Joint Study on aviation capacity in the Sydney region

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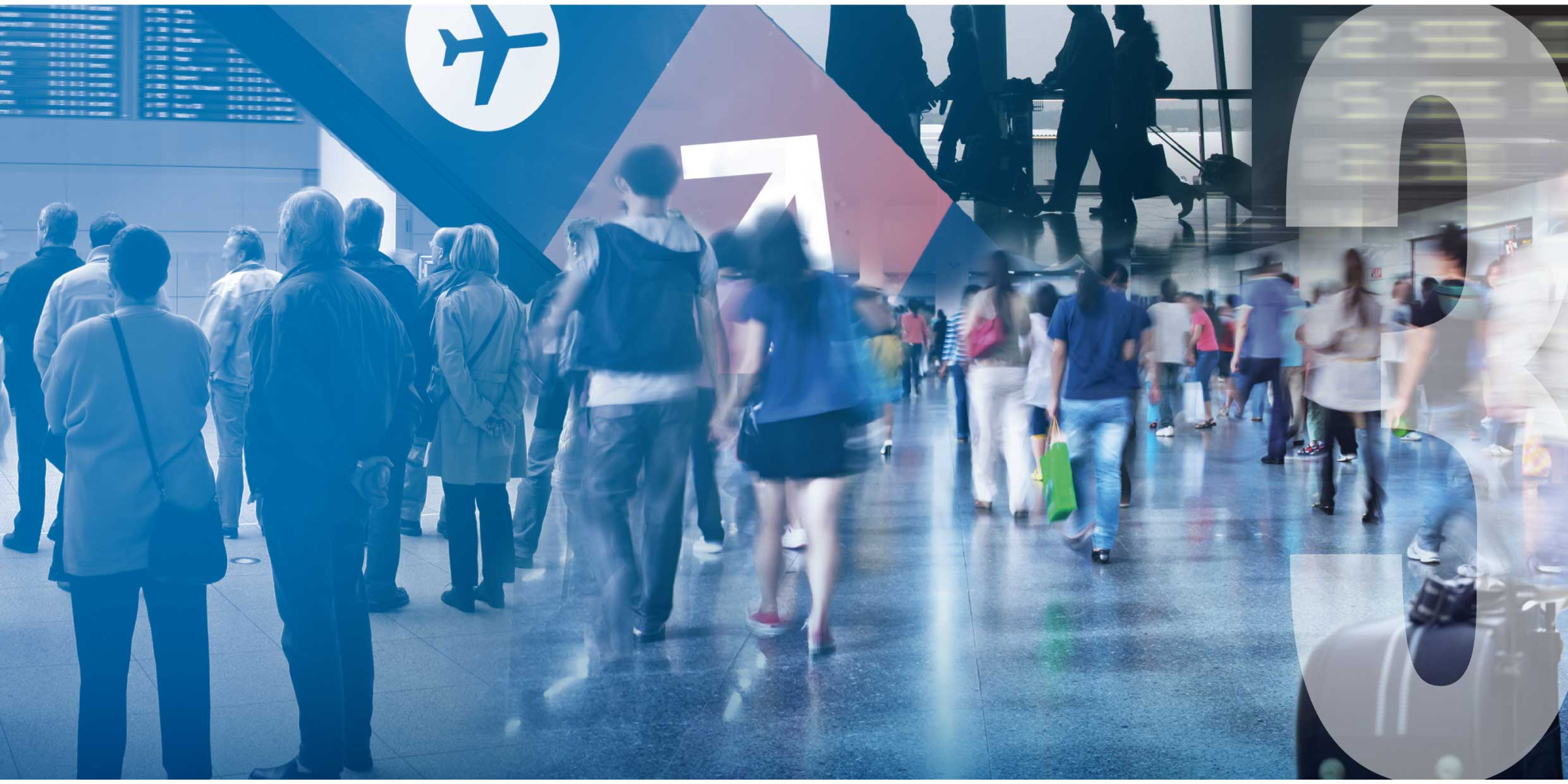
TECHNICAL PAPERS



REPORT TO

Australian Government

NSW GOVERNMENT

Assessment of options for meeting aviation needs in the Sydney region

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Assessment of options for meeting aviation needs in the Sydney region

Technical Paper

Department of Infrastructure and Transport

Technical paper

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Contents

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Executive summary

There are a number of ways in which additional aviation capacity could be provided within the Sydney region to meet future needs. These include:

- Refinement of policy settings at existing airports (i.e. the maximum runway movement limit per regulated hour and limit on slot allocations, curfew and regional ringfence arrangements at Sydney (Kingsford-Smith) Airport)
- Enhancement or expansion of facilities at existing airports
- Changing the way in which existing airports are used within the network
- Development of greenfield aiport site(s).

Over the past 70 years a range of options have been considered by government and the private sector, or suggested by stakeholder groups, business and the community, to cater for aviation demand in the Sydney region. Some of the ideas for capacity expansion date back to the 1930s and 1940s when Sydney (Kingsford-Smith) Airport was still in its early days of operating as an international airport. A range of major studies of airport capacity were undertaken by the Commonwealth and New South Wales (NSW) governments over the 1970s. In addition to some of these significant studies, options have been put forward by stakeholders as part of submissions to government studies, as a result of separate studies, or through the media.

This paper presents findings and analysis in relation to a range of different types of options that have been publicly raised and, in some case, subjected to analysis already. The purpose of this paper is to consider the findings and recommendations of previous analysis and assess whether these remain relevant and up to date or whether circumstances have changed in such a way that these options should be revisited to test previous conclusions on their ability to provide additional aviation capacity in the Sydney region. In some cases options have been subjected to very little scrutiny or analysis in the past. In such cases, this paper seeks to identify possible benefits as well as challenges presented by these options and, in light of these, consider whether they warrant consideration as approaches to provide future capacity in the region or should not be further explored.

The paper has been developed from a desk based review of publicly available information that identifies and/or assesses options previously put forward as possible capacity solutions in the Sydney region. This is intended to complement other Joint Study evaluation processes, and ensure that the fullest range of feasible options have been included for consideration.

A large number of the options that are contained in this paper have been considered by multiple previous studies. In most cases there are existing, strong arguments as to why options have been ruled out in the past, which remain valid. In these cases it is not recommended that these be considered further. In other cases ideas have been proposed but little analysis, if any, undertaken. For a number of these options it is considered that additional analysis is not required to determine that sufficient additional capacity would not be provided, and it has not been recommended that these options not be considered further.

Of the options presented in this technical paper there is a selection considered to warrant further consideration by the Joint Study Steering Committee. In some cases these options have been subjected to previous analysis but it is considered that further work should be undertaken to determine, in more detail, whether these options could deliver required capacity. In other cases they have been subject to little previous analysis but appear to have merit as options to deliver capacity Sydney's long term needs.

The options that are recommended for consideration as part of the Joint Study are:

- Refinement of Sydney (Kingsford-Smith) Airport policy settings
- Enhancement of facilities at existing airports in the Sydney region to provide regular passenger transport (RPT) capacity, in particular RAAF Base Richmond and Bankstown Airport
- Development of greenfield site(s) in the Sydney region.

In addition, if a significant change to the current situation occurs, such as high speed rail being introduced between Brisbane, Newcastle, Sydney, Canberra and/or Melbourne, then the expanded role of existing airports at Williamtown/Newcastle and Canberra would warrant further consideration. The role of high speed rail to assist meeting aviation capacity needs is expected to be dependent, not only on the likely mode shift from air, comparative travel times and the routes served, but also the timing of its viability and if it will be in place in time to address capacity issues.

1. Introduction

Purpose of this technical paper

The purpose of this technical paper is to assess the feasibility of a broad spectrum of the types of options which could add a material amount of new aviation capacity for the Sydney region. This is intended to assist the Joint Study evaluation processes to ensure that the fullest range of feasible options have been included for consideration.

This technical paper presents the findings of a desk-based review of publicly available information that identifies and/or assesses options previously put forward as possible capacity solutions in the Sydney region. It considers the findings and recommendations of previous analysis and considers whether these findings remain relevant and up to date or whether changes have occurred that suggest these options should be revisited to test previous conclusions on their ability to provide capacity in the region.

This paper describes each option and details its proponents, provides a summary of previous analysis and findings, and considers whether circumstances have changed that may warrant further consideration of a particular option or that may affect viability of an option to support the Sydney region's future aviation needs. In some cases options have been subjected to very little scrutiny or analysis and in such cases this paper seeks to identify possible benefits or challenges presented by these options and, in light of these, consider whether they warrant consideration as approaches to provide future capacity in the region.

This technical paper has largely been prepared by PwC based on a desktop basis and has been supported by specialist input from Airbiz, WorleyParsons and Airport Master Planning Consultants (AMPC) relating to aviation and engineering technical expertise for particular options where limited public information was available.

Options considered

Over the past 70 years a range of options have been considered by government and the private sector, or suggested by stakeholder groups, business and the community, to cater for aviation demand in the Sydney region. Some of the ideas for capacity expansion date back to the 1930s and 1940s when Sydney (Kingsford-Smith) Airport was still in its early days of operating as an international airport. A range of major studies of airport capacity were undertaken by the Commonwealth and New South Wales (NSW) governments over the 1970s. In addition to some of these significant studies, options have been put forward by stakeholders as part of submissions to government studies, as a result of separate studies, or through the media.

The ways in which additional aviation capacity could be provided within the Sydney region to meet future needs include:

- Air traffic management and other efficiency measures to increase the efficiency of operations at existing airports
- Refinement of policy settings at existing airports (i.e. the maximum runway movement limit per regulated hour and limit on slot allocations, curfew and regional ringfence arrangements at Sydney (Kingsford-Smith) Airport)
- Enhancement or expansion of facilities at existing airports
- Changing the way in which existing airports are used within the network
- Development of greenfield airport site(s).

To explore these further, following this introductory chapter, this technical paper is structured into the following chapters:

2. Options for better use of Sydney (Kingsford-Smith) Airport
3. Utilisation of other existing aerodromes within the Sydney region
4. Utilisation of existing aerodromes outside the Sydney region
5. Other solutions (non-airport and greenfield options).

There is an extensive list of options for each of the broad capacity approaches outlined above. For example, there are numerous existing smaller airport facilities outside the Sydney region that could be upgraded to service larger aircraft and passenger volumes (e.g. Parkes, Dubbo or Bathurst). However, the paper has been developed to assess general types of options by evaluating key examples that will provide insights for similar options. As an example - in the instance of considering existing airport facilities outside the Sydney region, the paper documents findings concerning central west aerodromes, Brisbane and Melbourne airports– though the findings are expected to be broadly representative for all aerodromes in regional NSW or in other Australian capital city airports.

The table below lists the options and examples that have been considered in this paper.

Broad approach	*General option type considered in this paper*	*Examples used in this paper to consider general options*
Better use of Sydney (Kingsford-Smith) Airport	• Expansion beyond existing boundaries • Modification of infrastructure • Refinement of policy settings.	• Relocation to the Kurnell area or construction of a runway in Botany Bay at Towra Point/Kurnell • A range of proposals for additional or modified infrastructure at Sydney (Kingsford-Smith) Airport • Refinement of policy settings affecting Sydney (Kingsford-Smith) Airport.
Utilisation of existing airport facilities within the Sydney region	• Enhancement of facilities at existing airports to provide additional capacity in the region • Existing airports that may provide additional capacity based on non-aviation infrastructure development.	• Bankstown Airport • RAAF Base Williamtown (Newcastle Airport) • Canberra Airport.
Utilisation of existing airport facilities outside the Sydney region	• Using a existing aerodromes in regional NSW • Using an existing aerodrome for all Australian international flights • Spreading Sydney region flights to other capital city airports.	• Central west airport (such as at Parkes, Dubbo or Bathurst) • Airport at Alice Springs as the only international airport in Australia • Spreading international flights that currently arrive at Sydney (Kingsford-Smith) Airport to Brisbane Airport and Melbourne Airport.
Other solutions	• Construction of an offshore or island airport • Development of an airport in Sydney's central business district • Building or using an existing airport as a freight only airport • Development of a greenfield airport.	• Offshore airport in the vicinity of Sydney (Kingsford-Smith) Airport • Kooragang Island Airport • Sydney central business district airport • Freight only airport in the Sydney region • Greenfield airport in the Sydney region.

The analysis of each of the types of options presented here has been undertaken on a standalone basis. That is, the ability of each of these options to deliver a material amount of new capacity in an acceptable manner has been considered without reference to any other changes that could occur.

2. Options for better use of Sydney (Kingsford-Smith) Airport

A range of options have been put forward in the past to better use Sydney (Kingsford-Smith) Airport in order reduce the need for alternative capacity increases in the region. Broadly, these options could be categorised into the following approaches and examples:

- Expansion of Sydney (Kingsford-Smith) Airport beyond existing boundaries
- Modification of infrastructure at Sydney (Kingsford-Smith) Airport
- Refinement of policy settings affecting Sydney (Kingsford-Smith) Airport.

Summary of findings

Expansion of Sydney (Kingsford-Smith) Airport beyond existing boundaries

A material expansion of Sydney (Kingsford-Smith) Airport significantly beyond existing land boundaries as defined in its lease is likely to be challenging due to a range of issues including capital cost, bayside constraints, potential need to relocate some adjacent road and railway infrastructure and other operational issues. Within or adjacent to the leased area there maybe some scope to reclaim new land from the Bay to create new taxiways or lengthen runways but this would also be costly and it would also need to obtain new environmental approvals.

A potential addition of new capacity on the other side of Botany Bay in the Kurnell area is likely to result in airspace management challenges, due to probable interactions with flight paths for existing operations at Sydney (Kingsford-Smith) Airport. This could potentially limit capacity of the existing runways thereby reducing the capacity gains and cost effectiveness of any expansion.

In addition, extensive development has taken place in Port Botany in the Kurnell area in the period since most proposals to add aviation capacity around Kurnell were developed. This has restricted the land available for development for airport facilities. An oil refinery has operated at Kurnell since 1952 and while some production process plants have or are being rationalised (e.g. asphalt, Lubricating Oil Refinery) the site will remain a key NSW gateway for petroleum imports and storage for the foreseeable future. Other recent developments in the region include the desalination plant south west of the refinery and the third container terminal at Port Botany (which itself is capacity constrained by its proximity to the airport). Given the growth in activity of existing businesses in this precinct as well as the new developments around the site, a new airport development in the Kurnell area could increase, not decrease, the numbers of people exposed to aircraft noise in and around Sydney (Kingsford-Smith) Airport relative to capacity expansions in other parts of the region.

