Infrastructure Planning and Development Users Working Group
AOD	Airport Operational Development
APCO	Air Pollution Control Ordinance
APM	Automated people mover
AQOs	Air Quality Objectives
ARD	Airport Related Development
ASAs	Air Services Agreements
ASD	Airport Support Development
ASEAN	Association of Southeast Asian Nations
ASIC	Airport South Interchange
ASR	Air Sensitive Receiver
ATC	Air Traffic Control
ATM	Air traffic movement (also known as flight movement)
BAA	British Airports Authority
BAC	Business Aviation Centre
BHS	Baggage handling system
CAAC	Civil Aviation Administration of China
CAD	Civil Aviation Department
CAFTA	China-ASEAN Free Trade Area
CAGR	Compound Annual Growth Rate
CALINE4	California Line Source Dispersion Model Version 4
CASL	China Aircraft Services Limited
CDM	Construction and demolition material
CEDD	Civil Engineering and Development Department
CEPA	Closer Economic Partnership Agreement
CIP	Commercially important person
CIQ	Customs/Immigration/Quarantine
CMP	Contaminated mud pit
CPI	Consumer Price Index
CWD	Chinese white dolphin
DEP	Director of Environmental Protection
DCM	Deep Cement Mixing
DCV	Destination Coded Vehicle
EBS	Early bag store
ECFA	Economic Cooperation Framework Agreement
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EIU	Economist Intelligence Unit
ENPV	Economic Net Present Value
EPD	Environmental Protection Department
ESA	Enright, Scott & Associates
ESR	Ecological Sensitive Receiver
FAA	Federal Aviation Administration (from the United States)
FDI	Foreign Direct Investment

FTA	Free Trade Agreement
GDP	Gross domestic product
GFS	Government Flying Service
GIC	Government, Institution or Community
GPRD	Greater Pearl River Delta
GSE	Ground support equipment
GSEL	Ground Support Engineering Limited
GTC	Ground Transportation Centre
HAECO	Hong Kong Aircraft Engineering Company Limited
HKBCF	Hong Kong Boundary Crossing Facilities
HKIA	Hong Kong International Airport
HKLR	Hong Kong Link Road
HKO	Hong Kong Observatory
HKPSG	Hong Kong Planning Standards and Guidelines
HKSAR	Hong Kong Special Administrative Region
HST	High Speed Train
HZMB	Hong Kong-Zhuhai-Macao Bridge
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ILS	Instrument Landing System
INM	Integrated Noise Model
ISCST	Industrial Source Complex Dispersion Model IV Short Term
IVS	Individual Visit Scheme
LCC	Low cost carrier
LTO	Landing and take-off ratio
MCT	Marine Cargo Terminal
MEZ	Marine Exclusion Zone
MFM	Macao International Airport
MNCs	Multi-national corporations
MOD	Money-of-the-day
MP2025	Master Plan 2025
MP2030	Master Plan 2030
NATS	National Air Traffic Services (from the United Kingdom)
NCD	North Commercial District
NEF	Noise Exposure Forecast
NM	Nautical Miles
NSC	North Satellite Concourse
NSR	Noise Sensitive Receiver
OD	Origin-and-destination
OECD	Organisation for Economic Co-operation and Development
OOG	Out of gauge
OSA	Open Skies Agreement
PAFF	Permanent Aviation Fuel Facility
PATH	Pollutants in the Atmosphere and their Transport over Hong Kong
PFC	Public Fill Committee
PRD	Pearl River Delta
PTB	Passenger Terminal Building
RPK	Revenue Passenger Kilometres
SAQM	Multi-Species Photochemical Air Quality Model
SAR	Special Administrative Region
SARS	Severe Acute Respiratory Syndrome
SCIC	SkyCity Interchange
SEZ	Special Economic Zone

SMEs	Small and medium enterprises
SOIR	Simultaneous Operations on Parallel or Near-Parallel Instrument Runways
SOMAD	Strategic Overview of Major Airport Development
SS	Suspended solid
STD	Scheduled time of departure
T1	Terminal 1
T2	Terminal 2
TMCLKL	Tuen Mun-Chek Lap Kok Link
TMWB	Tuen Mun Western Bypass
TPI	Tender Price Index
TRPC	Third Runway Passenger Concourse
T-STANDS	Temporary Stands
ULD	Unit Load Device
VA	Value added
VSR	Visual Sensitive Receiver
WCZ	Water Control Zone
WEL	Hong Kong-Shenzhen Western Express Line
WKT	West Kowloon Terminus
WQOs	Water Quality Objectives
WSR	Water Sensitive Receiver
WTO	World Trade Organisation
XRL	Guangzhou-Shenzhen-Hong Kong Express Rail Link
YRD	Yangtze River Delta

Appendix 1 : HKIA Primary Demand Forecast GDP Assumptions

Major uncertainties existed when the forecast had been carried out. This resulted in conservative Gross Domestic Product (GDP) assumptions being retained for the traffic model.

Back in 2008, as financial stresses were becoming increasingly severe further to the sub-prime crisis in the US and the following freezing of credit markets in the developed world, most economists started to revise down their economy forecasts. When tangible signs of trade and economy contraction were observed, GDP forecasts were further worsened until Q2 2009.

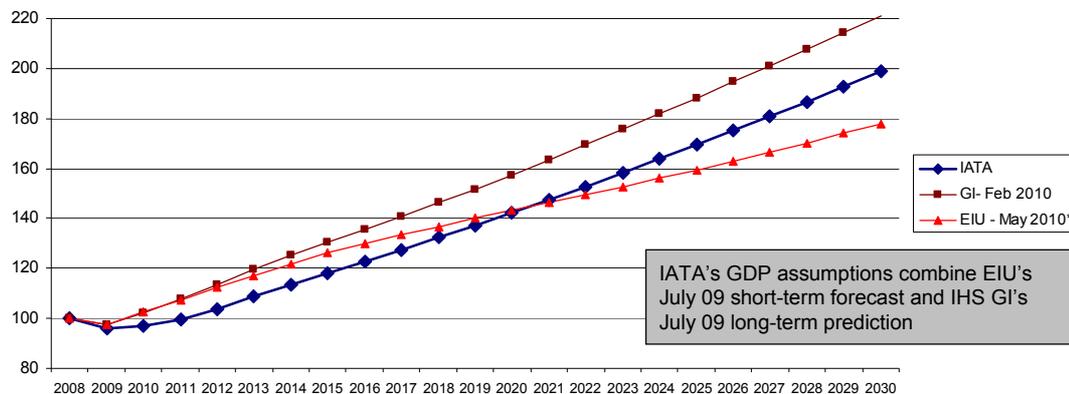
In the second half of 2009, the massive fiscal stimulus packages implemented by most of the major countries showed positive repercussions. Economic outlook started to improve. In early 2010, economists were still upgrading their expectations for 2009 and further years. At the worst of the crisis, Hong Kong 2009 GDP was expected to fall by -6.7% whereas latest estimates for 2009 (issued by Economic Intelligence Unit (EIU) in May 2010) counted on -2.7%.

In this context, IATA had to reconsider several times the GDP assumptions for the traffic forecast model. The final GDP assumptions (see Figure 2) were derived from EIU's July 2009 5-YR forecast and Global Insight July 2009 long-term forecast (2015 to 2030).

These assumptions predict a 3.2% annual growth for the HKSAR GDP between 2008 and 2030.

Eventually the main GDP assumptions retained in July 2009 look conservative in light of the most recent releases, particularly in the short- and medium-term (see Figure 1).

Figure 1 : Comparison of IATA's GDP assumptions against the most recent forecasts released by EIU and Global Insight - Cumulated HKSAR GDP growth at index 100 in 2008



(1) In May 2010, EIU has revised up its 5-YR forecast; further years (2015-2030) are based on the long-term forecast released in July 2009
Source: Economist Intelligence Unit, IHS Global Insight

Figure 2 : GDP Growth Assumptions for World Regions

Region	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
The Mainland	9.0%	7.2%	7.6%	8.2%	8.5%	8.8%	9.0%	8.8%	8.2%	7.8%	7.6%	7.4%	7.2%	7.1%	6.8%	6.7%	6.6%	6.4%	6.2%	6.1%	5.8%	5.6%	5.5%
Taiwan	0.1%	-4.5%	3.2%	5.7%	5.3%	4.8%	4.4%	4.2%	3.9%	3.7%	3.6%	3.5%	3.4%	3.2%	3.1%	3.1%	3.0%	2.9%	2.8%	2.8%	2.8%	2.8%	2.8%
Japan	-0.7%	-6.8%	0.9%	2.1%	2.9%	3.2%	3.0%	2.5%	1.5%	0.9%	0.7%	0.6%	0.5%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.4%	0.4%	0.4%	0.3%
USA & Canada	1.1%	-3.0%	1.4%	3.2%	3.8%	2.9%	2.7%	2.8%	2.9%	2.8%	2.9%	3.0%	3.3%	3.0%	2.8%	2.7%	2.6%	2.8%	2.6%	2.5%	2.5%	2.4%	2.5%
Australasia	1.7%	-0.6%	0.9%	3.3%	4.4%	4.0%	4.0%	3.5%	3.2%	3.1%	3.0%	2.9%	2.7%	2.3%	2.1%	2.5%	2.7%	2.8%	2.7%	2.5%	2.5%	2.5%	2.5%
Europe	1.1%	-4.6%	0.1%	1.4%	1.7%	1.9%	1.9%	1.8%	1.8%	1.8%	1.7%	1.7%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.5%	1.5%	1.5%	1.5%	1.5%
SE Asia	4.5%	-0.2%	4.2%	4.8%	4.9%	5.1%	5.0%	5.0%	5.0%	4.9%	4.8%	4.7%	4.5%	4.2%	4.1%	4.2%	4.2%	4.2%	4.1%	4.1%	4.1%	4.0%	3.9%
Others	4.9%	-0.7%	2.9%	4.4%	5.0%	5.0%	4.9%	4.8%	4.7%	4.6%	4.5%	4.4%	4.3%	4.2%	4.2%	4.1%	4.1%	4.1%	4.0%	4.0%	3.9%	3.9%	3.9%
Hong Kong	2.5%	-3.9%	0.9%	2.7%	4.1%	4.9%	4.4%	4.1%	3.9%	3.8%	3.8%	3.7%	3.7%	3.6%	3.6%	3.6%	3.5%	3.5%	3.3%	3.3%	3.2%	3.2%	3.1%

Source: 5-year forecast from EIU (July 2009) and long-term forecast from Global Insight (July 2009)

Appendix 2 : Constrained Air Traffic Demand Forecasts

1. Introduction

The following sections describe how the constrained demand forecasts were derived for the two-runway system option based on unconstrained air traffic forecasts prepared by the International Air Transport Association (IATA) Consulting.

A summary of the results of the analysis comparing the unconstrained and constrained traffic forecasts is given in Figure 9.

2. Methodology

The methodologies for estimating the constraints of a two-runway system at HKIA are outlined below.

Air Traffic Movements

The impact on air traffic movements has been calculated as follows:

- a) Take the practical maximum air traffic movements (ATM) capacity of a two-runway system estimated by NATS in analysing the airspace and runway capacity as a constraint.
- b) As and when the unconstrained ATM demand forecast hits the practical maximum ATM capacity, the loss of regular public transport passenger, cargo and non-revenue flights has been calculated assuming that the split of movements between these three groups remains similar to the split applied for the unconstrained ATM forecasts but with minor adjustments as follows:
 - i. Smaller share of non-revenue flights (a drop in share of total movements in 2030 from 2.3% for the unconstrained forecasts to 1.0% in the constrained environment) based on 2007⁸³ air traffic movement statistics.
 - ii. Reduction in freighter share (a drop in the share of total movements in 2030 from 17.9% for the unconstrained forecasts to 16.0% in the constrained environment) based on 2007 air traffic movement statistics.
 - iii. As a result of assumptions (i) and (ii) the passenger air traffic movement share increases in 2030 from 79.8% for the unconstrained forecasts to 83.0% for the constrained forecasts based on 2007 air traffic movement statistics.

The rationale for adjusting the passenger, cargo and non-revenue shares of total movements for the constrained environment is on the basis that flight schedule is known to be a more significant marketing attribute for passenger flights than for cargo flights, while non-revenue flights are accorded lower priority than passenger or cargo flights in the allocation of runway slots. It is anticipated that some of the runway slots occupied by cargo flights during busy hours of a day could be substituted by their operating airlines with passenger flights instead, as cargo demand overflowed from the belly hold of passenger flights could yet be captured via cargo flights operation outside the busy period of the day.

⁸³ The air traffic movements statistics in 2007 was the most updated year available for referencing the likely share of passenger/freighter/non-revenue flights handled by the airport when demand for runway slots on a busy day was edging near the then prevailing hourly capacity.

Passenger Throughput

In order to estimate the potential impact on passenger numbers based on the loss of passenger air traffic movements (determined in step b above), two scenarios have been developed.

Scenario 1

The first scenario maintains the aircraft mix as per the unconstrained forecasts. For this scenario (Scenario 1) the loss in passenger throughput is in direct proportion to the loss of passenger air traffic movements.

Scenario 2

For the second scenario (Scenario 2) the average number of passengers per movement has been increased to reflect the likely “up-gauging” of aircraft size by airlines and an increase in average passenger seat factors in response to the constrained situation.

Cargo Throughput

The potential impact on air cargo has been calculated by:

- Estimating the cargo reduction as a result of the reduced passenger air traffic movements.
- Estimating the cargo reduction as a result of the reduced cargo air traffic movements.
- Similar to the passenger throughput, two scenarios are developed for the constrained cargo throughput forecasts.

3. Loss of Forecast Air Traffic Movements (ATMs)

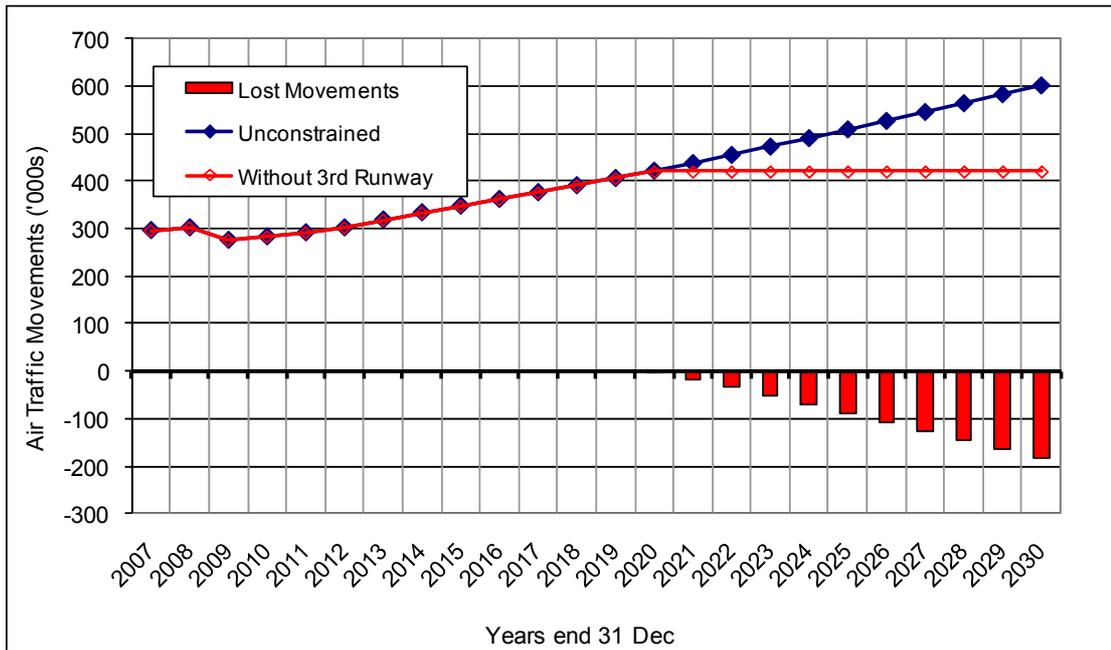
Figure 1 provides the annual unconstrained forecasts and the impact of the capacity constraint for 2021, 2025 and 2030. The outcome of the analysis is also presented graphically in Figure 2. The figure shows the unconstrained annual forecasts and the progressive impact of the limit of 420,000 annual air traffic movements. The conclusion from this analysis is a loss of around 30% of the unconstrained annual air traffic movements by 2030.

Figure 1 : The Loss in Air Traffic Movements ('000s)

Assumptions and Outcome:	2021	2025	2030
Unconstrained Forecasts – Third Runway Operational ('000s)	437	509	602
Constrained Forecasts - Two-Runway System ('000s)	420	420	420
Lost Movements ('000s)	-17	-89	-182
Lost Movements as % of Unconstrained	-4.0%	-17.4%	-30.2%

Note: Percentages based on unrounded figures.

Figure 2 : Unconstrained and Constrained Air Traffic Movement Forecasts to 2030



4. Constrained Passenger Movement Forecasts

Using the outcome shown in Figure 1, estimating the constrained number of passenger movements was based on two scenarios.

Scenario 1

Passenger Scenario 1 assumes no changes in assumptions other than the loss of movements from the unconstrained air traffic movements as shown in Figure 1.

Scenario 2

Passenger Scenario 2 varies assumptions as to the average number of passengers per passenger air traffic movement. Drawing from the experience of the last few years of saturated operations at the old Kai Tak Airport, the changed assumptions are shown in Figure 4.

For the constrained environment a higher average number of passengers per movement has been assumed based on an assessment that (i) airlines would choose to increase average aircraft size, and (ii) the average passenger seat factors would increase (assumed to increase from around 76.4% in the unconstrained environment to 80% in the constrained environment).

The outcome is shown graphically in Figure 3 and is presented in Figure 4. By 2030 the loss amounts to between 24% and 27% of unconstrained passenger movements.

Figure 3 : Unconstrained & Constrained Passenger Throughput Forecasts 2007 to 2030

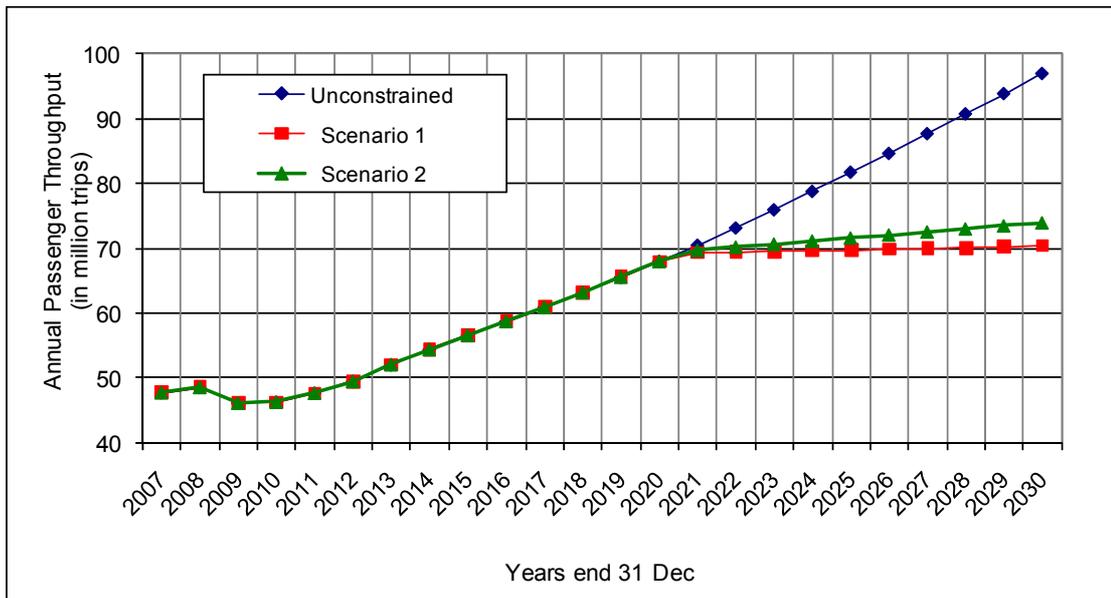


Figure 4 : Calculating the Loss of Annual Passenger Throughput

Assumptions and Outcome:	2021	2025	2030
Passenger Air Traffic Movements			
Unconstrained ('000s)	354.5	409.0	480.2
% of Total Unconstrained Air Traffic Movements	81.1%	80.4%	79.8%
Constrained ('000s)	348.6	348.6	348.6
% of Total Constrained Air Traffic Movements	83.0%	83.0%	83.0%
Lost Movements ('000s)	-5.9	-60.4	-131.6
Lost Movements as % of Unconstrained	-1.7%	-14.8%	-27.4%
Assumed Average Numbers of Passenger Per Movement			
Unconstrained	199	200	202
Constrained Assumptions - Scenario 1	199	200	202
Constrained Assumptions - Scenario 2	200	205	212
Summary of Outcomes (Annual Passenger Throughput)			
Unconstrained Passenger Throughput (Millions)	70.5	81.8	97.0
Scenario 1: Constrained Passenger Throughput (Millions)	69.4	69.7	70.4
Reduction in Passenger Throughput (%)	-1.7%	-14.8%	-27.4%
Scenario 2: Constrained Passenger Throughput (Millions)	69.7	71.6	73.9
Reduction in Passenger Throughput (%)	-1.1%	-12.5%	-23.8%

Note: Percentages based on unrounded figures.

5. Constrained Cargo Forecasts

Cargo is carried in the belly space of passenger aircraft and in specialist freighters. The impact of constrained runway movements is to reduce cargo carried by both sectors. The approach to estimating this loss of cargo is explained in the following sections.

Impact of Reduction in Passenger Air Traffic Movements on Cargo Throughput

The loss of cargo carried on passenger aircraft was calculated by multiplying the average cargo volume carried per passenger aircraft for the unconstrained forecast by the number of lost passenger air traffic movements. Figure 5 shows the results. The loss of passenger aircraft leads to a consequential loss of 27% of cargo that would have been carried on those aircraft.

Figure 5 : Calculating the Loss of Annual Cargo Throughput on Passenger Air Traffic Movements

Assumptions and Outcome:	2021	2025	2030
Passenger Air Traffic Movements			
Unconstrained ('000s)	354.5	409.0	480.2
Constrained ('000s)	348.6	348.6	348.6
Lost Movements ('000s)	-5.9	-60.4	-131.6
Lost Movements as % of Unconstrained	-1.7%	-14.8%	-27.4%
Assumed Average Cargo Carried Per Passenger Flight (Tonnes per Movement)			
Unconstrained	6.2	6.3	6.6
Constrained	6.2	6.3	6.6
Cargo Carried on Passenger Flights (Millions Tonnes)			
Unconstrained	2.18	2.59	3.16
Constrained	2.15	2.21	2.29

Note: Percentages based on unrounded figures.

Impact of Reduction in Cargo Air Traffic Movements on Cargo Throughput

Two scenarios have been prepared to estimate the impact of the two-runway constraint on cargo tonnage carried by freighters.

Cargo Scenario 1

The assumption was to split cargo carried on passenger and cargo flights and the volume of cargo per flight are as per the unconstrained forecasts.

The loss of cargo carried on freighter aircraft was calculated as follows: the volume of cargo per freighter aircraft as for the unconstrained forecast multiplied by the number of lost freighter movements.

Thus, for Scenario 1, any reduction in cargo results directly from the loss of cargo flights.

Cargo Scenario 2

The assumed average cargo carried on cargo aircraft has been increased from 51 tonnes in 2021 to a historical high of around 55 tonnes per flight in 2030 to reflect the anticipated moves of airlines to deploy larger capacity freighter in response to the runway constraints.

The outcome of the above methods and assumptions is shown in Figure 6, amounting to between 36% and 38% reduction of the unconstrained cargo volumes. The unconstrained cargo tonnages per freighter were derived from IATA Consulting forecasts.

Figure 6 : Calculating the Loss of Annual Cargo Throughput on Cargo Air Traffic Movements

Assumptions and Outcome:	2021	2025	2030
Cargo Air Traffic Movements			
Unconstrained ('000s)	73.5	88.4	107.7
% of Total Unconstrained Air Traffic Movements	16.8%	17.4%	17.9%
Constrained ('000s)	67.2	67.2	67.2
% of Total Constrained Air Traffic Movements	16.0%	16.0%	16.0%
Lost Movements ('000s)	-6.3	-21.2	-40.5
Lost Movements as % of Unconstrained	-8.6%	-24.0%	-37.6%
Assumed Cargo Tonnage Per Freighter			
Unconstrained	51.1	52.1	53.2
Constrained Assumptions - Scenario 1	51.1	52.1	53.2
Constrained Assumptions - Scenario 2	51.3	52.9	55.0
Cargo Carried on Freighters			
Unconstrained (Millions Tonnes)	3.76	4.60	5.73
Scenario 1: Constrained Cargo Throughput (Millions Tonnes)	3.44	3.50	3.58
Reduction in Cargo Throughput (%)	-8.6%	-24.0%	-37.6%
Scenario 2: Constrained Cargo Throughput (Millions Tonnes)	3.45	3.56	3.70
Reduction in Cargo Throughput (%)	-8.2%	-22.7%	-35.5%

Note: Percentages based on unrounded figures.