Options to expand or develop new runways in the Kurnell area would also have significant environmental impacts on lands and ecosystems and would impact international treaties entered into by the Commonwealth and NSW governments for protection of these areas. Reclamation of land and sand dunes protruding into Botany Bay could have implications for wave energy, beach profiles, water quality and sedimentation, aquatic flora and fauna in the area.

Given the high levels of existing urban and industrial development around the airport, any approach that required acquisition of land around the airport would be relatively more costly, would significantly impact local communities, and would make location in the airport vicinity difficult for a number of businesses around the airport that support airport activity.

Operationally, the Kurnell and Botany Bay expansion options could also be more challenging in terms of surface transport access than the current Sydney (Kingsford-Smith) Airport for the majority of passengers.

Overall, it is concluded that options for additional runways/infrastructure at Kurnell/Towra Point do not provide efficient or economic solutions to Sydney's long term aviation needs.

Modified infrastructure at Sydney (Kingsford-Smith) Airport

The addition or modification of existing infrastructure at Sydney (Kingsford-Smith) Airport are considered unlikely to provide the extent of additional aircraft movement capacity required for Sydney's long term needs.

A range of potential development options relating to additional or modified infrastructure at Sydney (Kingsford-Smith) Airport have been proposed in the past, such as extending the shorter north south runway (16L/34R) and constructing a second east west cross runway. Such modifications cannot be undertaken within the current airport footprint, and could require expansion of the footprint further into Botany Bay or into land to the east of the airport. As discussed above, the extent of further expansion into Botany Bay is limited by the location of Port Botany and a range of other environmental, social and cost factors. Furthermore, extension east of the airport could involve significant land acquisition and potential relocation of roads or railway lines.

Furthermore, while these developments may provide Sydney (Kingsford-Smith) Airport with greater flexibility or options for air traffic management, it is unlikely that any of these options would provide the extent of additional capacity that is required for Sydney's long term needs

For example, an additional cross runway could allow for greater movement levels to be achieved during poor weather conditions, which have been shown to reduce capacity by approximately 10% a year. However, capacity pressures are also being felt during fine weather conditions and an additional runway would not affect the upper physical limit for runway movements at the airport affected by the two parallel runways. In addition, such expansion would require acquisition of land around the airport site (with the feasibility issues discussed above), and would expand the noise footprint, particularly over the densely urban areas inland of the airport.

Refinement of policy settings

There are three operational policy settings that have been argued at times to impact on Sydney (Kingsford-Smith) Airport's ability to operate at maximum aircraft movement capacity. These are:

1. The demand management system which imposes a maximum movement limit per regulated hour on the runway and a limit on slot allocations
2. The curfew which limits takeoffs and landings between 11.00pm and 6.00am
3. The regional ring fence which protects the number of intrastate NSW movements in and out of the airport.

As past studies have not considered refinements to these policy settings in detail, and where they were considered the analysis is now likely to be dated, it is recommended that the Steering Committee consider refinement of Sydney (Kingsford-Smith) Airport policy settings to assist meeting future Sydney region aviation capacity needs.

Examples considered

Example option	Expansion of Sydney (Kingsford Smith) Airport into Botany Bay
Analysis of option	In 1946, the *Second Sydney Airport Site selection Programme Draft Environmental Impact Statement* investigated a range of potential international airport sites, with sites studied including Towra Point.[2] Between 1946 and 1968, Commonwealth, NSW and local governments evaluated the Towra Point site, which was eventually ruled out because of environmental difficulties. In November 1964, newspaper reports referred to a study undertaken by the NSW Government recommended establishing an airport at Towra Point in Botany Bay to provide additional capacity to the Sydney region.[3] In 1999, IAC Aviation Technical Services proposed development of 'Sydney (Kingsford-Smith) Airport South'. The late Dr Bill Bradfield was part of the group advocating this option. Dr Bradfield was also instrumental in the original 1946 proposal. This option, and a document prepared in 1999, was in January 2010 again provided to the NSW Government for consideration within the Joint Study. This proposal by IAC Aviation Technical Services suggests that the traffic capacity and noise problems can be solved by the development of two runways and passenger freight facilities in the southern part of Botany Bay, operated in coordination with Sydney (Kingsford-Smith) Airport, and as part of one airport complex.[4] Under IAC's option, two parallel runways - each up to 4,000 m and separated by 760 m - would be constructed in the southern parts of Botany Bay (see **Image 1**). It also proposed that all international and interstate domestic traffic would move to the Sydney (Kingsford-Smith) Airport South development, with the current Sydney (Kingsford-Smith) Airport used for interstate and general aviation operations.[5] Runway 16L/34R would be closed at Sydney (Kingsford-Smith) Airport. Three concept layouts were compiled as part of the report. Concept B layout, suggested by IAC to be more suitable than Concepts A and C (**Image 1**) includes: • Two 760 m centreline spaced parallel runways of up to 4,000 m, each aligned about 5-100 off the 16/34 runway alignment at Sydney (Kingsford-Smith) Airport • Provision for a road bridge across Botany Bay linking the two airports • Terminals located either on the eastern or western sides of the runway complex. The main environmental benefit articulated in the IAC proposal for this option is an improvement in off-airport noise impacts on residential areas due to displacement of the runways to the south compared to their current location at Sydney (Kingsford-Smith) Airport. However, the IAC proposal also acknowledges the potential for environmental impacts from further reclamation within Botany and Quibray Bays. Consultants SKM prepared indicative cost estimates (assumed to be for Concept B in 1999/2000 dollars) of $3.82 billion. These appear to be preliminary estimates as a contingency allowance of only 7% of total costs has been applied.[6] Based on an inflation factor of 1.35[7] the estimate in today's dollars would be about $5.2 billion. This compares with preliminary, strategic cost estimates of at least $7 to $11 billion[8] for a parallel runway airport of similar scale constructed in rather less challenging conditions on land. WorleyParsons/AMPC advise that this suggests the 2000 cost estimate may substantially under estimate of total airport development costs.[9]

[2] Department of Aviation. Second Sydney Airport. Site selection Programme Draft Environmental Impact Statement. Ultimo, NSW, Kinhill Stearns, April 1985, cited in: http://www.aph.gov.au/library/pubs/chron/2003-04/04chr02.htm

[3] 'Site for new jet airport is right on our doorstep', Daily Telegraph, 4 November 1965, cited in: http://www.aph.gov.au/library/pubs/chron/2003-04/04chr02.htm

[4] IAC Aviation Technical Services 2010, *A solution to the problems of Sydney: Text No. 3 January 2010*, p3.

[5] *Ibid.*

[6] IAC Aviation Technical Services 2010, *A solution to the problems of Sydney: Text No. 3 January 2010*

[7] Reserve Bank of Australia, 2011, as cited by WorleyParsons and AMPC, 2011.

[8] Ernst & Young, 2011, based on Airbiz and Arup cost analysis.

[9] WorleyParsons and AMPC, 2011.

Example option	*Expansion of Sydney (Kingsford Smith) Airport into Botany Bay*
Findings of previous analysis	Between 1946 and 1968, Commonwealth, NSW and local governments deliberated the Towra Point site, which was eventually ruled out because of environmental difficulties.[10] Since that time, IAC Aviation Technical Services reconsidered and conducted analysis of this option in 1999. They concluded that their proposed Sydney (Kingsford-Smith) Airport South would have capacity of 350,000 aircraft movements per annum and in their view this option could potentially double capacity at Sydney (Kingsford-Smith) Airport.[11] The analysis cited the advantages of the site including: • Proximity to the Sydney central business district (CBD), rail access and road infrastructure • A potential reduction in airport noise in Sydney and surrounding areas from the relocation of international and interstate traffic to Sydney (Kingsford-Smith) Airport South • Less impact on the environment at Towra Point than previous proposals of a similar nature due to the location of the site • Based on initial costing, Sydney (Kingsford-Smith) Airport South was considered by IAC to cost less than a greenfield airport at Badgerys Creek.[12]
Recent developments	Since the times of some of the previously identified options and analysis in 1999, there have been some developments to the Botany Bay area around Kurnell, which could restrict the land available for development for airport facilities: • *Port Botany third container terminal:* Adjoining the existing Patrick container terminal at Port Botany, a new terminal is being constructed with operations due to commence in early 2013. The new terminal is closer to the third runway (see **Image 2**). WorleyParsons/AMPC conducted analysis of this option and note that the Port expansion would need to be taken into account for any options that add aviation capacity on the eastern side of Sydney (Kingsford-Smith) Airport. • *Desalination plant:* South west of the existing refinery, a desalination plant has been constructed (see **Image 2**). This will impact on the area of the land that can be reclaimed. Additionally, the reclamation layout shown in the option may cross over or come very close to the Sydney Desalination Pipeline. The pipeline location would also affect the available locations for any dredging if this was proposed to be carried out to provide reclamation material.[13] • *Refinery:* The oil refinery at Kurnell was constructed in 1952, covering a large area at Kurnell (see **Image 2**), and whilst production and refining activity on the site has reduced, it is unlikely that this area could be used for any construction due to its major ongoing role as an import gateway and storage facility. **Sydney (Kingsford-Smith) Airport South proposed by IAC** WorleyParsons, AMPC and Airbiz have reviewed the IAC Aviation Technical Services proposed 'Sydney (Kingsford-Smith) Airport South' for this paper. (**Appendix B** contains the WorleyParsons/AMPC analysis and **Appendix D** contains the Airbiz analysis.) WorleyParsons/AMPC suggest that about half[14] of the Sydney (Kingsford-Smith) Airport South site would be located on relatively flat land and therefore would require limited earth works, though there are some sandhills that would require re-profiling. The other half of the site is within

[10] Department of Aviation 1985, *Second Sydney Airport. Site selection Programme Draft Environmental Impact Statement*. Ultimo, NSW, Kinhill Stearns, April 1985, cited in : http://www.aph.gov.au/library/pubs/chron/2003-04/04chr02.htm

[11] IAC Aviation Technical Services 2010, *A solution to the problems of Sydney: Text No. 3 January 2010*

[12] *Ibid.*

[13] WorleyParsons and AMPC, 2011.

[14] WorleyParsons and AMPC have suggested that 'about half the site would need to be on reclaimed land from Botany Bay' (WorleyParsons and AMPC, 2011.)

Example option	*Expansion of Sydney (Kingsford Smith) Airport into Botany Bay*

the bay and would require expensive land reclamation and environmental works to protect remaining Towra Point sensitive habitats, mangroves and marshes.

Due to the immediate approach areas being over water, it would be expected that Obstacle Limitation Surface (OLS) compliance would be achieved in these areas. However, an obstacle survey would be required to assess the full extent of the relevant approach areas and other OLS components.[15]

Other issues that Airbiz and WorleyParsons/AMPC have identified as potential constraints relating to a Kurnell expansion of Sydney (Kingsford-Smith) Airport, considering the IAC Aviation Technical Services option, include:

- *Flight path interaction with existing airport:* Airbiz considered the flight path interaction between the runways at Sydney (Kingsford-Smith) Airport and the one runway that would remain at Sydney (Kingsford-Smith) Airport, 16R/34L. They identified a range of potential issues:
  - There could not be a departure from Sydney (Kingsford-Smith) Airport South within 1 minute of an arrival at the existing runway. This may be able to be mitigated by implementing some form of Required Navigation Procedure curved approach to Sydney (Kingsford-Smith) Airport South but that this would have noise implications for residents to the west of Botany Bay.[16]
  - The runway separation of 760 m would not permit parallel approach, however note that there is no detailed analysis as to how both airports would be able to function operationally in terms of airspace capability other than an assumption of coordinated air traffic control.[17]
- *Aircraft capacity of the new and existing runways:* Airbiz advises that the aircraft capacity created would be limited due to the position of the runways and the flight path conflicts between Sydney (Kingsford-Smith) Airport South and Sydney (Kingsford-Smith) Airport. As described, the runway separation would not allow simultaneous runway operations. It is proposed that Sydney (Kingsford-Smith) Airport South would have capacity of 340,000 aircraft movements per annum and Airbiz notes that with a conservative 2% growth in movements per annum, that capacity could be reached in 8 years time.[18]

  WorleyParsons and AMPC also suggest that the option has a lower capacity compared to the existing Sydney (Kingsford-Smith) Airport's parallel runway configuration. They suggest that IAC believes the combined capacity of the new southern airport could about double that of the existing Sydney (Kingsford-Smith) Airport or around 680,000 movements per annum in total. However, this needs to be considered in terms of future demand based on the relative proportions of traffic as it assumed to apply to operations at each airport. In 2010, Sydney Airport Corporation Limited (SACL) reported total aircraft movements at the current airport of just under 309,000 broken down as follows:

Aircraft Traffic Type	*Movements (2010)*	*%*
International	59,285	19.2%
Domestic	162,130	52.5%
Regional	63,120	20.4%
Freight	7,160	2.3%
GA	17,219	5.6%
TOTAL	308,914	100.0%

  Assuming the relative traffic proportions in the table above remain, the existing facility would

[15] WorleyParsons and AMPC, 2011.

[16] Airbiz, 2011.

[17] WorleyParsons and AMPC, 2011s

[18] Airbiz, 2011.