Aggregate Loss of Cargo Throughput

The aggregated outcome of the loss of cargo on passenger and cargo aircraft is provided in Figure 7 and shown graphically in Figure 8.

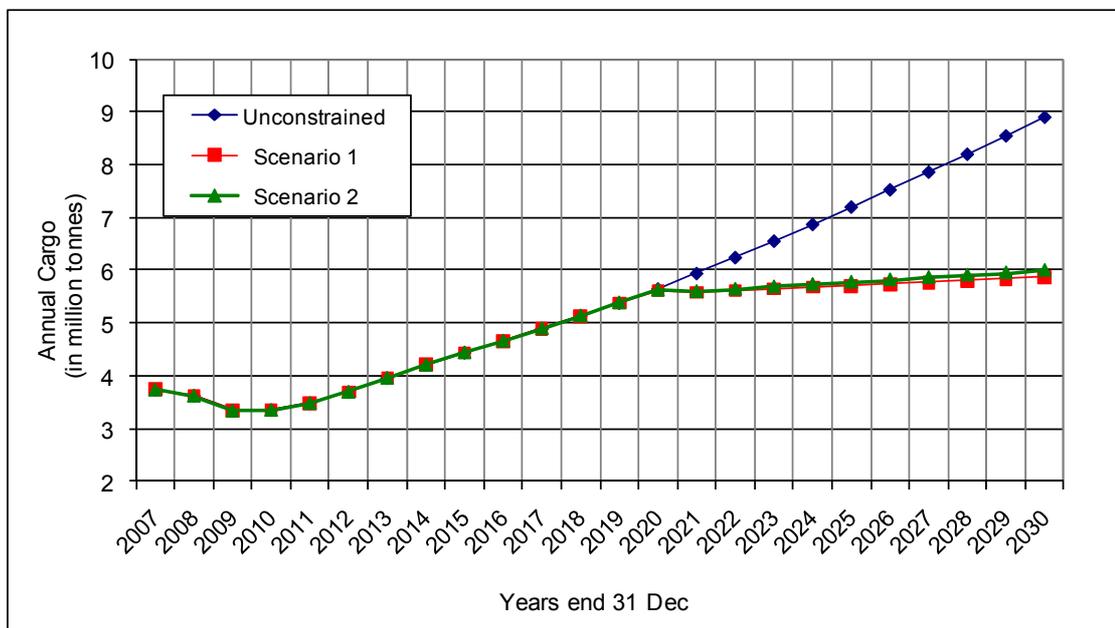
The aggregated outcome is a loss of between 32.6% and 34.0% of freight compared to the forecast unconstrained cargo tonnes.

Figure 7 : Loss of Annual Cargo Tonnes - Aggregated Loss on Passenger Aircraft and Freighters

Summary of Outcome:	2021	2025	2030
Unconstrained (Million Tonnes) - Carried on Passenger & Cargo Aircraft	5.94	7.20	8.89
Scenario 1: Constrained Cargo Throughput (Million Tonnes)	5.58	5.71	5.87
Reduction in Cargo Throughput (%)	-6.0%	-20.7%	-34.0%
Scenario 2: Constrained Cargo Throughput (Million Tonnes)	5.59	5.77	5.99
Reduction in Cargo Throughput (%)	-5.8%	-19.8%	-32.6%

Note: Percentages based on unrounded figures.

Figure 8 : Unconstrained and Constrained Cargo Throughput Forecasts to 2030



6. Adopted Constrained Traffic Forecast Scenario

AAHK, decided that Scenario 2 be adopted in order to reflect a more realistic capacity constraint that a two-runway system can impose if the Third Runway is not built (i.e. at approximately 74 million passengers and 6 million tonnes of cargo per annum as shown in Figure 9).

Figure 9 : Summary of Unconstrained and Constrained Forecasts

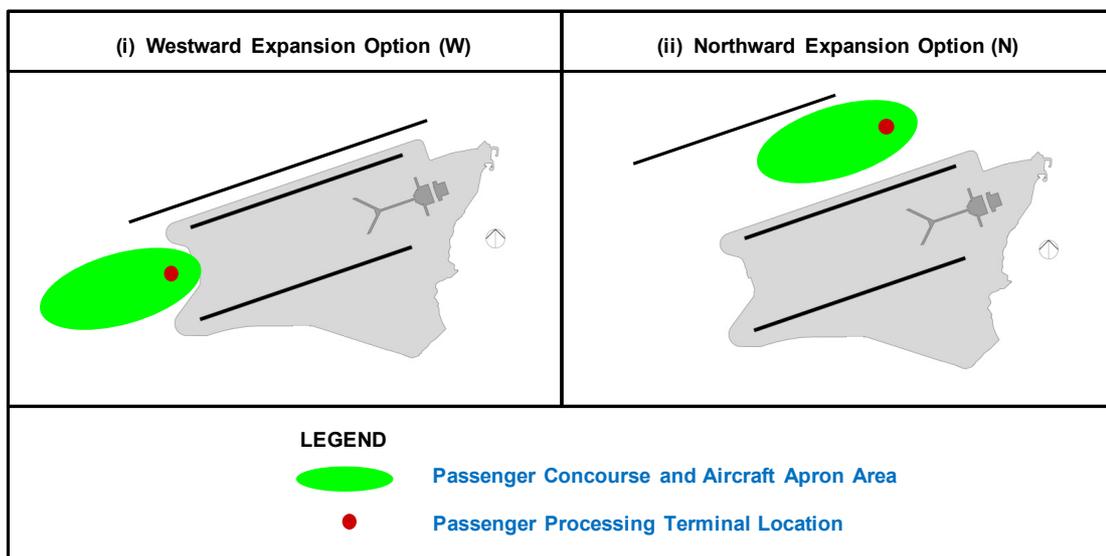
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
ATMs ('000s)										
Unconstrained	437	455	472	490	509	527	546	564	583	602
Without 3rd Runway	420	420	420	420	420	420	420	420	420	420
Lost Movements	-17	-35	-52	-70	-89	-107	-126	-144	-163	-182
Lost Movements %	-4.0%	-7.6%	-11.1%	-14.3%	-17.4%	-20.3%	-23.0%	-25.6%	-28.0%	-30.2%
Pax (Millions)										
Unconstrained	70.5	73.2	76.0	78.8	81.8	84.7	87.7	90.8	93.9	97.0
Scenario 1	69.4	69.4	69.5	69.6	69.7	69.8	70.0	70.1	70.3	70.4
Scenario 2	69.7	70.2	70.7	71.1	71.6	72.1	72.5	73.0	73.5	73.9
Lost Movements (Millions)										
Scenario 1	-1.2	-3.8	-6.5	-9.2	-12.1	-14.8	-17.8	-20.7	-23.6	-26.6
Scenario 2	-0.8	-3.0	-5.3	-7.7	-10.2	-12.6	-15.2	-17.8	-20.4	-23.1
Lost Movements %										
Scenario 1	-1.7%	-5.2%	-8.5%	-11.7%	-14.8%	-17.5%	-20.2%	-22.8%	-25.2%	-27.4%
Scenario 2	-1.1%	-4.1%	-7.0%	-9.8%	-12.5%	-14.9%	-17.3%	-19.6%	-21.8%	-23.8%
Freight Tonnes (Millions)										
Unconstrained	5.9	6.2	6.6	6.9	7.2	7.5	7.9	8.2	8.5	8.9
Scenario 1	5.6	5.6	5.6	5.7	5.7	5.7	5.8	5.8	5.8	5.9
Scenario 2	5.6	5.6	5.7	5.7	5.8	5.8	5.9	5.9	5.9	6.0
Lost Movements (Millions)										
Scenario 1	-0.4	-0.6	-0.9	-1.2	-1.5	-1.8	-2.1	-2.4	-2.7	-3.0
Scenario 2	-0.3	-0.6	-0.9	-1.1	-1.4	-1.7	-2.0	-2.3	-2.6	-2.9
Lost Movements %										
Scenario 1	-6.0%	-10.1%	-13.8%	-17.3%	-20.7%	-23.7%	-26.5%	-29.1%	-31.6%	-34.0%
Scenario 2	-5.8%	-9.7%	-13.3%	-16.6%	-19.8%	-22.7%	-25.4%	-28.0%	-30.4%	-32.6%

Appendix 3 : Northward and Westward Land Reclamation Comparison

Given the recommendation of National Air Traffic Services (NATS) of a parallel third runway north of the existing airport island from operational and runway capacity considerations, there are basically only two families of airport layout options available (see Figure 1) for the expansion of the airport footprint to accommodate the expansion needs of airport operational development and airport support development:

- Westward Expansion Option resulting in a close-spaced separation of the third runway of around 380m from the existing North Runway; or
- Northward Expansion Option resulting in a separation of the third runway of around 1645m from the existing North Runway comparable to the current separation between the existing two runways.

Figure 1 : Expansion Options



The Airport Master Plan Consultant has conducted a comparative evaluation of the above two options from the airport planning, engineering and environmental perspectives and has recommended the Northward Expansion Option as the preferred airport development option. The comparative performance between the two airport expansion options is shown in Figure 2.

Figure 2 : Comparative Performance between Two Airport Expansion Options

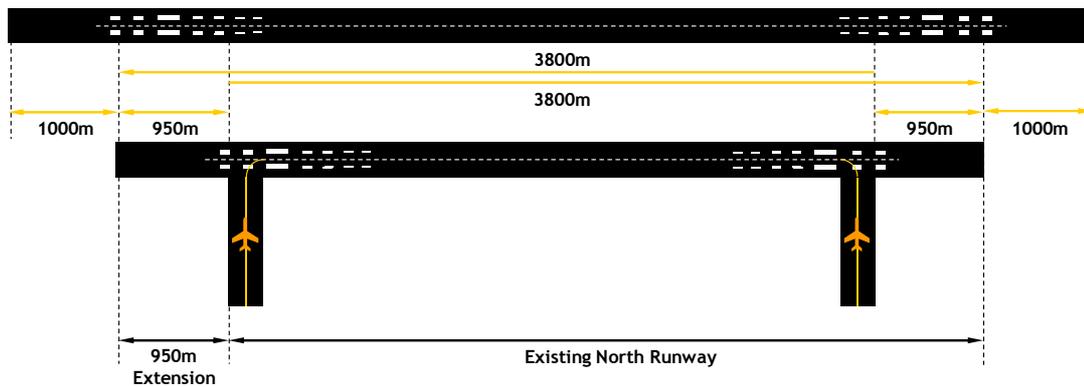
Criteria	Westward Expansion	Northward Expansion
Airfield Efficiency	x	✓
Passenger Convenience	x	✓
Surface Access	x	✓
Cargo Operations Efficiency	x	✓
Degree of Environmental Impact	x	✓

A summary of the comparison between the Westward Expansion Option relative to the Northward Expansion Option is as follows:

Airfield Efficiency

- a) For close-spaced parallel runways to be able to maintain independent segregated operations under International Civil Aviation Organization (ICAO) guidelines, it is necessary to extend the third runway length from 3,800m to 6,750m, and the Second Runway (i.e. existing North Runway) length by 950m to the west so that a 1,950m stagger towards the arriving aircraft is available for both runway directions 07 and 25 (see Figure 3).

Figure 3 : Runway Extension



This entails substantial additional land reclamation area for the third runway as compared to the Northward Expansion Option, which has sufficient runway separation to adopt a normal length of 3,800m for the third runway.

- b) The separation of the close-spaced third runway from the First Runway (i.e. existing South Runway) is also not sufficient to support independent parallel approaches. Only dependent staggered approaches can be accepted which will reduce the overall capacity of the three-runway system to 97 movements per hour as compared to 102 under the Northward Expansion Option supporting independent parallel approaches (see Figure 4).

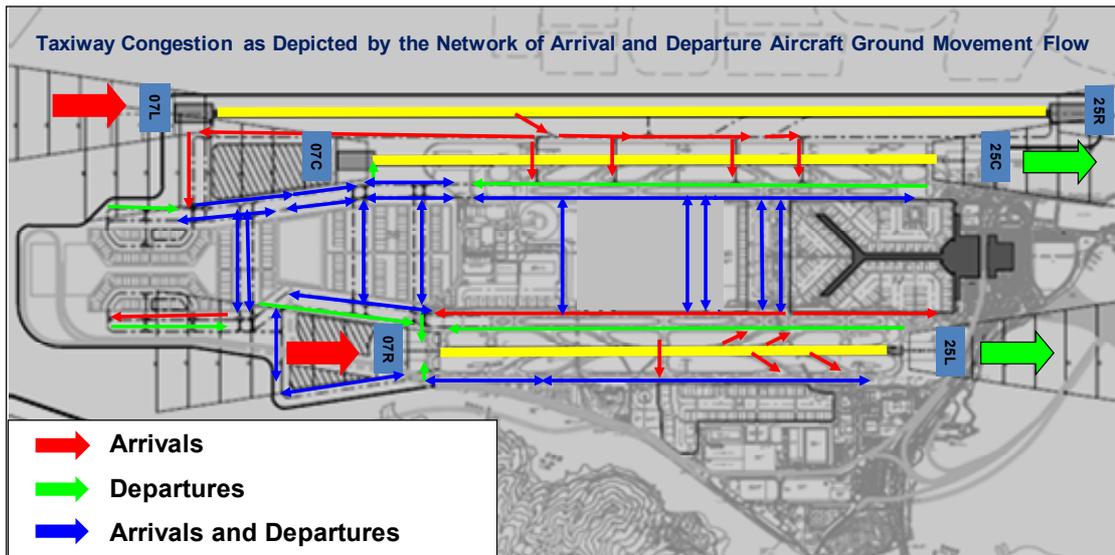
Figure 4 : Runway Capacity of the Westward Expansion Option

Runway	Use	Capacity	Arrivals	Departures
07L/25R	Arrivals	31	31	—
07C/25C	Departures	35	—	35
07R/25R	Mixed	31	15.5	15.5
Total	—	97	46.5	50.5

- c) The close-spaced third runway does not allow room for locating the additional passenger aircraft stands requirement adjacent to the third runway as compared

to the Northward Expansion Option. Passenger aircraft arriving on the third runway need to move through the existing airfield to reach the apron on the western land reclamation or Midfield area for parking, creating longer taxiing time, more ground congestion and delays, and more runway crossings than the Northward Expansion Option which will likely further reduce runway capacity of this option to less than 97 movements per hour (see Figure 5).

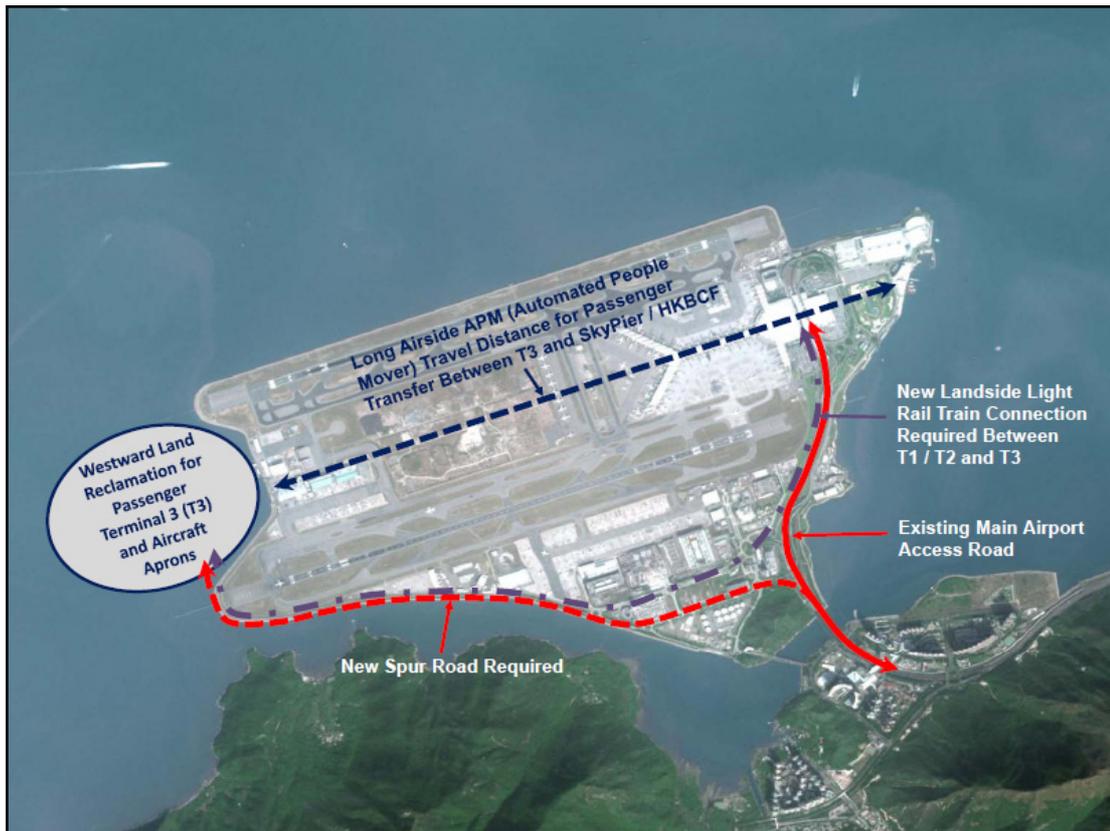
Figure 5 : Aircraft Ground Movements Congestion under the Westward Expansion Options



Passenger Convenience

The Westward Expansion Option for developing a new passenger processing terminal (referred to as Terminal 3 or T3 during the preliminary assessment stage) and a new passenger concourse at the western side of the airport island would require passengers to make an early decision when approaching T1, T2 or T3. Due to the large distance separation between T3 and T1/ T2, a problem of route recovery is expected from T3 to T1/ T2, or vice versa, in case passengers were to proceed to the wrong passenger processing terminal. There would also be more hassle and longer travelling distances for inter-terminal transfers and inter-modal connections with Hong Kong-Zhuhai-Macao Bridge (HZMB) (see Figure 6) and SkyPier already located on the eastern side of the airport island.

Figure 6 : Passenger Inconvenience of the Westward Expansion Options



On the other hand, the Northward Expansion Option for the development of the new passenger concourses would lessen passenger inconvenience issues associated with the Westward Expansion Option. The Northward expansion option would have passengers from the new concourses processed through the existing passenger terminal zone via reconfiguration of the existing T2 into a full-fledged departures and arrivals terminal with dedicated underground Automated People Mover (APM) and Baggage Handling System (BHS) linked to the new passenger concourses.

Surface Access Quality

- d) The Westward Expansion Option cannot share the existing fully integrated ground transportation facilities already established at the eastern side of the airport island, particularly the direct connections to the Airport Express Line (AEL) station to downtown and the APM station to the SkyPier ferry terminal and future Hong Kong Boundary Crossing Facilities (HKBCF) (see Figure 7). The split passenger terminal zones associated with the Westward Expansion Option would inevitably lead to inferior surface access quality compared to that of a centralised passenger processing terminal zone that is provided for under the Northward Expansion Option.

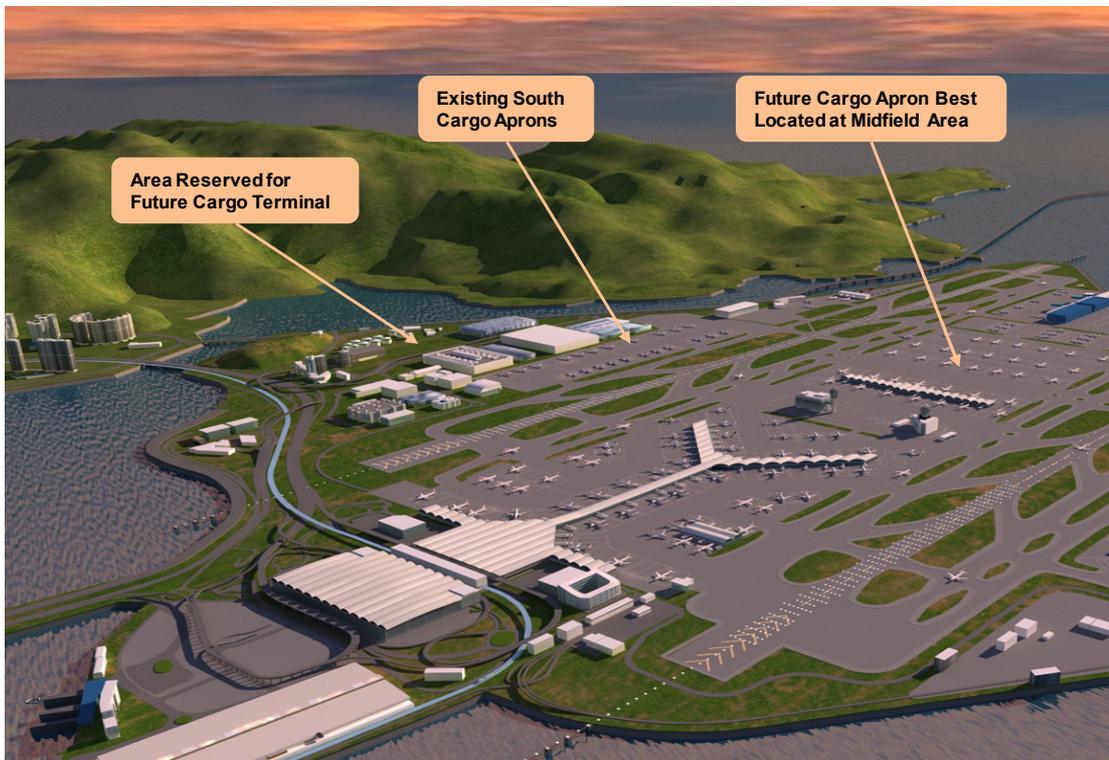
Figure 7 : AEL and SkyPier Ferry Terminal



Cargo Operations Efficiency

- e) Given that cargo transport is time-critical, it is preferred to locate the new freighter stands at the Midfield to allow shorter towing distances between the new freighter stands and the cargo terminals in the Southern Cargo Precinct (see Figure 8). This could only be achieved under the Northward Expansion Option but not the Westward Expansion Option which needs to assign the entire Midfield area for new passenger concourses development to minimise taxiing distance to/from passenger aircraft stands.

Figure 8 : Preferred Location of Future Cargo Apron and Freighter Stands



Environmental Considerations

The environmental review and preliminary assessments were designed to inform the options selection process in this Master Plan, and environmental aspects have been a key factor in the determination of a preferred expanded airport layout plan. The preliminary environmental assessment has identified environmental impacts that may potentially arise during the construction and operational phases of the proposed airport expansion.

A more focused preliminary assessment of several key identified environmental issues was completed, and based on this a set of key environmental impact “differentiators” were identified to compare and rank the two airport expansion options systematically.

In evaluating the relative ranking of the two options (see Figure 9), best professional judgment from an environmental perspective was exercised, giving more focus on key environmental impacts that were regarded as long-term and irreversible.