Example option	***Expansion of Sydney (Kingsford Smith) Airport into Botany Bay***
	need to accommodate about 26% of all operations with Sydney (Kingsford-Smith) Airport South accommodating the bulk at around 74% (noting this could vary if the terminals are reconfigured based on SACL's new terminal concept announced in December 2011). There would therefore be an imbalance in traffic between the two sites rather than the 50/50 assumed by the proponent.[19] • *Arrivals with strong cross winds (easterly or westerly) at Sydney (Kingsford-Smith) Airport South:* in strong cross wind conditions we would be unable to operate concurrently Sydney (Kingsford-Smith) Airport and Sydney (Kingsford-Smith) Airport South. During such periods, the South arrivals would have to be accommodated on Runway 07/25. While it does not impact departures and it is a relatively small proportion at around 2% annually, it is highly seasonal and it would constrain operations in August/September when strong westerly winds are relatively more common. This would create a range of issues: – These conditions can persist and raise issues of passenger, baggage and freight facilitation – Aircraft may not be able to land at the scheduled airport and therefore, aircraft would later need to be retrieved to their designated airport – Some South facility flights would need to be held on the ground until cross winds ease. This could affect major carriers making use of a mix of turbo-prop and jet aircraft on regional and Canberra (considered inter-state) routes.[20] • *Aircraft scheduling challenge assuming current aircraft fleet composition:* The Sydney (Kingsford-Smith) Airport South and Sydney (Kingsford-Smith) Airport operating scenario could create some scheduling challenges assuming current aircraft fleet composition. For example, QantasLink turbo-prop aircraft operating from Canberra –Sydney to Sydney South but needing to be at the existing Sydney (Kingsford-Smith) Airport for the next departure to a regional airport could give rise to repositioning costs and this may consume some of the extra capacity created.[21] • *Aircraft noise impacts:* WorleyParsons/AMPC advise that the option may still result in aircraft noise impacts to the north of Sydney (Kingsford-Smith) Airport and the areas under the flight paths would be slightly different due to the different runway alignment of Sydney South. – North of Sydney (Kingsford-Smith) Airport: Noise impacts may be improved due to operations only being conducted by regional and GA aircraft as would noise to the east and west of Sydney (Kingsford-Smith) Airport from Runway 07/25 operations – South of Sydney (Kingsford-Smith) Airport: Noise to and from the south is based on avoiding the urban areas of Cronulla and Kurnell in terms of overflights, i.e. flight paths would be over water. Additionally, due to the southern displacement of the site, typical aircraft on approach would be about 600ft higher compared to those landing on Runway 16R at Sydney (Kingsford-Smith) Airport assuming an overflight of the same area. This would result in a lesser noise impact being experienced. • *Aquatic reserve and sandhill environmental impacts:* WorleyParsons/AMPC advise that 'about half of the site would need to be on reclaimed land from Botany Bay'.[22] They have also indicated that the construction of Sydney (Kingsford-Smith) Airport South would have a range of environmental impacts: – The reclamation of land and sand dunes in Botany Bay would have implications for wave energy in the area is somewhat unknown but could have impacts such as causing reflected wave energy that could impact on Silver Beach at Kurnell leading to

19 WorleyParsons and AMPC, 2011.

20 *Ibid.*

21 *Ibid.*

22 WorleyParsons and AMPC, 2011.

Example option	Expansion of Sydney (Kingsford Smith) Airport into Botany Bay
	adjustments in beach profiles with loss of offshore sand – There may also be a range of effects on the coastal processes that could impact at some locations in the area. However, these could potentially be managed though appropriate structural and non-structural coastline management measures[23] – The reclamations in Botany Bay may alter estuarine circulation and hence water quality and sedimentation in areas such as Woolooware Bay – The dredging of the surrounding area may be necessary and this would have similar effects to the reclamation of land such as potential wave reflections, diffraction and altered refraction causing changes to cross shore and longshore sediment transport processes.[24] Furthermore, in setting the reclamation level, there would need to be allowance for sea level rise over an appropriately long planning period. Based on the NSW Sea Level Rise Policy Statement, (DECCW 2009), sea level rise planning benchmarks of 0.4 m at 2050 and 0.9 m at 2100 (relative to 1990) have been adopted in NSW. It is not clear if these sea level rises would have an impact of existing Sydney (Kingsford-Smith) Airport runways. The increase in level would be in addition to elevated water levels from severe storms including high astronomical tide, storm surge, and any superimposed wave action. The existing Captain Cook Drive road from to Woolooware and Cronulla to Kurnell is low lying in some sections, and therefore may be impassable at times of elevated water levels, particular under sea level rise. This road may need to be elevated in parts to maintain a permanent access route to Sydney (Kingsford-Smith) Airport South, if road access to the site from the south was proposed.[25] • *Transport connection issues:* WorleyParsons/AMPC have advised that the transport connections to a Sydney (Kingsford-Smith) Airport South would be 'complex and expensive'. These include: – If there was to be terminal infrastructure at the Kurnell location, travelling to the Kurnell/Towra Point site would add an additional 40 minutes or 27 km to a journey to the airport – A significant upgrade of the access roads would likely be required to accommodate additional traffic accessing an expanded Sydney (Kingsford-Smith) Airport – If there was to be just a runway and no terminal, infrastructure would still have to be built to accommodate the transfer of passengers from the existing Sydney (Kingsford-Smith) Airport terminals to the runway – It was proposed that a 2 km long road and rail bridged crossing be built across Botany Bay to connect the 30R/160L runway. [26] The road cross would likely need to be linked to the existing M5 and Eastern Distributor system in the form of a full grade separated intersection in the vicinity of the existing junction of Foreshore Road. As the proposed bridge location is to the west of the container terminal it can be relatively lower in height and it will not impinge container shipping movements. The bridge would still need to be higher than the Captain Cook Bridge which has a clearance for recreational boats of approximately 6 metres. If the 340R/160L runway stays in any form of service there would be a major conflict of the road and the taxiways giving access to the runway which would require the road to be sunk below the taxiway. The Airport rail link currently accessing Sydney (Kingsford-Smith) Airport is not a standalone line but an integrated part of the rail services in Sydney. Any proposed

[23] WorleyParsons and AMPC, 2011.

[24] Ibid.

[25] Ibid.

[26] IAC Aviation Technical Services 2010, *A solution to the problems of Sydney: Text No. 3 January 2010*, p3, p11.

Example option	*Expansion of Sydney (Kingsford Smith) Airport into Botany Bay*

additional rail connection such as a branchline to the Airport-East Hills line would need to be subject to detailed operational feasibility assessment to determine whether there is capacity to accommodate them.

Other Kurnell/Towra Point alternatives to expand Sydney (Kingsford-Smith) Airport

As part of the preparation of this technical paper, WorleyParsons and AMPC considered the Sydney (Kingsford-Smith) Airport South option (as described in **Appendix B**), as well as other potential options to locate airport infrastructure in the Kurnell/ Towra Point locality (see **Appendix C**). To do this, they developed example forms of adding capacity which might be compatible with Sydney (Kingsford-Smith) Airport continuing to operate at approximately 80 aircraft movements per hour. This involved development of the following three options for additional runway capacity at in the area:

- *Sydney (Kingsford-Smith) Airport fourth runway:* A 2,600 m long Code 4E runway within Botany Bay that is parallel to the existing 16/34 runways at Sydney (Kingsford-Smith) Airport
- *Kurnell 1:* A full service RPT airport[27] located at Kurnell (incorporating 4,000 m long Code 4F and 2,600 m Code 4E runways) which are parallel to the existing 16/34 runways at Sydney (Kingsford-Smith) Airport
- *Kurnell 2:* A Limited service RPT airport located at Kurnell (incorporating a 2,600 m long Code 4E runway) which is parallel with the existing 07/25 runway at Sydney (Kingsford-Smith) Airport (see **Image 4**). The lengthening this runway beyond 2,600 m requires a longer extension into Botany Bay which would have significant environmental issues and be expensive (due to the depth of water and length of the reclamation).

In regard to their likely effect on aviation capacity, WorleyParsons and AMPC concluded the following:

- The Sydney (Kingsford-Smith) Airport fourth runway option theoretically could provide an increase in runway capacity but with a significant effect on exposure to aircraft noise (both existing distribution of aircraft noise over the greater Sydney Region due less use of Runway 07/25 and new exposure of urban areas west and north of the airport to aircraft noise)
- The Kurnell 1 option is not likely to provide the degree of sum total of total aviation capacity that may be available where the sites are not co-located and so interdependent, and
- The Kurnell 2 option is not likely to result in any significant increase in runway capacity due to operational dependences between Kurnell and Sydney (Kingsford-Smith) Airport.

WorleyParsons/AMPC and Airbiz concluded that 'none of these options provide a useful solution to Sydney's long term aviation needs. This is due to their interaction with and/or reduction in capacity to some extent or another at Sydney (Kingsford-Smith) Airport, by being in a location which is even less accessible than is the current Sydney (Kingsford-Smith) Airport to their likely sources of passengers, by increasing, not decreasing, the numbers of people exposed to aircraft noise in and around Sydney (Kingsford-Smith) Airport and the magnitude of their likely environmental impact on lands and ecosystems which the Commonwealth has undertaken, in various forms of legislation, to protect.[28]

Sydney (Kingsford-Smith) Airport fourth runway

The Sydney (Kingsford-Smith) Airport fourth runway option assumes the runway would effectively be an extension to Sydney (Kingsford-Smith) Airport and be linked both landside and airside. The separation with runway 16R/34L is shown as 1,650 m but could be as close as 1,035 m and still potentially be able to operate independently but on a staggered rather than simultaneous basis. The provision of this runway may be capable of delivering a throughput of around 40 movements/hour, when operating concurrently with Sydney (Kingsford-Smith) Airport's parallel

[27] In this paper, a full service RPT airport is defined as an airport providing for all types of RPT aviation with parallel runways

[28] WorleyParsons and AMPC, 2011.

Example option	*Expansion of Sydney (Kingsford Smith) Airport into Botany Bay*
	runway operations, i.e. potentially up to 120 movements/hour. WorleyParsons and AMPC designed this concept in order to avoid direct effects on existing urban areas. However, they acknowledge that it would not be possible to avoid 'major indirect effects such as aircraft noise on existing urban areas'. Based on indexing the cost of constructing the third runway at Sydney (Kingsford-Smith) Airport, WorleyParsons/AMPC suggest, based on high level, indicative analysis only, that a 4,000 m fourth runway could cost at least $500 million in today's dollars (this project was estimated at $273 million in 1991). The advantages identified by WorleyParsons and AMPC are detailed in **Appendix B** and include: • This option may potentially provide about a 50% increase in capacity • It provides a logical extension to Sydney (Kingsford-Smith) Airport making use of existing infrastructure and established transport infrastructure, employee and passenger travel patterns • It might be a relatively lower capital cost option to help meet short-term demand for more runway capacity • For movements to/from the south, noise impacts are mainly over water (noting – as outlined below, however – large urban areas north and west in Kogarah and beyond at the northern end of the runway would become newly exposed to aircraft noise). The disadvantages of the fourth runway could include: • The potential capacity increase would require reconsideration of the Long Term Operating Plan and the statutory cap of 80 movements per hour • With a total capacity of up to 120 movements per hour, airlines could be expected to take up all available slots and, as a result, there would be increased pressure on terminals and other aspects of Sydney (Kingsford-Smith) Airport infrastructure. This could be expected to require more investment in these facilities • It does not provide an additional Code 4F 4,000 m runway although it may free up sufficient capacity on the existing 16R/34L Code 4F runway to meet forecast demand • Large urban areas north and west in Kogarah and beyond at the northern end of the runway would become newly exposed to aircraft noise • The capacity increase achieved may not meet forecast demand i.e. need for a new airport would be delayed but still required • There probably would be increased aircraft noise impacts over Kurnell community as aircraft departing 16R may have more difficulty turning to the west • It would not increase capacity in those weather conditions requiring use of Runway 07/25 • There would likely be major impact on the coastal processes of Lady Robinsons Beach and in Botany bay more generally • No environmentally acceptable source of dredged fill within an economically viable distance may be able to be found • It would be likely to exacerbate local road congestion and land transport issues due to a further intensification of activity at Sydney (Kingsford Smith) Airport. WorleyParsons and AMPC conclude that though the fourth runway option would be deliverable in an engineering sense, it would increase aircraft noise and could cause major environmental effects. *Kurnell 1 and Kurnell 2 options* According to WorleyParsons and AMPC, the Kurnell 1 and Kurnell 2 options have many similar

Example option	Expansion of Sydney (Kingsford Smith) Airport into Botany Bay

impacts to the Sydney (Kingsford-Smith) Airport South proposal. They also suggest that for the options they explored, the extent of environmental and legislative protections under both Commonwealth and NSW law would, in the present circumstances, be sufficient to exclude this locality from further consideration.[29]

Kurnell 1 option

The Kurnell 1 option would be a self contained airport having no direct landside and airside connectivity with Sydney (Kingsford-Smith) Airport, with the runways aligned with Sydney (Kingsford-Smith) Airport's 16/34 direction and positioned with horizontal separation in order to maximise operations.[30] This enables the runways to be aligned with Sydney (Kingsford-Smith) Airport's 16/34 direction and positioned with horizontal separation in order to try to maximise operations. It also means that there would be no physical loss of existing airport infrastructure. If disposed further the west or to the north, the airport platform would cause major change in the flow regime of the Georges River.

By having direct landside and airside connectivity means that all airport facilities currently available at Sydney (Kingsford-Smith) Airport would have to be duplicated at the Towra Point Airport.

It is assumed both the existing and new airports would accommodate the same classes of traffic, i.e. long haul international, regional international, and full domestic including intrastate regional. Accordingly, it would have similar airline operational issues to the Sydney (Kingsford-Smith) Airport South proposal and also the Kurnell 2 Option.

WorleyParsons and AMPC identified a range of advantages of the Kurnell 1 option, including:

- More of the noise impacts to the south would mainly be over water and therefore, have a limited on households (noting – as outlined below, however – it would result in new and substantial tracts of urban land becoming exposed to noise to the north and west)
- It may be possible to achieve a 1,035 m separation between the eastern runway and the Sydney (Kingsford-Smith) Airport 16R/34L runway suggesting that simultaneous operations could occur.[31]

A significant number of disadvantages were however identified, including:

- Due to the interaction with Sydney (Kingsford-Smith) Airport, this option may not be the most cost-effective solution to meet some passenger demand requirements when compared to a more distant Full service RPT airport site
- This option is potentially inoperable with the current runway crossing modes under the Long Term Operating Plan
- It would result in new and substantial tracts of urban land becoming exposed to noise to the north and west of Sydney (Kingsford-Smith) Airport and generally more noise along the current broad flight paths flown by existing aircraft to access Sydney (Kingsford-Smith) Airport
- The cost of creating a platform from which to construct an airport would be very high given the need for dredged fill – this may need to come from a remote location as there may be no more dredge sites in Botany Bay available.[32]

Overall, WorleyParsons and AMPC concluded that:

- On a high level, indicative basis, the Kurnell 1 option could cost in the order of $20-22 billion based on the typical cost of onshore airports such as Chubu Centair International Airport and

[29] WorleyParsons and AMPC, 2011.