Figure 9 : Qualitative Environmental Impact Comparison between the Two Airport Expansion Options, with the Ranking “1” Representing the Better Performer between the Two

Key Environmental Aspect and Differentiators	Relative Ranking of Options	
	Option W	Option N
<p>Water Quality & Hydrodynamics <i>Construction Phase:</i></p> <ul style="list-style-type: none"> - Increase in suspended solid (SS) concentrations at water sensitive receivers (WSRs) - Release of sediment fines and contaminants during ground treatment with deep cement mixing (DCM) within contaminated mud pits (CMPs) <p><i>Operational Phase:</i></p> <ul style="list-style-type: none"> - Change in tidal flow - Erosion of seabed - Change in flushing capacity at existing Airport channel - Potential water quality impact from poorly flushed embayment 	<p>Although avoids need for DCM over CMPs, less preferred option in terms of change in tidal flow and most significant increase in SS concentration at nearest WSRs (Sha Lo Wan coastline). Also, reduction in flushing capacity may occur due to narrowing of the width of the Airport channel and extension of its length. Impacts judged as “high”.</p>	<p>Preferable option due to expected less increase in SS concentrations during the construction phase and least impact on tidal flow and erosion of seabed during the operational phase. The requirement for DCM to stabilize CMPs is not considered significant due to effective available mitigations including use of a sand blanket during DCM work. Impacts judged as “medium”.</p>
Ranking	2	1
<p>Marine Ecology <i>Construction Phase:</i></p> <ul style="list-style-type: none"> - Disturbance to Horseshoe Crabs nursery grounds - Impact of increased SS concentrations on marine ecological sensitive receivers - Disturbance to existing coral and artificial reefs <p><i>Operational Phase:</i></p> <ul style="list-style-type: none"> - Loss of intertidal habitats - Loss of soft-bottom habitats - Loss of coral communications 	<p>Less preferred option in terms of marine ecology due to proximity to Sha Lo Wan coastline and due to as relatively more significant dredging requirement, resulting in increased disturbance to Horseshoe Crab nursery grounds. Disturbance judged “medium”.</p>	<p>This option performs relatively better as it is associated with the smallest extent of potential intertidal habitat loss and coral community loss. Disturbance to nursery grounds of Horseshoe Crabs in Sha Lo Wan is also judged as “low”.</p>
Ranking	2	1
<p>Chinese White Dolphins <i>Construction Phase:</i></p> <ul style="list-style-type: none"> - Disturbance to CWD feeding grounds - Disturbance to dolphin calves <p><i>Operational Phase:</i></p> <ul style="list-style-type: none"> - Habitat loss - Permanent loss of feeding grounds - Proximity to Sha Chau & Lung Kwu Chau Marine Park 	<p>Less preferred in terms of potential impact on CWD. Footprint affects the highest number of CWDs in terms of habitat loss; largest area with dolphin calves; and the largest feeding ground to be lost permanently. Although the site boundary is most distant from the Sha Chau and Lung Kwu Chau Marine Park, overall impacts rank as “high” significance.</p>	<p>Extent of loss of feeding grounds is lower than Option W. Potential Impacts during construction and operational phases are judged to be of “medium” significance.</p>
Ranking	2	1

Key Environmental Aspect and Differentiators	Relative Ranking of Options	
	Option W	Option N
Waste <i>Construction Phase:</i> - Quantity of dredged sediment	Less preferred option as volume of dredged sediment requiring disposal is highest; impact classified as "high".	Preferable option due to less dredged sediment requiring disposal; impact classified as "low".
Ranking	2	1
Landscape & Visual <i>Construction & Operational Phases:</i> - Distance to Visual Sensitive Receivers in Sha Lo Wan Distance to Visual Sensitive Receivers in Tung Chung	Less preferred from potential visual impact perspective - due to closer proximity to VSRs in Sha Lo Wan.	This option performs relatively better by increasing distance separation from nearest VSRs in Sha Lo Wan.
Ranking	2	1

It is reiterated that should the Three-Runway system option be adopted, the airport expansion project will be subject to full EIA in accordance with criteria and stipulations detailed in the EIA Ordinance and its 'Technical Memorandum on EIA Process'.

Appendix 4 : Assumptions Used in the Preliminary Aircraft Noise Analysis for the Three-Runway System Option

1. Methodology

This section provides an overview of the assumptions considered in the preliminary analysis on the aircraft noise for the Three-Runway System Option conducted by the consultant, URS, and the analytical techniques utilized to develop the Noise Exposure Forecast (NEF) contours.

Based on historical profiles of air traffic movements as well as patterns of runway directions and flight tracks utilisation, AAHK has provided aircraft operational forecasts while the Airport Infrastructure Planning and Development Users Working Group (AIPDUWG) comprising the airport community has provided broad assumptions on potential noise mitigation measures for URS to compile the detailed model input parameters that were used in the noise modelling for the Three-Runway System Option at Design Capacity Year.

Computer Noise Modelling

- 1.1 The average daily aircraft operational forecasts were used to develop cumulative noise contours in the NEF metric using the Computer Noise Modelling tool called Integrated Noise Model (INM). The following provides additional information regarding the INM and the NEF metric.

1.2 *Integrated Noise Model*

INM Version 7.0b, was used to perform the noise analysis. The INM was developed in the United States by the Federal Aviation Administration (FAA) specifically for the analysis of aircraft noise levels in the vicinity of airports. Although developed in the U.S., the INM is a state-of-the-art and internationally accepted method for the prediction of airport-related noise levels.

The INM combines accepted mathematical methods for the calculation of aircraft noise with an extensive database of aircraft acoustic and performance information. The model requires user input in the form of air traffic movements, runways, runway use, flight tracks, flight track use, and other airport operational conditions. The output can be obtained in either tabular or graphic form for a variety of noise metrics. The model is most frequently used to develop plots of equal cumulative average daily noise levels called noise contours.

1.3 *Noise Exposure Forecast Metric and Hong Kong Noise Standards*

The INM was used to generate cumulative noise contours for average-daily conditions assuming the Noise Exposure Forecast metric, or NEF. The NEF metric is one of several accepted methods to measure and evaluate cumulative aircraft noise levels. NEF has been adopted as the official noise metric for several countries and is the official metric used in Hong Kong.

The NEF metric represents average daily noise levels that would occur over a 24-hour period with a 12.2 dB penalty added to noise levels of air traffic movements occurring between the hours of 10:00 p.m. and 6:59 a.m., which is considered night-time. The 12.2 dB penalty is applied to account for the increased disturbance that noise intrusions can cause during night-time hours. Therefore, in terms of disturbance and NEF impacts, this penalty is equivalent to one night-time movement equalling 16.7 daytime movements (of the same aircraft). Since the penalty is applied to night-time (10:00 p.m. through 6:59 a.m.) movements in the NEF metric, daytime and night-time movements by aircraft types (and departure stage length) are separated in the INM.

Contours were generated at levels of NEF 25, 30, and 40. In Hong Kong, most land uses are considered compatible at noise levels of 25 NEF or less. Conversely, most non-aviation and non-industrial land uses are considered to be incompatible at noise levels of 40 NEF or more. Noise standards documented in *Environmental Guidelines for Planning in Hong Kong* (April 1991) are summarised in Figure 1.

Figure 1 : Summary of Hong Kong Noise Standards

Uses	Aircraft Noise (Noise Exposure Forecast: NEF)
All domestic premises including temporary housing accommodation	25
Hotels and hostels	25
Offices	30
Educational institutions including kindergartens, nurseries, and all other where unaided voice communication is required	25
Places of public worship and courts of law	25
Hospitals, clinics, convalescences and homes for the aged	25
Amphitheatres, and auditoria, libraries, performing arts centres and country parks	Depends on use, extent, and construction.

Notes: The above standards apply to uses that rely on opened windows for ventilation.
The above standards should be viewed as the maximum permissible noise levels at the external facade.

Source: Planning Department’s Hong Kong Planning Standards and Guidelines, Chapter 9 on Environment relating to Guidelines on Noise Emitters for Aircraft Noise, Table 4.1 on Summary of Noise Standards, Weblink: http://www.pland.gov.hk/pland_en/tech_doc/hkpsg/full/index.htm

2. Summary of Assumptions for the Three-Runway System Option

Figure 2 : Air Traffic Movements Forecast by Aircraft Category at Design Capacity Year

Aircraft Group	Design Capacity Year	
	Annual	Average Day
Large	372,014	1,019.22
Medium	33,133	90.78
Small	214,731	588.30
Military	121	0.33
Total Movements	620,000	1,698.63

Notes: Large Aircraft – A330, A340, A380, B747, B777, DC10, MD11, etc.
 Medium Aircraft – A300, A310, B757, B767, etc.
 Small Aircraft – A319, A320, B717, B727, B737, MD81, MD90, CRJ, EMB, LRJ, etc.
 Military Aircraft – C2, C5, C17, etc.

Figure 3 : Air Traffic Movements Forecast by Market Split at Design Capacity Year

Market								
Europe	Japan	Mainland	SE Asia	Taiwan	USA & Canada	Australasia	Others	Total
8%	6%	37%	17%	11%	7%	4%	10%	100%

Sources: AAHK, 2010; URS Corporation, 2010.

Aircraft Movements Forecast by Day/Night Split at Design Capacity Year

- 2.1. The temporal distribution of air traffic movements throughout the day at Design Capacity Year was forecast to be 82% for the NEF daytime period (7:00 a.m. – 9:59 p.m.) and 18% for the NEF night-time period (10:00 p.m. – 6:59 a.m.)

Figure 4 : Runway Primary Mode of Operation

Runway 07 Direction	
Runway	Use
07L (North)	Arrivals
07C (Centre)	Departures
07R (South)	Mixed
Runway 25 Direction	
Runway	Use
25R (North)	Arrivals
25C (Centre)	Departures
25L (South)	Mixed

Source: Recommendation from the Airspace and Runway Capacity Consultancy Study by NATS

Figure 5 : Runway Direction Usage (07/25) at Design Capacity Year

Runway Utilisation 7:00 A.M. to 10:59 P.M.		
Runway End	Arrivals	Departures
07	60%	60%
25	40%	40%
Runway Utilisation 11:00 P.M. to 4:59 A.M.		
Runway End	Arrivals	Departures
07	10%	10%
25	90%	90%
Runway Utilisation 5:00 A.M. to 6:59 A.M.		
Runway End	Arrivals	Departures
07	90%	90%
25	10%	10%

Note: Runway 07 means take-off to the east or land from the west; Runway 25 means take-off to the west or land from the east

Source: Recommendation from the AIPDUWG

Proposed Flight Tracks

2.2. NATS, the consultant for the airspace and runway capacity analysis has taken into account terrain surrounding HKIA, existing and potential restructuring of airspace use with the presence of neighbouring airports, performance capability of aircraft and air traffic control (ATC) handling procedures etc. in recommending the flight tracks to be adopted by the Three-Runway System Option, which are summarised in Figures 6-8. For the purpose of noise analysis, the allocation of air traffic movements to/from different markets onto various flight tracks was assumed upon discussions and judgement amongst the AIPDUWG to strive towards routing traffic in the most direct path and efficient manner, taking into consideration the airspace structure and ATC traffic handling procedures as well.

Figure 6 : Preliminary Noise Contour Analysis for Third Runway System Option – 8:00am to 11:00pm Flight Tracks

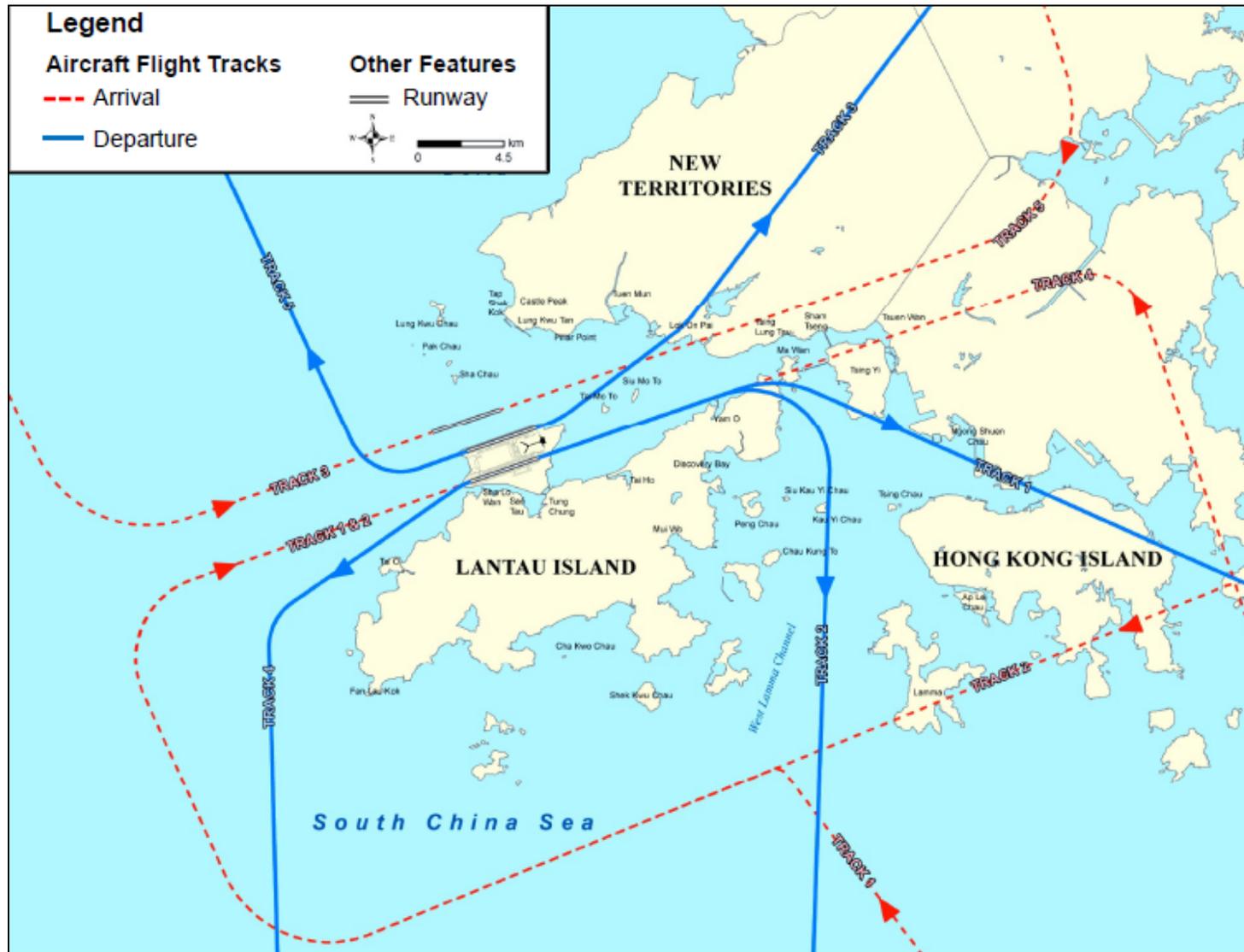


Figure 7 : Preliminary Noise Contour Analysis for Third Runway System Option – 11:00pm to 1:00am Flight Tracks

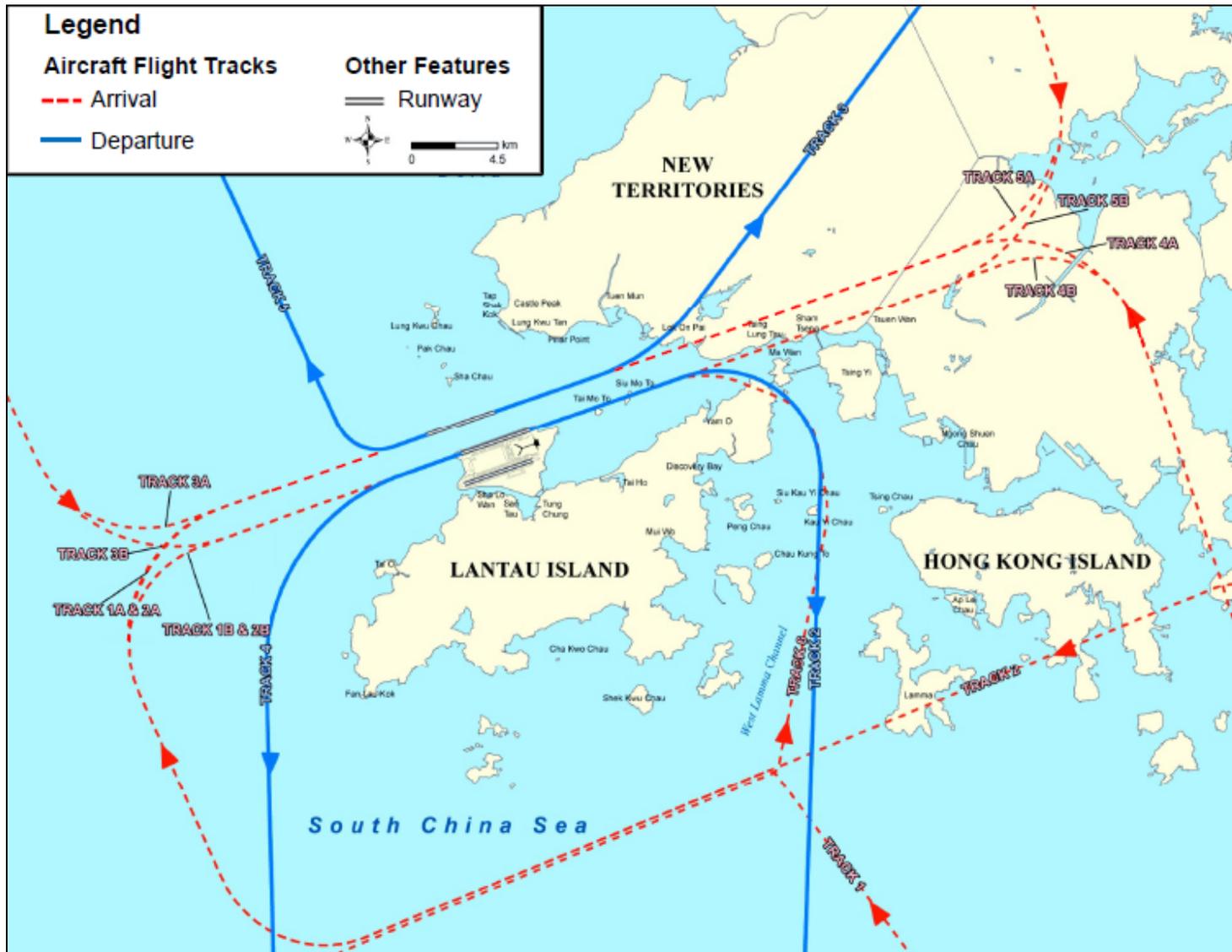
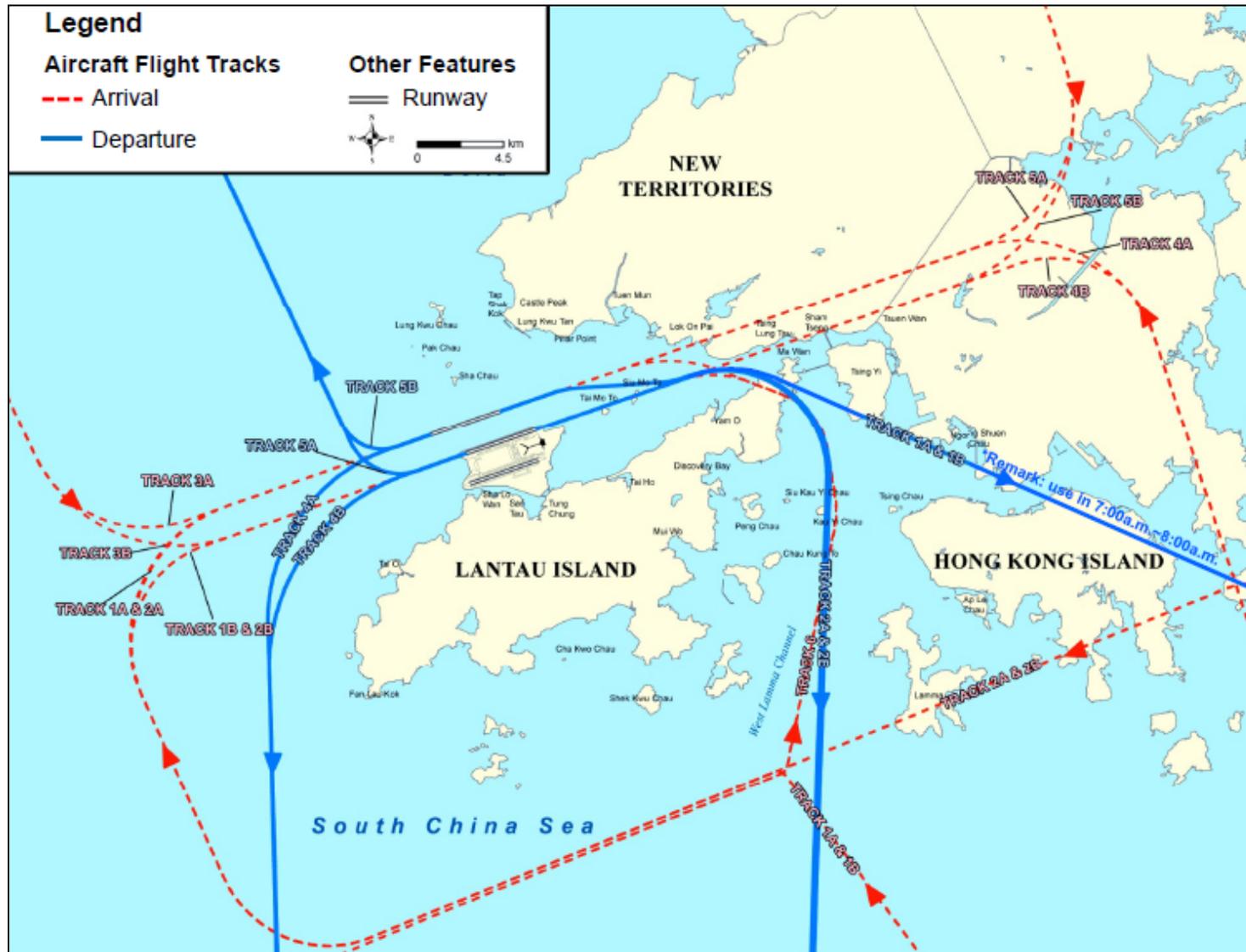


Figure 8 : Preliminary Noise Contour Analysis for Third Runway System Option – 1:00am to 8:00am Flight Tracks



Appendix 5 : Economic Impact Assessment Methodology

1. Methodologies and Data Sources

This section on methodologies and data sources describes the details of how the economic impact analysis has been implemented for Master Plan 2030. First, it will describe the methods behind the estimation of the present economic impact of Hong Kong International Airport (HKIA) and related businesses on Hong Kong's economy. Second, it will describe how future economic impacts and the specific investment options for HKIA were addressed.

Present HKIA Economic Impact

The present economic impact consisted of two major components. First, the direct, indirect, and induced impacts of aviation-related industries were estimated. Second, estimates were made of the direct, indirect, and induced impacts of other businesses on Chek Lap Kok, the airport island. This appendix focuses on the estimation procedure and data sources for these two components. The economic impact of HKIA was estimated for 2008 to correspond with other Airport Authority Hong Kong (AAHK) planning documents. 2009 was taken as the base year for future economic impact projections.

Direct impacts of aviation and non-aviation businesses at HKIA

Aviation-related businesses

Direct impacts from aviation-related businesses result from the revenues, value added, and employment in aviation-related sectors in Hong Kong. The core assumption made is that these businesses would not exist without the presence of HKIA. The direct aviation-related businesses identified for the present analysis correspond with the Hong Kong Census and Statistics Department (HKCSD) category "Air Transport and Incidental Services." This category includes Hong Kong-based airlines and helicopter companies, the local representative offices of overseas airline companies, air cargo forwarding services, and supporting services to air transport (including HKIA). The revenue, value added and employment figures for this category were taken directly from the HKCSD data⁸⁴. It should be noted that a significant portion of the activities of the aviation-related businesses take place outside of HKIA itself.

Non-aviation businesses at HKIA

In addition to aviation-related businesses, there are a number of other businesses at HKIA and on Chek Lap Kok. These include retail, food and beverage, and hotels at the airport itself, as well as the exhibition and convention businesses at AsiaWorld-Expo. In order to estimate the direct impact of the retail and food and beverage businesses, data on the revenues and employment of the relevant businesses at HKIA was obtained from the AAHK. These figures were adjusted by removing estimates of the spending of Hong Kong residents. The reason is that it can be argued that in the absence of HKIA, retail and food and beverage spending by Hong Kong residents at HKIA would go to retail and

⁸⁴ Hong Kong Census and Statistics Department (HKCSD), direct communication January 2011.

food and beverage outlets elsewhere in Hong Kong and therefore HKIA is not responsible for new spending accruing to Hong Kong by these passengers. To the extent that a full 100 percent of this expenditure would not actually occur in the absence of HKIA, the estimate will be conservative. Direct value added and employment for these sectors were estimated by applying the value added to revenue and employment to revenue ratios for these sectors reported by HKCSD⁸⁵ to the adjusted revenues at HKIA.

For hotels on the airport island, including the five-star Regal Airport Hotel and the five-star Hong Kong SkyCity Marriott Hotel, expected hotel revenue was calculated by multiplying the average occupancy rate for five-star hotels in Hong Kong by the five-star hotel average annual revenue per room⁸⁶ and by the number of rooms in each hotel⁸⁷. Value added and employment were estimated by applying to the estimated revenues the value added to revenue and employment to revenue ratios reported for the hotel industry by HKCSD⁸⁸.

Revenues for the exhibition and convention business were taken to equal the total square meters of exhibition space let times the average industry expenditure per square meter⁸⁹. Expenditures by exhibitor and delegate staff attending the events were not included in the estimates, making these estimates conservative. As HKCSD does not provide a specific category analogous to the exhibition and convention industry, value added and employment were estimated by using the ratios of value added to revenue and employment to revenue for HKCSD's "Administrative and support service activities" category⁹⁰.