[30] *Ibid.*

[31] *Ibid.*

[32] *Ibid.*

Example option	Expansion of Sydney (Kingsford Smith) Airport into Botany Bay
	Kansai Airport Osaka[33] • It would be 'technically feasible' and the proximity to Sydney (Kingsford-Smith) Airport would mean that they would effectively operate as one airport which may lead to 'a lesser capacity than the sum of their individual capacities and from an airline and airport management perspective this would be 'extremely inefficient' having two airports so closely located operating separately'. [34] *Kurnell 2 option* The Kurnell 2 option would be a self contained limited service RPT airport with no direct land access and airside connectivity to Sydney (Kingsford-Smith) Airport, with the runway aligned approximately to the east-west. The runway is proposed to be aligned approximately east-west which is nearly parallel to the 07/25 .cross runway at Sydney (Kingsford-Smith) Airport. This alignment was chosen in order to contain the airport within the landform at Kurnell to the maximum extent. Accordingly, capacity would be maximised when operating concurrently with Sydney (Kingsford-Smith) Airport's Runway 07/25, i.e. notionally up to 80 movements/hour overall. This is a theoretical throughput, as it would depend on actual demand. The actual fleet mix which would operate at this airport may be contrary to the types of traffic actually able to use the runway. In this context, it has similar airline operational issues to the previously reviewed proposal by IAC Aviation Technical Services - that is the potential for an aircraft to be at Kurnell when it is actually needed at Sydney (Kingsford-Smith) Airport and vice versa to conduct a subsequent operation. When operated concurrently with the existing Sydney (Kingsford-Smith) Airport's 16/34 parallel runway operations, there are likely to be dependency issues which may have significant capacity implications at both airports. It should also be noted that historical wind data suggests a generally north-south runway alignment – i.e. like a 16/34 runway - will have a higher usability than an east-west – e.g. 07/25 – alignment in this location. WorleyParsons/AMPC suggest that it would be likely that this option would require significant amounts of imported or dredged fill to construct the airport. Due to the cost of dredged fill, the cost could be in the order of $5-6 million, based on high level, indicative analysis.[35] A number of advantages of this option were identified: • The noise impacts to the east would primarily be over water meaning there would be limited impact on households (noting – as outlined below, however – it would result in urban areas to the west in the Sutherland Shire would become newly exposed to aircraft noise) • The site could be used for corporate jet, RAAF VIP and helicopter activity, therefore allowing the 80 movements per hour to be used by commercial airlines • Operating in conjunction with Sydney (Kingsford-Smith) Airport 07/25 could provide system capacity for up to 80 movements per hour in weather conditions that require an east-west runway alignment, though this could pose operational difficulties. A number of disadvantages of the Kurnell 2 option were also identified, including: • The potential dependencies with Sydney (Kingsford-Smith) Airport's 16/34 runway may limit the additional capacity that this option could offer • A limited service RPT airport at Kurnell with an east/west runway alignment would likely only operate safely when Sydney (Kingsford-Smith) Airport is also operating on its east/west runway. In the future, Sydney (Kingsford-Smith) Airport will operate most of the time on its north/south parallel runways and that would probably render inoperable an (east/west) airport

33 *Ibid.*

34 *Ibid.*

35 *Ibid.*

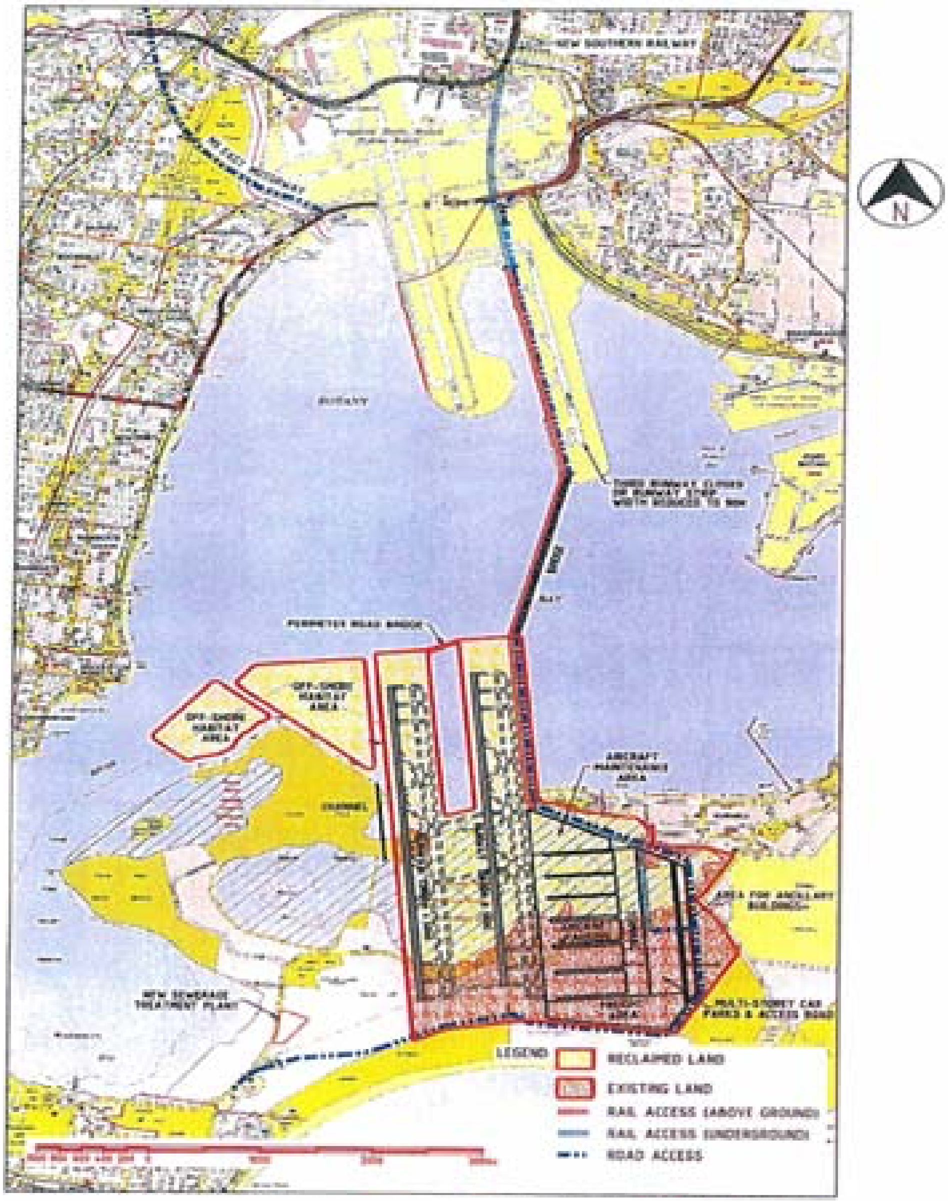
Example option	*Expansion of Sydney (Kingsford Smith) Airport into Botany Bay*
	at Kurnell • Operational difficulties would be likely to arise where aircraft and people could be at Kurnell when they are wanted or need to be at Sydney (Kingsford-Smith) Airport • Urban areas to the west in the Sutherland Shire would become newly exposed to aircraft noise • Due to interaction with Sydney (Kingsford-Smith) Airport, it may not be a particularly cost-effective solution to meet some demand requirements, compared to a more distant Limited service RPT airport site. WorleyParsons and AMPC concluded that: • The Kurnell 2 option would likely have significant and adverse operational interaction with Sydney (Kingsford-Smith) Airport which may not allow it to operate at full capacity or conversely act as a major constraint on Sydney (Kingsford-Smith) Airport's operations and that this would create undesirable inefficiency for such a major investment[36] • All Kurnell/Towra Point options would have significant environmental impacts and therefore may impinge on international treaties entered into by the Commonwealth and NSW governments[37] • The Towra Point Nature Reserve is subject to environmental and legislative protections, as listed in **Appendix C**.
Potential to provide new/additional capacity in the Sydney region	There has been little detailed analysis of this option to date. Additional analysis has been undertaken by Airbiz and WorleyParsons/AMPC for this technical paper, based largely on desk top analysis by technical experts. Their analysis indicates that none of the options would likely provide a solution to Sydney's long term aviation needs. Airbiz and WorleyParsons/AMPC suggest that the capacity created from a Sydney (Kingsford-Smith) Airport South expansion would be limited due to the position of the runways and the flight path conflicts. In addition, there are engineering marine, environmental and engineering technical challenges relating to connect Sydney (Kingsford-Smith) Airport South with Sydney (Kingsford-Smith) Airport. Transportation links would be very expensive and may be impractical to achieve given continued operation of Sydney (Kingsford-Smith) Airport and capacity issues on existing systems. Infilling of Botany Bay may cause unacceptably adverse hydrodynamic changes, and environmental effects of more filling of Botany Bay may not be acceptable. While the 1999 Sydney (Kingsford-Smith) Airport South option would provide some noise benefits to residential areas to the north and south, it may impact more adversely on the Kurnell residential area in terms of ground-based and side-linelateral noise sources. WorleyParsons/AMPC also suggests the 2000 cost estimate may be a substantial under-estimate of total airport development costs. WorleyParsons and AMPC conclusions, in relation to the options for additional runways/infrastructure at Kurnell/Towra Point, were: • *Kurnell 1:* This option is not likely to provide capacity that would be equal to an airport located on land with less airspace interactions with Sydney (Kingsford-Smith) Airport • *Kurnell 2:* This option is not likely to result in any significant increase in runway capacity due to operational dependences between Kurnell and Sydney (Kingsford-Smith) Airport • *Sydney (Kingsford-Smith) Airport fourth Runway:* This option provides an increase in runway capacity but with a significant effect on aircraft noise (both existing distribution of aircraft noise over the greater Sydney Region due to less use of 07/25 and new exposure to urban areas

36 *Ibid.*

37 *Ibid.*

Example option	*Expansion of Sydney (Kingsford Smith) Airport into Botany Bay*
	north of the airport). Overall, it is concluded that options for additional runways/infrastructure at Kurnell/Towra Point do not provide efficient or economic solutions to Sydney's long term aviation needs.[38] This is largely due to the interaction between each option and the existing airport, which would lead to a reduction in capacity at the existing Sydney (Kingsford-Smith) Airport.

Image 1: Proposed location of Sydney (Kingsford-Smith) Airport South: Concept B



Source: IAC Aviation Technical Services 2010, *A solution to the problems of Sydney: Text No. 3 January 2010*

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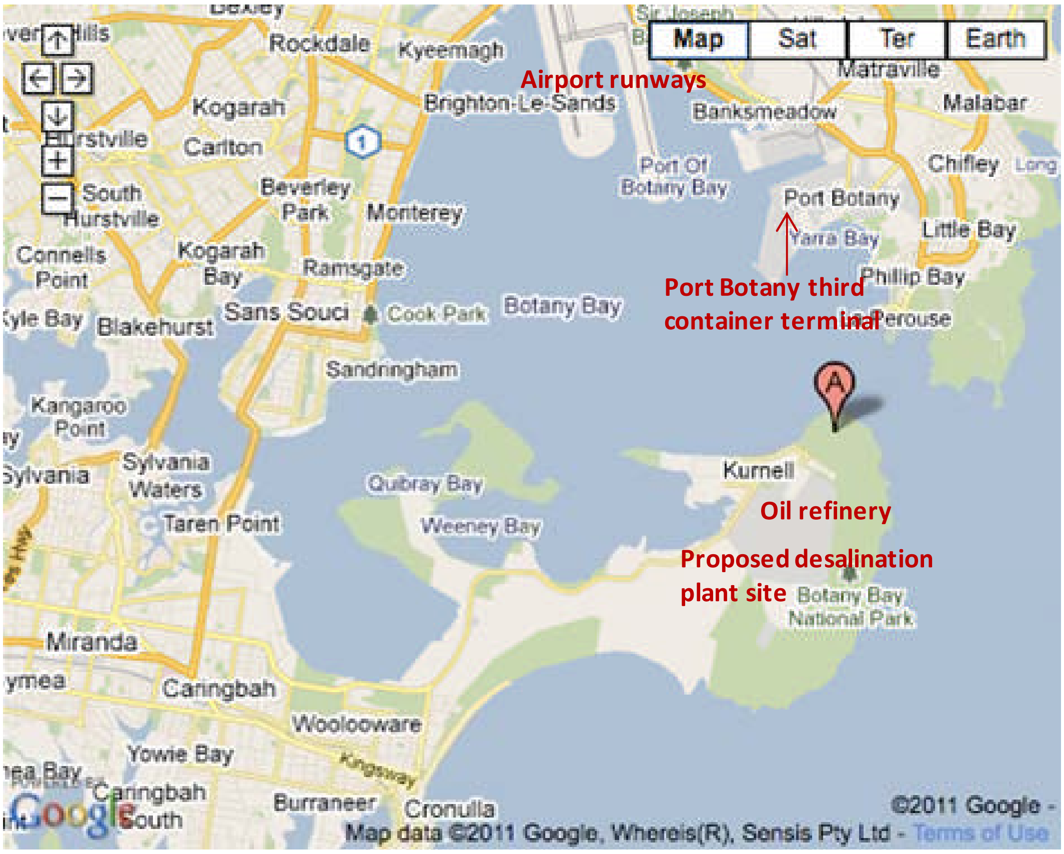
38 *Ibid.*

Image 2: Kurnell/Towra Point and surrounding areas



Source: Botany Bay Environmental Education Centre, 2011. *Location and study sites.* Available at: http://www.google.com.au/imgres?imgurl=http://www.botanybay-e.schools.nsw.edu.au/images/google-map.jpg&imgrefurl=http://www.botanybay-e.schools.nsw.edu.au/location.html&usg=__tJBCdmy6xWH3Z6GjODvgY_DkAZg=&h=400&w=500&sz=104&hl=en&start=6&sig2=FVq2UwR5cVXm56PO9IHHOA&zoom=1&tbnid=3xN9M5F1EuoguM:&tbnh=104&tbnw=130&ei=xHNFT_6bBc2xrAel_-SxDw&prev=/search%3Fq%3DKurnell%2B%2522Towra%2BPoint%2522%2B%2522Botany%2BBay%2522%2Bmap%26hl%3Den%26sa%3DN%26gbv%3D2%26tbm%3Disch&itbs=1

Image 3: Kurnell 1 option

Source: WorleyParsons and AMPC, 2011. *Botany Bay/Kurnell- New Runway/Airport Options*

Image 4: Kurnell 2 option

Source: WorleyParsons and AMPC, 2011. *Botany Bay/Kurnell- New Runway/Airport Options*

Image 5: Sydney (Kingsford-Smith) Airport fourth runway option

Source: WorleyParsons and AMPC, 2011. *Botany Bay/Kurnell- New Runway/Airport Options,* p. 16

Example	***Additional / modified infrastructure at Sydney (Kingsford Smith) Airport***
This table presents a number of potential modifications/additions to Sydney (Kingsford-Smith) Airport infrastructure:	
Extend shorter of the parallel runways from 2.44 km to 3.9 km	The third runway (34R/16L) is currently 2.44 km long and this is sufficient on a standard day (normal weather), with a normal load for 747 planes and all other planes, except for A380s, to use.[39] Extending the runway would either require relocating the terminal or extending into the bay area (see **Appendix A**). Both these options would be costly and are considered unlikely to provide the extent of additional aircraft movement capacity required for Sydney's long term needs. In addition, the ability to expand further into Botany Bay is limited by the location of Port Botany and the port access needs of container vessels. In addition, an extension east of the airport could involve significant land acquisition and relocation of roads.
Additional cross runway or a second east west runway	There have been a range of options for a second east-west runway to be constructed, two of these were examined in: • *The MANS Study: Commonwealth Members' Recommendations* (1975) • *The Proposed Third Runway Kingsford Smith Airport: Draft Environmental Impact Statement* (1990). After initial analysis, the *MANS Study: Commonwealth Members' Recommendations* reported that the construction of a second east-west runway would require the acquisition of between 300 to 600 dwellings, conflict with possible future development of Port Botany, have significant capital costs and introduce significant noise disturbances.[40] *The Proposed Third Runway Kingsford Smith Airport: Draft Environmental Impact Statement* also suggested that a second east-west runway was not a viable option because it would require: • Extensive land acquisition and relocation of infrastructure east of Foreshore Drive • The relocation of the foreshore road intersection • The restriction of expansion of Port Botany • Negative impacts on Seagrass beds in Botany Bay • Negative environmental impacts on Engine pond • The relocation of a major above ground sewer line.[41] To the north of the current east-west runway is the international terminal and the domestic terminal, as well as a number of major thoroughfares. To construct a second east west runway to the north would require the relocation of this entire infrastructure and thus, would be costly. Constructing a second east-west runway to the south would also be very costly and difficult. To ensure the minimum separation between runways is adhered to (1 035 m) the runway would need to be constructed over the bay area or just south of Southern Cross Drive into suburban areas of Botany (see **Appendix A**). This would require the relocation of parts of the M5 East Freeway and Southern Cross Drive and the acquisition of dwellings in the Botany area. This could also involve filling in the embayment area in order to provide the necessary taxiways for the runway. An additional cross-runway could assist with capacity on windy days (when the north-south runway cannot be used). However, it would add minimal additional capacity the reminder of the time.

[39] Boeing 2005. *F.A.R Takeoff Runway Length Requirements*

[40] MANS Study 1975. *Abstract Report: Commonwealth Members' Recommendations*, p. 20

[41] Federal Airports Corporation 1990, *Proposed Third Runway Sydney Kingsford Smith Airport: Draft Environmental Impact Statement*, p. 6-4

Example	*Additional / modified infrastructure at Sydney (Kingsford Smith) Airport*
A third north-south runway west of 16R/34L	Constructing a third runway to the west of the main north-south runway would require: • Building into the bay, or • Filling in parts of the Alexandra Canal and constructing the runway in residential parts of Kyeemagh and over nature reserves (see **Appendix A**). Both of these options would be very costly (due to land acquisition or construction costs) and have significant environmental effects, as discussed above relating to expansion into the Kurnell area.
Infilling embayment between 16/34 runways	Infilling the bay area between the two north south runways would not allow for the construction of a third runway between the two. The distance between the centre lines of the runways is 1082m.[42] The minimum distance required between the centre lines of parallel runways is 1035m.[43] Therefore, infilling the bay area between the two runways would not allow the construction of additional parallel runway. Acknowledging this, such an option would allow the construction of additional taxiways, though this would provide limited capacity relief at a significant cost.
Closing of east west runway (as per Sydney (Kingsford-Smith) Airport Draft Planning Strategy)	*The Sydney Airport Draft Planning Strategy* (1990) proposed that the east-west runway be closed. The Strategy proposed an incremental downgrade in the use the east-west runway in order to provide an additional 53 ha for terminal and support facilities.[44] Since the *Sydney Airport Draft Planning Strategy* was published there have been upgrades to facilities and the future constraints be the result of runway and taxiway constraints rather than terminal and facility constraints.
Potential to provide new/additional capacity in the Sydney region	It is unlikely that any of these options would provide the additional capacity that is required for Sydney's long term needs. The ability for these enhancements to provide additional capacity will be limited by the existing use of Sydney (Kingsford-Smith) Airport infrastructure. While they may provide Sydney (Kingsford-Smith) Airport with greater flexibility or options for air traffic management, it is expected that this would be enough to meet Sydney's future needs.

42 Sydney Airport Corporation 2009, *Airfield- Development Concept*, p. 54

43 ICAO 2004, *Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument Runways*, p. 12

44 Federal Airport Corporation 1990, *Sydney Airport Draft Planning Strategy*, p. iv

3. Utilisation of existing aerodromes within the Sydney region

A range of options previously considered to meet Sydney's aviation needs have related to expanding the use of existing aerodromes in the region. Broadly, these options could be categorised into the following approaches and examples:

- Enhancement of facilities at existing airports to provide additional capacity in the region
- Existing airports that may provide additional capacity based on non-aviation infrastructure development.

Summary of findings

Enhancement of facilities at existing airports to provide additional capacity in the region

There are a range of existing aerodromes in the Sydney region that currently fulfil a role serving particular demand segments in the region.

There have been a number of options considered previously relating to expansion of existing airport facilities within the Sydney region to provide regular passenger transport (RPT) capacity, such as RAAF Base Richmond, Camden Airport, Holsworthy Army Air Base, HMAS Albatross Navy Air Station, Illawarra Regional Airport, Goulburn Airport, and airports in the Hunter region.

It is suggested that the Steering Committee undertake analysis of the main existing aerodromes in the region to understand their potential role providing future capacity. In particular, RAAF Base Richmond and Bankstown Airport warrant consideration. Bankstown Airport is currently only serving general aviation (GA) demand, but due to its close proximity to the Sydney central business district (CBD) and master plan objectives to accommodate some RPT, may warrant further consideration. RAAF Base Richmond has a number of positive aspects including existing aviation infrastructure, existing surface transport access by road and rail, and location relative to Sydney's major population centres, and as such may warrant further consideration.

Existing airports that may provide additional capacity based on non-aviation infrastructure development

Bankstown Airport, RAAF Base Williamtown and Canberra Airport have been considered as examples in this technical paper as there may be scenarios beyond the current 'status quo' situation where these airports can provide capacity.

Existing aerodrome	*Runways*	*Site area (ha)*	*Distance from Sydney CBD*
Bankstown Airport	Three runways - longest of which is 1,416 m	313 ha	23 km
RAAF Base Williamtown	One runway- 2,438 m long	800 ha (23 ha allocated to civilian aviation)	175 km
Canberra Airport	Two runways- longest of which is 3,283 m	440 ha	290 km

If a change to the current situation occurs, whereby a high speed rail is introduced between Brisbane, Newcastle, Sydney, Canberra and Melbourne then the expanded role of existing airports RAAF Base Williamtown/Newcastle Airport and Canberra Airport may warrant further consideration. The role of high speed rail to assist meeting aviation capacity needs is expected to be dependent, not only on the likely mode shift from air and the routes served, but also the timing of its viability and if it will be in place in time to address capacity issues.

Examples considered

The tables below consider the example aerodromes that may have an increased ability to provide aviation capacity if high speed rail was introduced on the east coast of Australia.

Example	*Bankstown Airport*
Description of option and site	Bankstown Airport functions as the primary GA airport for the Sydney region and NSW. Bankstown Airport and Perth's Jandakot airport (which provides a similar role in Western Australia that Bankstown Airport performs in NSW) consistently rank as either the busiest or second busiest airport in Australia in terms of aircraft movements.[45] In 2008-09 there were 370,842 GA aircraft movements, although this fell significantly in 2009-10 to 300,000, principally as a result of some flying schools closing.[46] Bankstown Airport has three parallel runways, the longest of which is 1,416 meters. The shortest runway can accommodate aircraft up to Metro II, the longest runway can accommodate aircraft up to DHC8-300 and the middle runway can accommodate up to DHC8-100/200 aircraft.[47] Located 23 km from Sydney's central business district (CBD), Bankstown Airport covers 313 ha. It is located within the Bankstown Local Government Area (LGA), which has a population of 188,814 people and has a population density of 2,301 people/km^2.[48] The Airport is located in the central west of the LGA It has three runways, the longest of which is 1,416 m (see **Image 6**). There are no scheduled passenger services currently, but it is able to accommodate up to Code 3C medium aircraft.[49] The site was first identified as a potential airport location by the Department of Civil Aviation (DCA) in the 1930s.[50] In 1940 the site was acquired for a RAAF airport and it was used as such until control of the airport was passed to DCA in 1948. In 1988, ownership of the airport was transferred to the Federal Airport Corporation (FAC).[51] When the FAC was wound up, the airport was transferred to Sydney Airport Corporation and then in 2003 the lease for Bankstown, Camden and Hoxton Park airports was sold to the BaCH Consortium for $211 million.[52] The airport is currently leased by Sydney Metro Airports who also operate Camden Airport and have the lease until 2097.[53] Since 2000, the airport has been available for overflow from Sydney (Kingsford-Smith) Airport but has rarely been used for RPT services.[54] A number of studies have considered using Bankstown Airport's potential to provide additional GA or RPT capacity for the region, and to alleviate demand at Sydney (Kingsford-Smith) Airport. The following reports considered different options for the use of Bankstown Airport: • *Development of an International Airport at Sydney* (1946) considered using Bankstown Airport as an international airport[55] • *Major Airport Needs of Sydney (MANS) Study* (1974-1976) considered using Bankstown

[45] WorleyParsons and AMPC 2010, *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Bankstown Airport, Section 6.3, p.6
[46] *Ibid.*
[47] Department of Infrastructure and Transport (2011), information relating to use of Bankstown Airport for RPT Services
[48] ABS 2010. Regional Population Growth. Cat No. 3218.0
[49] *Ibid.*
[50] *Ibid.*
[51] *Ibid.*
[52] Leighton Properties 2004, *Airport Deal Lands Safely*. Available at: http://www.leighton.com.au/verve/_resources/lppl_news_march_2004.pdf
[53] *Ibid.*
[54] Commonwealth Department of Transport and Regional Development 1997, *Draft Environmental Impact Statement: Second Sydney Airport Proposal*, Volume 1, p. 15 Smith & Stuart 2001, *Options for Sydney's Second Airport*, Briefing Paper No. 4
[55] *The 1946 Development of an International Airport at Sydney* report conducted a broad analysis of three potential sites for an international airport: Towra Point, Bankstown and Mascot. Analysis considered cost, capacity and residential impacts. The report found that there were significant disadvantages to using Bankstown compared to Towra Point and Mascot. Source: Commonwealth Department of Aviation 1985, *Second Sydney Airport Site Selection Programme: Draft Environmental Impact Statement,* p. 67

Example	*Bankstown Airport*
	Airport as a major RPT airport in the Sydney region • *Draft Environmental Impact Statement (EIS): Second Sydney Airport Proposal* (1997) also considered using Bankstown Airport to provide RPT capacity for the Sydney region • *Supplement to Draft EIS Second Sydney Airport Proposal* (1999) considered using the Bankstown Airport for regional flights.
Findings of previous analysis	*The Major Airport Needs of Sydney (MANS) Study* was a combined inquiry of the Commonwealth and NSW governments. Significant consultation of government, airlines, unions, community representatives and other stakeholder groups was undertaken.[56] Options were evaluated on a range of criteria including environmental impacts, cost, capacity and impacts on residential areas. The study involved a number of reports including an EIS, options reports, and noise and congestion analysis. *The MANS Study* considered the use of Bankstown Airport for commuter and non-jet interstate aircraft and to provide additional capacity for the Sydney region. This option was considered by the Commonwealth Government as it was the policy of the NSW Government at the time to close Bankstown Airport. Serious doubts were raised during the course of the study as to the effectiveness of the option to provide significant additional capacity for Sydney due to possible flight path conflicts between Sydney (Kingsford-Smith) Airport and Bankstown Airport. It was suggested that any capacity relief created by the use of Bankstown Airport would be offset by a reduction in the number of flights at Sydney (Kingsford-Smith) Airport due to the flight path conflict.[57] The key benefits of some regional turbo prop traffic relocation to Bankstown Airport were considered to be: • Lower economic costs than all the new runway development options at Sydney (Kingsford-Smith) Airport • No identified house or land acquisition required for adding a small number of RPT services • Could defer the need for major runway development at Sydney (Kingsford-Smith) Airport • Could defer capital costs and environmental impacts at Sydney (Kingsford-Smith) Airport.[58] The key disadvantages were identified as: • Impact on the surface transport links around both airports • Flight path conflicts between Sydney (Kingsford-Smith) Airport and Bankstown Airport if significant RPT traffic use Bankstown Airport • Opposition likely from a number of operators and users who may face higher costs and loss of convenience.[59] The *Draft EIS: Second Sydney Airport Proposal* was prepared for the Commonwealth Department of Transport and Regional Development by PPK Environment and Infrastructure. It involved high level analysis of a range of options, including the expanded use of Bankstown Airport, as well as more detailed analysis of a smaller set of options. The primary focus of the Draft EIS was on the environmental impact of proposed sites for development/expansion. The *Draft EIS: Second Sydney Airport Proposal* highlighted several issues with the use of Bankstown Airport for regional turbo prop and most general aviation presently using Sydney (Kingsford-Smith) Airport. Specifically, the high cost of upgrading the facility and the

56 Commonwealth Department of Aviation 1985, *Second Sydney Airport Site Selection Programme: Draft Environmental Impact Statement*, p. 67