Indirect and induced impacts

Indirect impacts reflect the result of the purchases of the direct businesses. Induced impacts reflect the result of the spending of employees in the direct and indirect businesses in the wider economy. Indirect and induced multipliers were calculated from a combination of ratios derived from data available from HKCSD and economic multipliers (see Figures 1 and 2) for years 2008 and 2006-2008. The multipliers relating direct plus indirect value added to gross output and business receipts were provided by the Economic Analysis and Business Facilitation Unit (EABFU), Hong Kong Financial Secretary's Office, as broad working assumptions for use in the HKIA Master Plan 2030 economic impact analysis. These are produced based on the observed linkages between sectors and the resultant pattern of intermediate consumption, import leakages of the various economic activities, gross margin of external trade, and the ratios of value added to gross-output and business receipts for the affected sectors in recent years. In addition, Economic Analysis and Business Facilitation Unit provided multipliers for the link between consumer spending and value added in the Hong Kong economy. ESA have

⁸⁵ Hong Kong Census and Statistics Department, Website Table 90, *Selected Statistics for All Establishments in the Industry Sections of Import/Export, Wholesale and Retail Trades, and Accommodation and Food Services*.

⁸⁶ Hong Kong Hotels Association and Hong Kong Tourism Board, *Summary of the Hong Kong Hotel Industry Review*, 2008 and 2009. All Hong Kong Census and Statistics Department tables were accessed January 2011.

⁸⁷ Regal Airport Website and Airport Authority.

⁸⁸ Hong Kong Census and Statistics Department, Website Table 90, *Selected Statistics for All Establishments in the Industry Sections of Import/Export, Wholesale and Retail Trades, and Accommodation and Food Services*.

⁸⁹ Exhibition and convention industry sources.

⁹⁰ Hong Kong Census and Statistics Department, Website Table 91, *Selected Statistics for All Establishments in the Information and Communications, Financing and Insurance, Professional and Business Services Sections*.

taken these values as the Induced Value Added to Revenue Multiplier, as induced spending is consumer spending by employees in direct and indirect industries. ESA also applied the air transport ratio of gross output to revenue to transform the air transport value added to gross output multipliers provided by EABFU into value added to revenue multipliers for the economic impact analysis. As the bulk of the economic impact of non-aviation businesses at HKIA is generated by foreign spending on hotel, retail, food and beverages, Enright, Scott & Associates (ESA) has used the multiplier for tourism for this category.

Figure 1 : Economic Multipliers 2008

Industry	Multiplier
Direct + Indirect Value Added Multiplier	
Air Transport	0.251
Tourism	0.561
Induced Value Added to Induced Revenue Multiplier	0.593

Source: Economic Analysis and Business Facilitation Unit, Hong Kong Financial Secretary's Office and Enright, Scott & Associates, Ltd.

Figure 2 : Economic Multipliers 2006 - 2008

Industry	Multiplier
Direct + Indirect Value Added Multiplier	
Air Transport	0.291
Tourism	0.563
Induced Value Added to Induced Revenue Multiplier	0.605

Source: Economic Analysis and Business Facilitation Unit, Hong Kong Financial Secretary's Office and Enright, Scott & Associates, Ltd.

For aviation-related businesses and non-aviation businesses at HKIA, Indirect Value Added was estimated by first multiplying Direct Revenue by the relevant Direct Plus Indirect Value Added Multiplier and then subtracting the Direct Value Added obtained through methods described above.

$$\text{Indirect Value Added} = (\text{Direct Revenue} \times \text{Direct Plus Indirect Value Added to Direct Revenue Multiplier}) - \text{Direct Value Added}$$

For aviation-related businesses and non-aviation businesses at HKIA, Indirect Revenue was estimated by subtracting Direct Value Added from Direct Revenue. The assumption here is that import leakage is balanced by the contribution of all of the local supply industries upstream of the focal industry. Since no other estimate depended on Indirect Revenues, and in the absence of a Hong Kong-specific multiplier for Direct to Indirect Revenue, this approximation was taken as the best available.

$$\text{Indirect Revenue} = \text{Direct Revenue} - \text{Direct Value Added}$$

For all industries, Indirect Employment was estimated by multiplying Indirect Value Added by the economy wide ratio of employment to value added. The economy-wide ratio was used because it is not possible to reverse engineer all of the upstream

industries that are involved from the multiplier.

$$\text{Indirect Employment} = \text{Indirect Value Added} \times (\text{Employment/ Value Added})_{\text{Hong Kong}}$$

Induced Revenue refers to the revenue generated by the purchases of people employed in the direct and indirect industries and was calculated from the following formula:

$$\text{Induced Revenue} = [(\text{Direct VA})_{\text{Industry}} \times (\text{Comp/ VA})_{\text{Industry}} \times (1 - \text{HK SR})] + [(\text{Indirect VA})_{\text{Industry}} \times (\text{Comp/ VA})_{\text{Economy}} \times (1 - \text{HK SR})]$$

Where (Direct VA)_{Industry} is the direct value added for the industry, (Comp/ VA)_{Industry} is the compensation portion of value added in the industry, HK SR is the economy-wide Hong Kong savings rate, (Indirect VA)_{Industry} is the industry's indirect value added, and (Comp/ VA)_{Economy} is the compensation portion of value added in the Hong Kong economy. (1-HK SR) or one minus the savings rate, is the portion of income that is spent by consumers in Hong Kong.

Induced Value Added was estimated by multiplying Induced Revenue by the Induced Value Added to Induced Revenue Multiplier found in the figure above. Induced Employment was estimated by multiplying Induced Revenue by the ratio of retail trade employment to revenue for Hong Kong. The assumption here is that most spending will be on retail goods.

$$\text{Induced Value Added} = \text{Induced Revenue} \times \text{Induced Value Added to Induced Revenue Multiplier}$$

$$\text{Induced Employment} = \text{Induced Value Added} \times (\text{Employment/Value Added})_{\text{Retail, Hong Kong}}$$

The methodology for calculating direct, indirect, and induced impacts is summarised in Figure 3.

Figure 3 : Economic Impact Method Summary

	Revenue	Value Added	Employment
Direct	DREV from HKCSD data or AA	DVA from HKCSD or relevant VA/REV ratio from HKCSD	DEMP from HKCSD or relevant EMP/REV ratio from HKCSD
Indirect	INDIREV = DREV-DVA, except for trade INDIREV = INDIVA x EREV/EVA	INDIVA = DREV x MULTIPLIER₁ – DVA	INDIEMP = INDIVA x EEMP/EVA
Induced	INDUREV = DVA x (DCOMP/DVA) x (1-HKSR) + INDIVA x (ECOMP/EVA) x (1-HKSR)	INDUVA = INDUREV x MULTIPLIER₂	INDUEMP = INDUVA x Retail EMP /Retail VA

D = Direct, INDI = Indirect, INDU = Induced

REV = Revenue, VA = Value Added, EMP = Employment

E = Economy wide, COMP = Compensation

MULTIPLIER₁ = Direct + Indirect Value Added Multiplier for relevant industry

MULTIPLIER₂ = INDUVA to INDUREV Multiplier

HKSR = Hong Kong Savings Rate

Economic Impact of Capital Investment

The infrastructure construction under each of the investment options, Option 1 (expansion of two runway capacity at HKIA), and Option 2 (including construction of a third runway at HKIA) will generate direct, indirect, and induced economic impacts.

In order to calculate the direct construction impacts, data for each option on the forecast material, labour and plant costs, and persons to be employed were obtained from the AA, together with details of the planned construction phases.

Option 1 construction activity is planned to take place in three phases. Phase 1 of construction would take place during the period 2015 to 2020, Phase 2 from 2020 to 2025, and Phase 3 from mid 2025 to 2030. Phase 1 to 3 activities would include the development of mid-field infrastructure such as terminal buildings, and aprons to maximise capacity for two runways.

Option 2 construction activity is planned to take place in three phases. Phase 1 of construction would take place during the period mid 2012 to mid 2020, Phase 2 from 2021 to 2025, and Phase 3 from 2026 to 2030. Phase 1 activities would include land reclamation, the construction of the third runway and associated terminal buildings, and the construction of related infrastructure. Phases 2 and 3 will include continued construction of concourse and associated taxiways/ taxilanes.

For each of these options, Direct Revenue to the construction companies is equal to the projected total sum of material, plant, and labour costs for the project. Direct Value Added is calculated as projected labour costs minus projected labour import leakages plus the projected profit margin for the construction companies. Labour leakages were estimated with reference to figures for the construction of Chek Lap Kok airport which indicate that labour import percentages ran as high as 20 percent⁹¹, and in consultation with the AA. Given that the project scale of building Option 1 or Option 2 is smaller than that for building Chek Lap Kok, and there are likely to be fewer major projects going on in Hong Kong at the same time than was the case then, it seems likely that there will be less competition for labour than there was when Chek Lap Kok was built, and that the need for imported labour will be mainly limited to specialists in the technical and management aspects of airport runway construction. On this basis, an estimate of 5 percent labour leakage is considered reasonable and is assumed in the present case. The projected profit margin for construction companies is 6.2 percent. This was taken as the ratio of gross surplus to total revenue for the Hong Kong construction industry.

Direct Employment, measured in "person-years," was calculated using estimates of the average "person-days" to be worked on each of the various activities involved in the construction of each option. The AA provided the estimated average person-day construction works schedule. The impact on Direct Employment was adjusted to take into account estimated import leakages for labour which again were assumed to be 5 percent.

Indirect revenue was estimated by taking projected costs for material and plant and

⁹¹ Legislative Council Brief, Special Importation of Labour Scheme for the New Airport and Related Projects, Education and Manpower Branch, 1993

adjusting them by subtracting import leakages. Import leakages for materials were assumed to be 80 percent on the basis that the majority of goods that are imported into Hong Kong arrive in a finished, or close to finished, state. Plant import leakages were assumed to be 50 percent. Although all, or nearly all, of the plant is likely to be imported, the total cost of plant includes items such as setup, ongoing maintenance work, and the management of leases relating to plant, and these items are estimated to reduce overall leakage to 50 percent.

Indirect Value Added was estimated by multiplying Indirect Revenue by the economy wide ratio of Value Added to Revenue. This ratio was calculated from HKCSD data. Indirect Employment was estimated by multiplying Indirect Value Added by the economy wide ratio of Employment to Value Added. This ratio was calculated from HKCSD data.

Induced Revenue, Value Added, and Employment were calculated following the same method as used in estimating the operational economic impact of HKIA. Accordingly, Induced Revenue was calculated from the following formula:

$$\text{Induced Revenue} = [(\text{Direct VA})_{\text{Industry}} \times (\text{Comp/ VA})_{\text{Industry}} \times (1 - \text{HK SR})] + [(\text{Indirect VA})_{\text{Industry}} \times (\text{Comp/ VA})_{\text{Economy}} \times (1 - \text{HK SR})]$$

Where $(\text{Direct VA})_{\text{Industry}}$ is the Direct Value Added for the industry, $(\text{Comp/ VA})_{\text{Industry}}$ is the compensation portion of Value Added in the industry, HK SR is the economy-wide Hong Kong savings rate, $(\text{Indirect VA})_{\text{Industry}}$ is the industry's Indirect Value Added, and $(\text{Comp/ VA})_{\text{Economy}}$ is the compensation portion of Value Added in the Hong Kong economy.

Induced Value Added is estimated using the multiplier on private consumption expenditure provided by the EABFU, Hong Kong Financial Secretary's Office for the value added to consumer spending ratio for Hong Kong. Induced Employment was estimated by multiplying estimated Induced Value Added by the ratio of retail trade Employment to Value Added of calculated from HKCSD data. Implicit in this is the assumption that employment in the retail sector per dollar of value added is broadly comparable to employment in the other spending categories per dollar of value added.

Future Projections

The economic impact analysis for the present provides a basis for estimates of future economic impacts. However, a number of additional assumptions and methods are necessary to project these impacts. We separate these into assumptions and methods that affect base economic impact projections and those specific to the projection of the economic impact of each option at HKIA.

Base projections

To generate future economic impact projections, it was necessary to obtain throughput or traffic forecasts (representing both demand and capacity) for HKIA, and to generate scale factors that link future economic impact to the number of passengers and the amount of cargo handled by HKIA. The traffic forecasts were provided to ESA by AAHK, as produced by their Airport Master Plan Consultant for Option 1 and Option 2.

Scale factors for each major line of business were generated based on year 2009 data, and the relevant passenger and cargo throughput information. For businesses that are likely to scale with passenger numbers (retail, food and beverage, and land transport for passengers), the most recent revenue per passenger was calculated and applied to projected passenger numbers. For businesses most likely to scale with cargo (cargo related services, exhibitions, etc.), revenue per tonne of cargo throughput was calculated for the most recent year for which data was available and then applied to the projected cargo throughput numbers. For businesses where it was not possible to separate passengers and cargo (for example, the HKCSD “Air Transport and Incidental Services” category), the future projections were scaled by work load unit (WLU) defined in Figure 4.