57 Major Airport Needs of Sydney Study 1975, *Abstract Report: Commonwealth Members" Recommendations*, p. 16

58 *Ibid.*, p.13

59 MANS Study 1975 Op. cit., p.13

Example	*Bankstown Airport*
	displacement of aircraft that were already using the airport. Furthermore, it was concluded that using Bankstown Airport 'could only provide minor capacity to satisfy Sydney's long term air traffic needs' due to current operating arrangements.[60] The *Supplement to Draft EIS Second Sydney Airport Proposal* considered similar issues as *Second Sydney Airport Draft EIS* (primarily environmental impacts but also some consideration of cost and capacity) and noted that the facilities at Bankstown Airport could handle the aircraft type that account for 99% of aircraft movements by regional airlines to Sydney (Kingsford-Smith) Airport.[61] However, *Supplement to Draft EIS Second Sydney Airport Proposal* noted a range of factors that would impact on the viability of using Bankstown Airport for regional flights: • Proximity to Sydney (Kingsford-Smith) Airport would require the coordination of flight paths • Need for additional terminal and runway facilities • Need for better land transport access • Noise impacts • Displacement of general aviation, training and related activities.[62]
Recent developments	The Bankstown Airport Limited *2005 Master Plan and Airport Environment Strategy* proposed the introduction of limited RPT traffic, growing from four movements per day in 2006/07 to a peak in 2009/10 of 12 movement per day, six days per week – a total of 3,744 RPT movements per annum.[63] In its *Bankstown Airport Preliminary Draft Master Plan 2010*, which was rejected by the Minister, as insufficient information was available to the local community on the impacts of the rise in RPT flights,[64] BAL was seeking to attract RPT services, initially suggesting Bankstown Airport may accommodate up to 16 RPT movements a day, growing to 32 movements a day in 2011/12.[65] The airport has been granted an extension until February 15 2013 to submit another Draft Master Plan. In 2008 there was speculation that low cost carrier, Tiger Airways, would offer passenger services to and from Bankstown Airport after Tiger purchased two Airbus A139 aircraft.[66] At the time a spokesperson for Bankstown Airport indicated that the airport would need its taxiways, runways and other infrastructure upgraded to accommodate the passenger services and therefore would require at least 18 month lead time.[67] However, this did not eventuate and instead Tiger Airways operates out of Melbourne Airport, Adelaide Airport and Avalon Airport.[68] Over recent years, airlines - particularly regional airlines - have had the option of relocating some of their operations to Bankstown Airport (up to the existing Master Plan limit of 16 RPT movements per day). Airlines are yet to pursue this location despite potential savings in aeronautical charges as well as avoiding peak capacity challenges at Sydney (Kingsford-Smith) Airport. Hence, it appears that there is a market signal that Bankstown Airport is not viewed as an attractive RPT option. This could be because airlines prefer one site per city to centralise operations and make transfers easier for passengers, thus creating efficiency gains. The limited quantity of flights per day available at Bankstown Airport is likely to make it less attractive for airlines to split their operations between it and Sydney (Kingsford-Smith) Airport.

[60] Commonwealth Department of Transport and Regional Development 1997, *Draft Environmental Impact Statement: Second Sydney Airport Proposal*, Volume 1, Section 6.5.4, pp. 6-11.
[61] Commonwealth of Australia 1999, *Supplement to Draft Environmental Impact Statement Second Sydney Airport Proposal*, Volume 3, Supplement
[62] *Ibid.*
[63] Bankstown Airport 2004, *Master Plan 2005*, p. 48
[64] Minister for Infrastructure and Transport, 2011. *Media Release: Bankstown Airport Master Plan not Approved*, 16 February 2011. Available at: http://www.minister.infrastructure.gov.au/aa/releases/2011/February/AA023_2011.htm
[65] Bankstown Airport Ltd (2010), *Bankstown Airport: Preliminary Draft Master Plan 2010*, 10 September, Sydney
[66] ABC News 2008, *Tiger Airlines sparks Bankstown Airport rumours*. Available at: http://www.abc.net.au/news/2008-03-07/tiger-airlines-sparks-bankstown-airport-rumours/1065008
[67] Rochfort, Scott 2008, *Tiger flights to Sydney more likely*. Available at: http://www.theage.com.au/travel/travel-news/tiger-flights-to-sydney-more-likely-20081113-6112.html
[68] Last Chance To Vote For Your Top, Tiger Airways Route From Avalon!, 02 June 2010:

Example	*Bankstown Airport*
	The Bankstown Airport annual operational capacity of the airport runway system has been estimated at 480,000 to 500,000 aircraft movements per annum and Bankstown Airport recorded more than 484,000 aircraft movements in 1989/90 during the pilot's strike.[69] Assuming GA growth of 0.5-1.0% per annum, this level of movement could be reached between 2060 and 2090. In relation to airspace issues, the proximity between Bankstown Airport and Sydney (Kingsford-Smith) Airport, combined with the orientation of runways at the two airports create the potential for airspace conflicts which also limit the potential additional capacity provided by expanding RPT to Bankstown Airport. Such conflicts became an issue in 1998 when a Ministerial direction was given to Airservices Australia that Sydney (Kingsford-Smith) Airport be given priority over Bankstown Airport in managing conflicts. The Bankstown Airport control zone (CTR) extends out 3 nautical miles (NM) from the airport, except where overlaps with the Sydney (Kingsford-Smith) Airport CTR to the east where the Bankstown Airport CTR is truncated to only 2 NM. To enable operation within the Bankstown Airport CTR, Airservices Australia established a Lane of Entry (LOE) which allows aircraft access to and from Bankstown Airport without needing to enter the Control Zones surrounding RAAF Richmond and Sydney (Kingsford-Smith) Airport. The LOE is a corridor of airspace 8-10 NM in width and a ceiling height of 2,000-2,500 feet. These complexities in airspace separation arrangements for airports in close proximity illustrate that airspace conflicts can become a material limitation to capacity and these become more constraining in the event that the number of RPT movements into Bankstown Airport was toward the levels proposed in the Draft Master Plan.[70] There have been a number of recent incidents and emergency landings of GA aircraft using Bankstown Airport including a tragic emergency landing on Canley Vale Road (5 km from Bankstown Airport) in June 2010 which resulted in two fatalities.[71] This incident followed over ten other light plane incidents since April 2006.[72] The recent aviation incidents illustrate there is some risk of accidents over this densely populated residential area which require assessment, particularly with an already high volume of GA and training flights in light aircraft. Some stakeholders have suggested expanding operations at Bankstown Airport will need to be very carefully considered due to the safety risks to residents living and working under Bankstown Airport's flight path.[73] As part of the WorleyParsons/AMPC work documenting the infrastructure, function and development plans of airports in the Sydney region, WorleyParsons/AMPC suggest that the existing/already planned infrastructure at Bankstown Airport could accommodate east coast domestic flights and NSW regional services.[74] They however identify major infrastructure related issues for any further development of Bankstown Airport, these were: • Existing urban development encroachment and potential noise impacts • No further runway extensions possible beyond what has been proposed in the Bankstown Airport *Preliminary Draft Master Plan 2010* • Low risk of flooding for the majority of the site, however the south west quadrant has a

[69] Bankstown Airport, Aviation Development Concept – Proposed Requirements, p 53, available at: http://www.bankstownairport.com.au/assets/documents/bnk_mp_13.pdf

[70] Sydney Metro Airports 2009, *Bankstown Airport Preliminary Draft Master Plan 2010* and Sydney Metro Airports 2009, *Preliminary Draft Airport Environment Strategy 2010*.

[71] Robinson, Georgina 2010, *'We have to put it down on the road' pilot tells control seconds before fatal crash'*, Sydney Morning Herald June 15. Available at: < http://www.smh.com.au/nsw/we-have-to-put-it-down-on-the-road-pilot-tells-control-seconds-before-fatal-crash-20100615-yasn.html>

[72] SBS News 2010, *At a Glance: Sydney Light Plane Incidents*. Available at < http://www.sbs.com.au/news/article/1279172/at-a-glance-sydney-light-plane-incidents>

[73] Rhiannon, Lee 2010, *Canley Vale Plan Crash: Bankstown Airport Expansion Should be Resisted.* Available at < http://archive.leerhiannon.org.au/news/canley-vale-plane-crash-bankstown-airport-expansion-should-be-resisted>

[74] WorleyParsons and AMPC 2010, *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Bankstown Airport, Section 6.4, p. 18

Example	*Bankstown Airport*
	medium to high risk of flooding - this currently has the terminal facilities • Rail link not easily provided – noting that the nearest station is 4.7 km away, currently served by charter bus services to/from Bankstown Airport, and is likely to require an underground branch line.[75,76] WorleyParsons/AMPC note that the airport currently accommodates a wide range of GA such as intensive flying training, charter, and aerial work, fire fighting and recreational. Also, the airport provides for a significant amount of businesses supporting GA such as aircraft maintenance, avionics, engine and propeller shops, aircraft interiors, paint workshops and aircraft hangars.[77] In total there are 90 separate hangar structure at Bankstown Airport, 26 of which are owned by the Airport and the remainder of which are privately owned by the businesses operating at Bankstown Airport.[78] Significant changes to operations at Bankstown Airport could require the relocation of businesses to alternative locations, for example Camden Airport (which takes overflow from Bankstown Airport) that could be costly and have implications for the GA sector in the Sydney region. Furthermore, if a significant proportion of GA movements were displaced from Bankstown Airport, it is not likely that Camden Airport alone could accommodate the level activity, potentially requiring a range of aerodromes in the region to assist providing GA capacity in the region. The introduction of RPT services could also require changes to airspace arrangements as they are currently designed to cater for high levels of GA, not RPT, travelling to Bankstown Airport. The proximity of Sydney (Kingsford-Smith) Airport and Bankstown Airport means the flight paths would potentially be complex and 'substantial redesign of the airspace of the two airports would be required'.[79] For the Joint Study, Airservices Australia considered the airspace requirements to support RPT operations at Bankstown Airport. This involved analysis of airspace and air traffic management feasibility and requirements regarding the development of Bankstown Airport to accommodate RPT operations, and analysis of the effect of the development of Bankstown Airport on Sydney (Kingsford-Smith) Airport operations. This analysis indicated that any RPT operations at Bankstown Airport would need to be turboprop aircraft as the proximity of Bankstown Airport to Sydney airport precludes the segregated operation of RPT jet traffic from both airports. Airservices Australia also suggests that current airspace classification and control zone dimensions do not support a combination of high density general aviation traffic and significant RPT turboprop movements. As a result, the feasibility of Bankstown Airport as a secondary RPT hub in the Sydney region will require the relocation of GA traffic to another airport. The Airservices Australia analysis suggested that the most viable option for Bankstown Airport to serve RPT was its use as a regional hub servicing Sydney with appropriate connections between Bankstown Airport and Sydney (Kingsford-Smith) Airport, though also suggested that any development of Bankstown Airport to support high performance RPT turbo-prop aircraft operations must also support the maintenance of capacity and efficiency of Sydney (Kingsford-Smith) Airport. [80] According to analysis conducted by WorleyParsons and AMPC as part of the Joint Study, the Bankstown Airport site is sufficient to accommodate a minimum service airport servicing GA and limited RPT. As already described, the current runway lengths can technically accommodate up

[75] WorleyParsons and AMPC 2010, *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Overview and Outline of Report, Section A.9, p. 15

[76] Note: The WorleyParsons/AMPC capability assessments of Bankstown and other existing aviation facilities were judgemental in nature based on the data collected and the plans disclosed by the owners/operators of the airports for their development

[77] WorleyParsons and AMPC 2010, *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Bankstown Airport, Section 6.3, p. 6

[78] *Ibid,* Section 6.3, p. 10

[79] Department of Infrastructure and Transport (2011), information relating to use of Bankstown Airport for RPT Services, p. 2

[80] Airservices Australia 2010, *Preliminary Report on Airspace Requirements to Support RPT Operations at Bankstown Aerodrome*, prepared for Joint Study on Aviation Capacity for the Sydney Region.

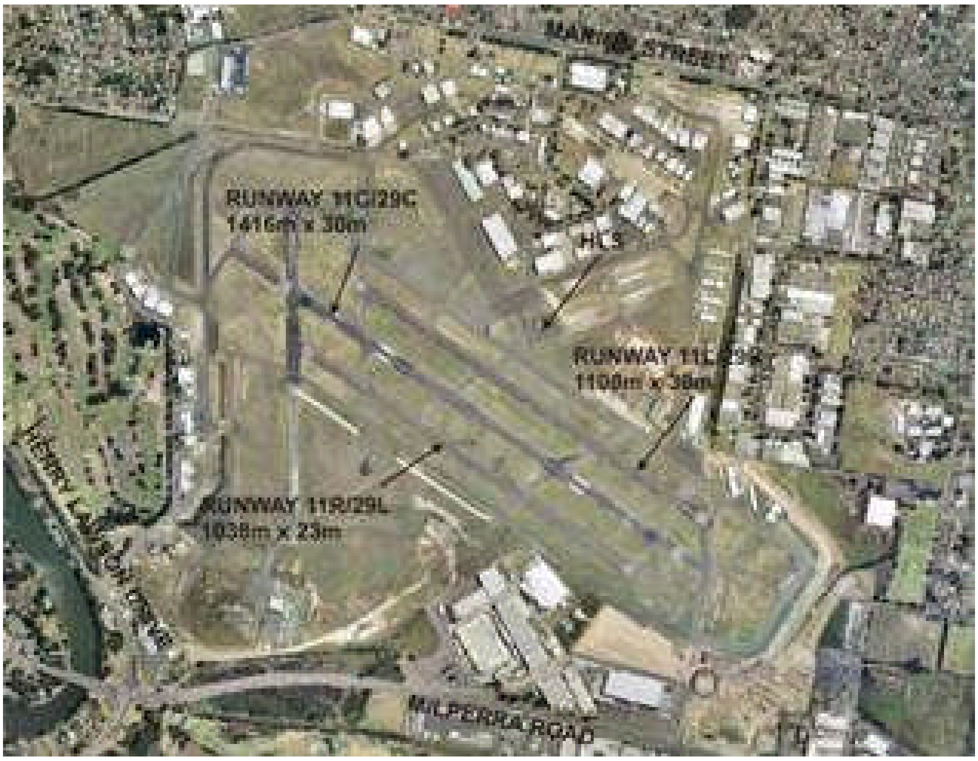
Example	*Bankstown Airport*
	to Code 3C medium aircraft such as B737 and A320.[81] The land surrounding the airport is zoned for the following uses: residential, open space, special uses- education and community purposes, private recreation, general industries and light industry.[82] As the images below show, the site is surrounded by substantial residential area particularly to the north, east and south (see **Image 7**). To the west of the site is the George's River as well as two nature reserves and a golf course. This means there would be little possibility for the construction of a cross runway and an additional parallel runway would also be problematic without affecting these areas. There may be amendments required at Bankstown Airport to accommodate RPT: • The runways at Bankstown Airport are 106 metres apart and therefore, could not support independent operations by RPT aircraft. This means that only one runway at a time could be used for RPT operations • The longest runway could be extended to approximately 1,650 metres within the current sight, making it suitable for category 3C aircraft such as Embraer 170 to be used at the airport • The runways would also require strengthening to accommodate RPT aircraft above 20,000 km MTOW • In order to accommodate RPT aircraft the runway and taxiway lighting facilities would need to be upgraded with High Intensity Approach Lighting and High Intensity Runway Lighting as well as new navigation aids such as Instrument Landing Systems • The passenger terminal at Bankstown Airport can currently accommodate 170 departing passengers and 150 arriving passengers. This may be sufficient for a small number of RPT services, however the paper noted that expansion would be necessary to handle a significant number of services at peak time.[83] The use of Bankstown Airport for RPT services would have significant implications for GA activities at the airport. Significant RPT movements at the airport could displace general aviation aircraft movements. The introduction of Class C airspace would mean a greater reduction in the capacity for GA, even at times when there are no RPT movements. It is expected that limited GA activity could operate when RPT is operating. Depending on the level of RPT, the introduction of RPT is likely to have a severe effect on flying related businesses located on the airport, including flying schools, aircraft maintenance services and charter operators potentially making most of these unviable at the airport'. This would likely mean that many businesses would need to reallocate to other facilities. The use of Bankstown Airport for RPT could also require upgrades to the roads and public transport surrounding the airport.
Potential to provide additional/new capacity in the Sydney region	Consideration of the ability of Bankstown Airport to provide additional Sydney region capacity has been undertaken in a number of studies. Each of these studies has not pursued the option for a range of reasons including its limited ability to provide sufficient capacity. There have been no material changes in circumstances to indicate these conclusions are no longer relevant. The more viable option for Bankstown Airport maybe for it to expand its role may be to serve RPT as a regional hub servicing Sydney, though any development of Bankstown Airport to support high performance RPT turbo-prop aircraft operations would also need to support the maintenance of capacity and efficiency of Sydney (Kingsford-Smith) Airport.