Figure 4 identifies each major line item in the analysis and whether the future projections are based on projected passenger numbers, cargo throughput or workload unit.

Figure 4 : Economic Model Industry Line Items Scale Factors

Industry	Scale Factor
<i>Aviation-related Business</i>	
Air Transport and Incidental Services - (i) Air Transport & Cargo	Work Load Unit (WLU)
<i>Non-aviation Business at the HKIA</i>	
Total Retail, Food, and Beverage	Visitors arriving by air and Transfer/ Transit passengers
Hotel	Fixed at 2008 occupancy rate
Exhibitions and Conventions	Cargo weight

Note: One WLU equals one passenger or 100 kg of cargo

Source: Enright, Scott & Associates, Ltd. research.

The economic impact of Option 1 and Option 2 at HKIA

The estimates of the economic impact of Option 1 and Option 2 at HKIA on Hong Kong’s economy were generated by taking the economic contribution of HKIA projected in Option 1 or Option 2 and subtracting from this the economic contribution of HKIA projected in the Status Quo situation with the net difference being the economic impact of Option 1 or Option 2.

Appendix 6 : Economic Impact Assessment – Economic Net Present Value (ENPV)

Beyond estimating and projecting the net economic impacts of each investment option in nominal dollars, it is useful to assess the size of the economic return on investment to Hong Kong from each investment option in turn.

In general, this can be expressed in the form of an Economic Internal Rate of Return (EIRR) and also as an Economic Net Present Value (ENPV). The EIRR and ENPV calculations are similar to the more commonly performed Internal Rate of Return (IRR) and Net Present Value (NPV) calculations, the main difference being that the “returns” or “inflows” used in doing an EIRR/ENPV are typically larger than the projected cash inflows that are used in doing an traditional IRR/NPV analysis because they may include broader economic benefits such as indirect impacts stemming from the suppliers providing goods and services to the direct activities in the project, and induced impacts from the spending of income generated by the direct and indirect activities. The capital costs or “outlay” expenditures that are estimated are the same as those that would be used in a regular IRR/NPV calculation and represent the actual cost of the project.

For the present project, given the significant difference in investment profiles and the noted shortcoming of EIRR (that it tends to favour projects with short-term paybacks at the expense of projects with longer paybacks regardless of the overall value generated by the project), ESA has recommended not to base the investment evaluation on EIRR and instead, ENPV was adopted. The ENPVs were calculated assuming a discount rate of 4 percent provided by the Economic Analysis and Business Facilitation Unit (EABFU) of the Hong Kong Financial Secretary’s Office and is understood to be the rate that is commonly taken as the imputed discount rate used for capital budgeting purposes for projects that are government funded in Hong Kong.

For the various options and cases investigated, ESA report the ENPVs for the direct benefits, direct plus indirect benefits, and direct plus indirect plus induced benefits.

For each of the cases estimated, a 50 year period from 2012 to 2061 was taken as the relevant project timeline for the purpose of estimating ENPV. The 50 year period was taken with reference to the time periods used in estimating the economic benefits of other major infrastructure projects, such as the Hong Kong-Shenzhen Western Express Line (WEL), which use 50 years as the projected period of time over which economic benefits may reasonably be estimated. The analysis assumes a nil terminal value for the project in the year 2061.

For each of the cases estimated, the projected costs of each option were taken as being equal to the construction costs for each of the phases.

The projected economic benefits of airport expansion were taken as being equal to the incremental value added for each option. This was calculated by subtracting the projected value added for the Status Quo situation from the projected value added in the Option 1 or Option 2. For each option, after 2030 the annual value added in each year remains constant.

The projected economic cost was subtracted from the projected economic benefit in each year to determine a net economic benefit for each year which was then discounted to present value terms using the 4 percent discount rate giving the estimated ENPV for each option.

The ENPV values can be found in Figures 1-4. In each case, the three rows of results take into account aviation-related businesses and non-aviation businesses at HKIA.

Figure 1 : Option 1 ENPV for a 50 Year Return

Impact	ENPV (HK\$ Millions)
Direct	233,646
Direct + Indirect	347,744
Direct + Indirect + Induced	431,673

Source: Enright, Scott & Associates, Ltd. analysis.

Figure 2 : Option 2 ENPV for a 50 Year Return

Impact	ENPV (HK\$ Millions)
Direct	481,862
Direct + Indirect	729,071
Direct + Indirect + Induced	912,009

Source: Enright, Scott & Associates, Ltd. analysis.

Figure 3 : Option 1 Pessimistic Case ENPV for a 50 Year Return

Impact	ENPV (HK\$ Millions)
Direct	141,502
Direct + Indirect	218,782
Direct + Indirect + Induced	274,527

Source: Enright, Scott & Associates, Ltd. analysis.

Figure 4 : Option 2 Pessimistic Case ENPV for a 50 Year Return

Impact	ENPV (HK\$ Millions)
Direct	162,551
Direct + Indirect	280,909
Direct + Indirect + Induced	367,057

Source: Enright, Scott & Associates, Ltd. analysis.

Appendix 7 : Option 1 – Summary Table of Cashflow and Funding Shortfall ^(Note 1)

(HK \$ billion)	Option 1 Capex (A)	Cash Generated from Our Operations (B)	Expenditure on Committed Capital Projects and Replacement of Fixed Assets (C)	Net Cashflow before Dividend (D) = (B) + (C)	Dividend (Note 2) (E)	Net Cashflow after Dividend (F) = (D) + (E)	Funding Surplus/ (Shortfall) for the year after Dividend (F) + (A)	Cumulative Funding Surplus/ (Shortfall) before Dividend (Note 3) $\sum_{i=1}^n [(D) + (A)]$	Cumulative Funding Surplus/ (Shortfall) after Dividend (Note 3) $\sum_{i=1}^n [(F) + (A)]$
2013/14	—	7.1	(5.0)	2.2	(3.1)	(0.9)	(0.9)	2.2	(0.9)
2014/15	—	6.2	(3.3)	2.9	(3.5)	(0.6)	(0.6)	5.1	(1.5)
2015/16	—	6.5	(1.4)	5.1	(3.8)	1.3	1.3	10.2	(0.2)
2016/17	(0.1)	7.0	(1.5)	5.5	(3.8)	1.7	1.6	15.6	1.4
2017/18	(1.6)	8.3	(4.1)	4.2	(3.8)	0.4	(1.2)	18.2	0.2
2018/19	(4.6)	8.4	(3.5)	4.9	(4.3)	0.6	(4.0)	18.5	(3.8)
2019/20	(3.7)	8.7	(7.1)	1.6	(4.4)	(2.8)	(6.5)	16.4	(10.2)
2020/21	(0.9)	7.7	(4.5)	3.2	(4.6)	(1.5)	(2.4)	18.7	(12.6)
2021/22	(1.1)	8.7	(4.0)	4.7	(4.7)	0.1	(1.0)	22.3	(13.6)
2022/23	(4.5)	10.4	(4.5)	5.9	(4.4)	1.5	(3.0)	23.7	(16.6)
2023/24	(7.1)	10.3	(3.6)	6.7	(5.0)	1.7	(5.4)	23.3	(22.0)
2024/25	(6.4)	10.4	(6.3)	4.1	(5.1)	(1.0)	(7.4)	21.0	(29.4)
2025/26	(1.9)	8.9	(4.5)	4.4	(5.2)	(0.8)	(2.6)	23.5	(32.0)
2026/27	—	9.8	(5.8)	4.0	(5.1)	(1.1)	(1.1)	27.6	(33.1)
2027/28	(0.1)	10.6	(5.0)	5.6	(4.4)	1.2	1.1	33.0	(32.0)
2028/29	(3.9)	11.9	(4.7)	7.2	(4.9)	2.3	(1.6)	36.3	(33.6)
2029/30	(5.4)	11.8	(5.1)	6.8	(4.8)	1.9	(3.4)	37.7	(37.1)
2030/31	(1.3)	10.9	(5.7)	5.2	(4.8)	0.4	(0.9)	41.6	(37.9)
Total (2013/14-2030/31)	(42.5)	163.7	(79.5)	84.2	(79.6)	4.6	(37.9)		

Note:

- The above projections are presented for illustration purposes only and do not represent any forecast adopted by AAHK on its future business performance. The actual outcome of the projections will depend on many factors which cannot be foreseen at this time, and which are outside the control of AAHK. The above figures are subject to rounding differences.
- Dividend refers to payout based on 80% of the net profit of the preceding year.
- Cumulative funding surplus/(shortfall) refers to the sum of preceding year's annual funding surplus/(shortfall) and current year's annual funding surplus/(shortfall).

Appendix 8 : Option 2 – Summary Table of Cashflow and Funding Shortfall ^(Note 1)

(HK \$ billion)	Option 1 Capex (A)	Cash Generated from Our Operations (B)	Expenditure on Committed Capital Projects and Replacement of Fixed Assets (C)	Net Cashflow before Dividend (D) = (B) + (C)	Dividend (Note 2) (E)	Net Cashflow after Dividend (F) = (D) + (E)	Funding Surplus/ (Shortfall) for the year after Dividend (F) + (A)	Cumulative Funding Surplus/ (Shortfall) before Dividend (Note 3) $\sum_{i=1}^n [(D) + (A)]$	Cumulative Funding Surplus/ (Shortfall) after Dividend (Note 3) $\sum_{i=1}^n [(F) + (A)]$
2013/14	(8.2)	7.2	(5.0)	2.4	(3.1)	(0.7)	(8.8)	(5.8)	(8.8)
2014/15	(8.6)	6.6	(3.3)	3.2	(3.5)	(0.3)	(8.9)	(11.1)	(17.7)
2015/16	(9.1)	6.8	(1.4)	5.4	(3.6)	1.8	(7.2)	(14.8)	(24.9)
2016/17	(9.6)	7.3	(1.5)	5.8	(3.8)	2.0	(7.6)	(18.6)	(32.5)
2017/18	(10.1)	8.3	(4.1)	4.2	(3.8)	0.4	(9.7)	(24.5)	(42.3)
2018/19	(12.0)	8.4	(3.5)	4.9	(4.3)	0.6	(11.4)	(31.6)	(53.7)
2019/20	(12.7)	9.3	(7.1)	2.1	(4.3)	(2.2)	(14.9)	(42.1)	(68.6)
2020/21	(13.0)	8.7	(4.5)	4.1	(4.6)	(0.5)	(13.5)	(51.1)	(82.1)
2021/22	(11.9)	9.1	(4.0)	5.2	(4.7)	0.5	(11.5)	(57.8)	(93.5)
2022/23	(5.2)	9.1	(4.5)	4.7	(4.9)	(0.3)	(5.5)	(58.4)	(99.0)
2023/24	(5.4)	10.4	(3.6)	6.8	(3.6)	3.2	(2.2)	(56.9)	(101.2)
2024/25	(6.8)	11.7	(6.2)	5.5	(4.0)	1.5	(5.3)	(58.2)	(106.5)
2025/26	(7.0)	11.5	(5.0)	6.5	(4.4)	2.1	(4.9)	(58.8)	(111.5)
2026/27	—	11.0	(6.3)	4.8	(4.7)	0.1	0.1	(54.0)	(111.3)
2027/28	(3.7)	14.1	(5.5)	8.6	(4.4)	4.2	0.5	(49.1)	(110.9)
2028/29	(3.8)	14.5	(5.1)	9.3	(5.4)	3.9	0.1	(43.6)	(110.8)
2029/30	(4.5)	15.4	(5.6)	9.8	(5.7)	4.1	(0.4)	(38.3)	(111.2)
2030/31	(4.6)	15.9	(6.8)	9.1	(6.0)	3.1	(1.6)	(33.9)	(112.8)
Total (2013/14-2030/31)	(136.2)	185.3	(83.0)	102.3	(78.9)	23.4	(112.8)		

Note:

- The above projections are presented for illustration purposes only and do not represent any forecast adopted by AAHK on its future business performance. The actual outcome of the projections will depend on many factors which cannot be foreseen at this time, and which are outside the control of AAHK. The above figures are subject to rounding differences.
- Dividend refers to payout based on 80% of the net profit of the preceding year.
- Cumulative funding surplus/(shortfall) refers to the sum of preceding year's annual funding surplus/(shortfall) and current year's annual funding surplus/(shortfall).