[81] WorleyParsons and AMPC 2010, *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Bankstown Airport, Section 6.3, p. 6

[82] WorleyParsons and AMPC 2010, *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Bankstown Airport, Section 6.3, p. 6

[83] Department of Infrastructure and Transport (2011), information relating to use of Bankstown Airport for RPT Services, p. 2

Image 6: Bankstown Airport runways



Source: WorleyParsons and AMPC 2010, *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Bankstown Airport, Section 6.1, p. 2

Image 7: Bankstown Airport and surronding areas

Source: WorleyParsons and AMPC 2010, *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Bankstown Airport, Section 6.1, p. 3

Example	*RAAF Base Williamtown (Newcastle Airport)*
Description of site and option	RAAF Base Williamtown (Newcastle Airport) is located approximately 17 km north-east of the City of Newcastle and is accessed from Nelson Bay Road and Medowie Road. It is approximately 175 km from the Sydney CBD and 2 hours and 16 minutes via car.[84] Furthermore, it is approximately 25 km from the Newcastle CBD and 30 minutes via car.[85] It is the RAAF's primary operational air base in NSW. RAAF operations are located on the northern side of the runway which is under the control of the RAAF. Civil operations are conducted from a dedicated leased area on the southern side of the runway. RAAF Base Williamtown accommodates a number of operational flying units, including operations of the F/A-18 Hornet, Hawk 127 PC-9/A, and Wedgetail Airborne Early Warning and Control (AEW&C aircraft (based on a B737-700 derivative airframe). The base accommodates a further number of support units and is intended to become one of three operational bases for the forthcoming F-35A Joint Strike Fighter (JSF) (along with Amberley and Tindall).[86] In terms of civil operations, Newcastle Airport Limited (NAL) operates the civil area including the feeder taxiways and apron supporting the passenger terminal and associated facilities. The airport provides for a wide range of domestic/regional (and limited international to Norfolk Island) passenger services and accommodates two major aircraft maintenance activities i.e. Jet star's A320 heavy maintenance and BAe Systems through life support for the RAAF Hawk 127 fleet. Scheduled services are provided by QantasLink, Jetstar, Virgin Blue, Brindabella and Aeropelican.[87] Civil operations at the sight began in 1947 when the Commonwealth Government agreed to allow limited civilian flights at the RAAF Base.[88] The Commonwealth continued to run the airport until 1990 when the Newcastle City Council and Port Stephens Council accepted an invitation to jointly operate the civil area. The two Councils formed NAL and signed a lease in 1993 for 30 years. In 2005 the lease was extended until 2045. [89] The entire site is 800 ha and the civil lease area is 23 ha.[90] There is one runway used for civilian purposes which is 2,438 m long and is a Code E runway. There are also three taxiways which are Code C, E and B. The base is in the LGA of Port Stephens which has a population of 67,825 and covers an area of 858.9 km^2.[91] Port Stephens has a population density of 77.7 people/km^2. The following reports and submissions have explored the option of expanded use of the Newcastle Airport to assist in meetings Sydney's aviation needs: • *Newcastle Airport Limited Master Plan* (2006) advocated for Newcastle to be used by travellers to Sydney and forecast that the airport had excess capacity • *Hunter Business Chamber's submission to the National Aviation Policy Green Paper* (2009) advocated for Newcastle to be used to provide additional RPT capacity to the Sydney region.

[84] WorleyParsons and AMPC 2010 *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Williamtown, Section 1.5, p.25 and Section 1.1, p.1

[85] Google maps, 2011. Available at http://maps.google.com.au/maps?saddr=1+Williamtown+Dr,+Williamtown+NSW+2318+(Newcastle+Airport)&daddr=Newcastle,+New+South+Wales&hl=en&sll=-32.923425,151.75&sspn=1.021331,2.458191&geocode=FY2EC_4dTgINCSGAcO_5aHoBDw%3BFUW7Cf4dcIULCSnlAsdxEz5zazGgqDIWaHoBBA&mra=pd&z=12

[86] WorleyParsons and AMPC 2010 *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Williamtown, Section 1.5, p.25

[87] *Ibid.*

[88] *Ibid.*

[89] Commonwealth Department of Transport and Regional Development 1997, *Draft Environmental Impact Statement: Second Sydney Airport Proposal*, Volume 1, pp.4-17

[90] WorleyParsons and AMPC 2010, *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Williamtown Airport, Section 1.1, p.1

[91] ABS 2010, *Regional Population Growth*, Cat No. 3218.0

Example	*RAAF Base Williamtown (Newcastle Airport)*
Findings of previous analysis	The *Newcastle Airport Limited (NAL) Master Plan* suggests the airport could be used to provide additional RPT capacity for the Sydney region.[92] The plan includes construction of an additional full length Code E parallel taxiway to the south (which is needed by the RAAF for larger aircraft, but will also be able to be used by civil aircraft), a 300 m wide runway strip (currently 230 m), allowance of a new terminal with a footprint of 10,000m^2 and additional aircraft parking aprons.[93] It does not consider development of a second runway for civilian purposes or lengthening of the runway (details of reasoning were not included in the Master Plan).[94] *The NAL Master Plan* forecasts that civilian aircraft movements for the next 20 years at the airport will remain well under the total number of movements allowed in the agreement with the RAAF.[95] The Plan projects that by 2020 there will be 1.5 million passenger movements (in 2008 there were 1.2 million passenger movement).[96] Currently, RPT aircraft movements are restricted to six landings per hour and unlimited departures (with priority given to military operations).[97] If additional runways were added to RAAF Base Williamtown/Newcastle Airport, this may assist the co-existence of military and civil operations. However, in the Master Plan 'the need for a second runway dedicated to civilian operations is excluded from consideration'.[98] In 2009, the Hunter Business Chamber proposed using Newcastle Airport to provide significant additional RPT capacity for the Sydney region.[99] This involved very high level analysis, drawing on information from the NAL Master Plan.
Recent developments	There have recently been a number of concerns raised regarding security if civilian movements at the site were increased, particularly if international carriers were allowed to the site. As the facility is a military base, sensitive information and technology are retained on site. This means there is particular sensitivity regarding international carriers having access to the site. As part of WorleyParsons/AMPC' work for the Joint Study relating to current airport infrastructure, the current infrastructure and role of RAAF Base Williamtown was considered as well as potential barriers to it providing additional RPT capacity to the Sydney region. WorleyParsons/AMPC suggest that RAAF Base Williamtown's basic infrastructure, if developed appropriately, could sustain up to a regional level of RPT service including a regional international service. However, issues identified with greater use of RAAF Base Williamtown for RPT were: • Further residential dwelling increases or 'encroachment' • Aircraft movement slots potentially limited by Defence needs (civil operations are capped per hour) • Limited land designated for civil operation to expand beyond current proposals • Rail link not easily provided.[100] In addition to RAAF Base Williamtown's ability to provide capacity for the Sydney region, a further consideration is RAAF Base Williamtown's ability to meet demand from the Hunter/Williamtown area. Domestic RPT traffic has increased 10-fold last 15 years to 1.1 million

92 Newcastle Airport Corporation 2006, *NAL Master Plan*, p.10

93 WorleyParsons and AMPC 2010, *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Williamtown Airport, Section 1.3, p. 15

94 *Ibid.*, p.10

95 Newcastle Airport Corporation 2006, *NAL Master Plan,* p.17

96 *Ibid.*

97 Royal Australian Air Force 2010, *Royal Australian Air Force Review: Civil access to Air Force airfields*, Air Vice Marshal Robert Treloar and Air Commodore Paul Devine, September 2010, p.12

98 Newcastle Airport Corporation 2006, *NAL Master Plan,* p. 19

99 Hunter Business Chamber 2009, *Submission on the National Aviation Policy Green Paper February 2009*, p.4

100 WorleyParsons and AMPC 2010, *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Overview and Outline of Report, Section A.9, p. 15

Example	RAAF Base Williamtown (Newcastle Airport)

passengers.[101]

WorleyParsons/AMPC review as part of the Joint Study suggests that planned military developments at RAAF Base Williamtown may affect reliability of civil operations as military movements have precedence in terms of access to the runway that may result in delays in some circumstances. However there is still some additional capacity to meet RPT demand: the current Operational Agreement with the RAAF allows six civilian or RTP aircraft landings per hour between 6am and 10pm. Current civilian movements are only taking up 27% of this capacity.[102] In the near future, it is likely that military flight numbers will increase as the Joint Strike Fighter program becomes operational. WorleyParsons/AMPC suggest that the 'main constraint' on growing civil operations at the airport will be runway access under the lease agreement.[103] Booz & Company aviation demand projections for the Sydney region prepared for the Joint Study suggest that the annual movement cap will not be exceeded in the next 50 years, considering current growth trends. However, it will become more constrained as the number of hours per day at the six landing per hour cap increases.

It is important to note that the issue of capacity at RAAF Base Williamtown/Newcastle Airport is more complex than the above graph may suggest. At peak times, there are currently approximately 4-5 flights per hour. As demand growth, the six landings per hour cap will be met during peak times prior to the total aircraft movements, reaching 800,000 per annum. It is anticipated that capacity constraints will emerge in peak periods between 2025-2030 and peak spreading will start have to start to occur.

For many airports, peak spreading is relatively simple to implement. However, at Newcastle Airport military operations, such as training, take precedent. Peak spreading may constrain military operations and therefore may not be possible.

The capacity of the roads surrounding the airport could act as a barrier to an expansion of Newcastle's use. The surrounding Nelson Bay, Medowie and Tomago Roads are all single lanes and not designed to handle large volumes of traffic. This has been identified by WorleyParsons/AMPC as a key barrier to expansion or expanded use of the airport.[104]

In August of 2010, Minister Albanese announced that a strategic study would be conducted on the implementation of a high speed rail network on the east coast of Australia.[105] The first phase of this study was released in August of 2011. Four corridors were shortlisted for further analysis in phase 2, these corridors included:

- A coastal corridor between Brisbane and Newcastle, with potential variations around coastal cities and the Gold Coast, and
- A Central Coast corridor between Newcastle and Sydney.[106]

The patronage forecasts assume a one-way fare between Sydney and Newcastle of $16.50 for commuters, $30 for non-business travellers and $60 for business travellers. The study found that inter-city non-stop running times would be approximately forty minutes between Sydney and Newcastle. [107]

The construction of high speed rail would significantly mitigate the issue of the distance between Metropolitan Sydney and RAAF Base Williamtown. However, it should be noted that construction

[101] Booz & Company 2010, *Draft Final Report*: *Forecast growth estimates for aviation activity in the Sydney region,* prepared for the Sydney Region Aviation Capacity Study, p. 12

[102] WorleyParsons and AMPC 2010 *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Williamtown, Section 1.3, p. 6

[103] *Ibid.*

[104] WorleyParsons and AMPC 2010 *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Overview and Outline of Report, Section A.9, p. 15

[105] AECOM 2011, *High Speed Rail Study- Phase 1,* prepared for the Department of Infrastructure and Transport, p. 2.

[106] *Ibid,* ii

[107] *Ibid,* v

Example	RAAF Base Williamtown (Newcastle Airport)
	of a high speed rail would not occur for some time.
Potential to provide new/additional capacity in the Sydney region	This option could provide additional capacity to the Sydney region if developed appropriately. As the location is greater than 2 hours and 110 km from Sydney, its role in serving the broader Sydney region is likely to be limited. However, it is likely to continue playing a role as a low-cost gateway to NSW, and serving the Hunter and Central Cost and surrounding regions. Introduction of the Joint Strike Fighter aircraft, and increasing use by the RAAF, may limit the availability of the facility for other services. Additionally, expansion in the greenfield area surrounding the current airport site may be difficult due to Grahamstown Lake to the north and Fullerton Cove and Beach to the south. RAAF Base Williamtown (Newcastle Airport) has the physical capacity to accommodate existing demand levels, and can accommodate some growth in its current RPT services. However, its distance from Sydney results in the airport principally serving the Hunter and Central Coast regions. If high speed rail between Sydney and Newcastle was introduced it would likely increase passenger numbers at Newcastle Airport travelling from Sydney. However, high speed rail, if found to be viable by the study, would not be constructed for some time. Additionally, the annual movement cap of civilian movements would likely constrain RPT growth over time. If future travel time from Sydney to Newcastle could be reduced, and RPT demand unable to be met at Sydney (Kingsford-Smith) airport relocated to Newcastle Airport, the different scale of activity between the airports would see Newcastle Airport rapidly reach capacity constraints and regularly reach its hourly RPT arrivals cap within only a few years.

Image 8: RAAF Base Williamtown civil and military areas

Source: WorleyParsons and AMPC 2010 *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Williamtown, Section 1.1, p. 2.

Image 9: RAAF Base Williamtown civil lease area

Source: WorleyParsons and AMPC 2010 *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Williamtown, Section 1.1, p. 3.

Image 10: RAAF Base Williamtown and surronding areas

Source: WorleyParsons and AMPC 2010 *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Williamtown, Section 1.5, p. 26.

Example	*Canberra Airport*
Description of site and option	Canberra Airport is located 6 km south-east of the Canberra CBD and 290 km from Sydney. It is the primary airport serving Canberra, the Australian Capital Territory (ACT) and southern NSW. The airport currently has two 45 metre wide runways, one of which is 3,283 m long and the other 1,679 m long (see **Image 11**).[108] These runways can accommodate most aircraft types. The airport was one of a number of airports offered to the private sector by the Federal Airports Corporation (FAC) in 1998. Since 1939 the site has also been used for military purposes and in 1998 the RAAF area was sub-leased back to RAAF and the civilian area was leased to the Capital Airport Group (CAG).[109] A new terminal has recently been constructed at the airport which provides significant additional capacity.[110] The ACT has a population of 330,000 people in an area of 2,394.4 km^2.[111] The population density is 137.9 people/km^2. Population is forecast to grow to 434,000 people by 2030 and 500,000 people by 2050.[112] The following documents have considered expanding the role of Canberra airport to assist in meeting Sydney's aviation needs: • *Draft EIS: Second Sydney Airport Proposal* (1997) considered expanding the amount of RFT to Canberra Airport • *Canberra Airport Master Plan* (2009) suggests that Canberra Airport could be used as a 'back-up' for RPT demand at Sydney (Kingsford-Smith) Airport.
Findings of previous analysis	The *Draft EIS: Second Sydney Airport Proposal* included a high level assessment of using Canberra Airport to provide capacity to the Sydney region. The Draft EIS highlighted that the travel time between Canberra and Sydney made it an unattractive option. Whilst the possibility of high speed rail was raised, the uncertainty surrounding the cost and the usage of such access infrastructure were seen as significant barriers.[113] The *Canberra Airport Master Plan* argued that it is the only airport that can act as a 'back-up' for Sydney (Kingsford-Smith) Airport and included some high level analysis of the level of excess capacity at Canberra Airport.[114] It highlighted that, apart from Sydney (Kingsford-Smith) Airport, Canberra Airport is the only 24 hour Boeing 747 and Airbus A380 capable airport between Brisbane and Melbourne and, in the long term, could accommodate overflow from Sydney (Kingsford-Smith) Airport.[115] In the *Canberra Airport Master Plan*, an upper range forecast for Canberra Airport volumes was calculated based on a scenario where the airport attracts some overflow from a congested Sydney (Kingsford-Smith) Airport. In this scenario, it was projected that RPT passenger numbers to Canberra could be 8.8 million per year in 2029-30 (compared to 2.85 million passengers in 2008-09).[116] The Master Plan stated that these numbers could be accommodated.

108 WorleyParsons and AMPC 2010, *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Canberra Airport, Section 12.1, p. 2

109 WorleyParsons and AMPC 2010, *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Canberra Airport, Section 12.1, p, 2

110 Canberra Airport 2009. *Master Plan*, p. 68

111 ABS 2010, *Regional Population Growth*, Cat No. 3218.0

112 ACT Chief Minister's Department 2010, *Population Ageing in the ACT: Issues and Analysis.*

113 Commonwealth Department of Transport and Regional Development 1997, *Draft Environmental Impact Statement: Second Sydney Airport Proposal*, Volume 1, p6-10.

114 Canberra Airport, 2009. *Master Plan*, p7.

115 *Ibid.*, p. 8

116 *Ibid.*, p. 64

Example	*Canberra Airport*
Recent developments	The site, which is an irregular shape, covers 440 ha. In surrounding areas, there are some residential developments planned. CAG has publically opposed proposals by the Queanbeyan Council to construct housing estates at Tralee and on farming land at Environa and Robin Land.[117] These developments could create community pressures for a curfew or a cap on movements to mitigate noise impacts on the developments. WorleyParsons/AMPC work for the Joint Study suggests that Canberra Airport has infrastructure that already allows the operation of sizable new RPT services – domestic or international. However, WorleyParsons/AMPC suggest that issues that could affect further operational development are urban encroachment and the lack of a rail link.[118] In addition to Canberra Airport's ability to provide capacity for the Sydney region, a further consideration is the airport's ability to meet demand from the Canberra area and south west of Sydney. Given the Capital Airport Group suggests that the new terminal developments have provided Canberra Airport with capacity of 10 million passengers, it appears that Canberra Airport will be able to serve the region's growth in coming years. Due to government travel to and from Canberra Airport, the Airport has higher greater usage per capita (nine passenger journeys per capita) than Sydney (Kingsford-Smith) Airport (seven passenger journeys per capita) and Melbourne (six passenger journeys per capital). As described above, the Department of Infrastructure and Transport is currently undertaking a study of high speed rail on the east coast. Of the four corridors shortlisted for further consideration in phase 2 of the study, two would connect to Canberra: • A Hume Highway and Princess Highway corridor between Sydney and Canberra, via the Southern Highlands, and • A Hume Highway corridor between Canberra and Melbourne via Riverina, Murray and with a potential route open via the Goulburn Valley. Phase 1 of the study indicated that a journey from Sydney to Canberra would be approximately one hour.[119]
Potential to provide new/additional capacity in the Sydney region	Sydney (Kingsford-Smith) Airport and Canberra Airport are the only two existing aviation facilities with infrastructure that already allows the operation of any form of RPT service. Canberra Airport is expected to continue to grow and potentially introduce some international services. However, it is three hours or more travel from most of the Sydney market, which means it is unlikely to make a material contribution in meeting future RPT demand from the Sydney basin. The airport is 290 km (or approximately 3 hours) from Sydney and therefore unlikely to generate sufficient demand to provide the additional capacity that is required. The issue of distance could be mitigated by the construction of high speed rail from Sydney to Canberra. Though the Sydney to Canberra corridor has been shortlisted for consideration in the second phase of the study, there is still another phase of the study to be completed and the study has used 2036 as an indicative year of when high speed rail could be operational.[120] A combined option of Canberra Airport plus a high speed rail connection could allow for further consideration of Canberra Airport to provide capacity for the Sydney region. However, at this stage, there is not enough information about high speed rail to enable credible further analysis of such an option.

[117] Capital Airport Group 2008, *Planning Investigations: Opportunities for Future Residential Development within Queanbeyan LGA,* and Capital Airport Group 2011, *Noise Sharing*. Available at: http://www.canberraairport.com.au/air_noise/noise_sharing.cfm

[118] WorleyParsons and Airport Master Planning Consultants 2010, *Airport Infrastructure in the Sydney Region*, prepared for the Sydney Region Aviation Capacity Study, Overview and Outline of Report, Section A.9, p. 16

[119] AECOM 2011, *High Speed Rail Study- Phase 1,* prepared for the Department of Infrastructure and Transport, p. 2

[120] *Ibid,* vi

Image 11: Canberra Airport runways

Source: WorleyParsons and AMPC 2010, *Airport Infrastructure in the Sydney Region*, Canberra Airport, Section 12.1, p. 2

Image 12: Canberra Aiport and surronding areas

Source: WorleyParsons and AMPC 2010, *Airport Infrastructure in the Sydney Region*, Canberra Airport, Section12.5, p 31.

4. Utilisation of existing aerodromes outside Sydney

The previous chapter presented options relating to better utilising existing aerodromes in the Sydney region. In addition to these, there have been a range of previously proposed options to better utilise airports outside of the Sydney region to assist in meeting Sydney's aviation needs. Three of these options are outlined in this section, as well as the findings of previous analysis of the options and any significant issues not considered in previous analysis. The options considered in this section are:

- Using a existing aerodromes in regional NSW
- Using an existing aerodrome for all Australian international flights
- Spreading Sydney region flights to other capital city airports.

Summary of findings

The range of previously proposed options to better utilise airports outside of the region to assist in meeting Sydney's aviation needs has included developing the role of a Central West Airport (such as those at Parkes, Dubbo or Bathurst) to contribute provide capacity. Ideas have also previously been suggested by proponents to develop a single international airport for Australia, an example proposed being to define an airport at Alice Springs as the only international airport in Australia (with passengers connecting to other locations in Australia via domestic flights). In addition, spreading of flights to other capital city airports, for example international flights that currently arrive at Sydney (Kingsford-Smith) Airport being spread to Brisbane and Melbourne International Airports has been previously raised as a capacity option for the Sydney region.

Findings common to all approaches

It is considered that as these options are a distance from Sydney, they would not provide significant relief to capacity constraints, and as such it is not recommended to consider options such as this further. This is because travellers to an aerodrome outside the Sydney region would either still require flights to connect to Sydney, or may not attract Sydney region users due to the significant land transport travel time required.

Examples considered

Example option	*Central West Airport e.g. at Parkes, Dubbo, Bathurst*
Description of option	The Dubbo City airport currently has two runways, the longer of which is 1,708 m and the site is 300 ha. In the airport's Master Plan there are plans to build an additional 1,700 m runway parallel to the current runway.[121] Dubbo Airport is approximately 400 km from Sydney with a travel time of over 5 hours to travel via car from the airport to Sydney.[122] The Bathurst Airport has two runways, the longer of which is 1,700 m long.[123] Bathurst Airport is over 190 km from Sydney CBD with a travel time of 2.5 hours to travel from the Sydney CBD to the Bathurst Airport.[124]

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[121] Dubbo City Council 2011, *Airport Facilities*. Available at: http://www.dubbo.nsw.gov.au/BusinessandIndustry/AirportFacilities.html

[122] Google maps 2011. Available at: http://maps.google.com.au/maps?f=d&source=s_d&saddr=Dubbo+City+Airport&daddr=Sydney,+New+South+Wales&hl=en&geocode=FeFfFP4d3BzbCCHDejM6lals5Q%3BFZsz-_odszwDCSnFAZBWlpcSazFgqDIWaH0BBA&mra=ls&sll=-25.335448,135.745076&sspn=34.778119,78.662109&ie=UTF8&z=8

[123] Bathurst Regional Council 2011, *Bathurst Regional Airport*. Available at: http://www.bathurst.nsw.gov.au/engineering/technical-services/bathurst-regional-airport.html

[124] Google maps 2011. Available at: http://maps.google.com.au/maps?f=d&source=s_d&saddr=Bathurst+Airport,+Bathurst,+New+South+Wales&daddr=Sydney,+New+South+Wales&geocode=FQ1BAv4dC33rCCFO1_fIuZwjrw%3BFZsz-_odszwDCSnFAZBWlpcSazFgqDIWaH0BBA&hl=en&mra=ls&sll=-33.495598,149.72168&sspn=2.029335,4.916382&ie=UTF8&z=9

Example option	*Central West Airport e.g. at Parkes, Dubbo, Bathurst*
	The Parkes Airport currently has two runways, each just over 1,600 m long.[125] The Airport is 350 km from Sydney with a travel time of nearly 5 hours via car.[126] The Parkes Shire Council is currently proposing a significant development of the Airport to facilitate it being used for the direct export of perishable agriculture products from the Central West of NSW. Under the plan the existing facilities would be demolished and dedicated facilities, as well as facilities for existing regional airlines and private operators, would be constructed. The cross-runway would also be shut down and a new 3,800 m runway constructed that could accommodate Boeing 747 class aircraft.[127] (Kingsford-Smith) Airport, and as part
Findings of previous analysis	While formal studies have not been identified that consider development of a Central West Airport in Dubbo, Parkes or Bathurst, discussion on these and similar locations in the central west being major road and rail hubs to other parts of NSW has turned discussion to an Airport in the Central West to provide Sydney region capacity. This section of the paper considers the scope for a Central West Airport to provide GA, freight and/or RPT capacity for the Sydney region.
Potential to provide new/additional capacity in the Sydney region	The distance from Sydney is significant and is of such a magnitude that it may still require additional services from the location to Sydney (Kingsford-Smith) Airport (or another location closer to Sydney). As a result it could in fact add to the pressure on capacity, depending on the number of flights required to transfer passengers from the central west to Sydney. Furthermore, there is no evidence that airlines are inclined to pursue this option based on the history of the airports and therefore, market forces do not seem to favour it.

Airport	Population	Distance to Sydney	Average RPT flights per day	Runway length
Dubbo City Airport	41,760[128]	400 km[129]	22[130]	1,708 m[131]
Bathurst Airport	39,915[132]	190 km[133]	Not available	1,700 m[134]
Parkes Airport	15,190[135]	350 km[136]	3[137]	1,600 m[138]

125 Parkes Shire Council 2011, *Parkes Airport Development*. Available at: http://www.parkes.nsw.gov.au/economic/7022/5767.html

126 Google maps 2011. Available at: http://maps.google.com.au/maps?f=d&source=s_d&saddr=Parkes+Airport,+Parkes,+New+South+Wales&daddr=Sydney,+New+South+Wales&geocode=FepYBv4dxNrVCCGgSGBpboonLA%3BFZsz-_0dszwDCSnFAZBWlpcSazFgqDIWaH0BBA&hl=en&mra=ls&sll=-33.023285,149.889235&sspn=2.040352,4.916382&ie=UTF8&ll=-33.495598,149.72168&spn=2.029335,4.916382&z=8

127 *Ibid.*

128 ABS 2011, *Regional Population Growth 3218.0.*

129 Google maps 2011. Available at: http://maps.google.com.au/maps?f=d&source=s_d&saddr=Dubbo+City+Airport&daddr=Sydney,+New+South+Wales&hl=en&geocode=FeFfFP4d3BzbCCHDejM6lals5Q%3BFZsz-_0dszwDCSnFAZBWlpcSazFgqDIWaH0BBA&mra=ls&sll=-25.335448,135.745076&sspn=34.778119,78.662109&ie=UTF8&z=8

130 Dubbo City Council 2011, *Dubbo City Regional Airport*. Available at: http://www.dubbo.nsw.gov.au/BusinessandIndustry/DubboCityRegionalAirport.html

131 Dubbo City Council 2011, *Airport Facilities*. Available at: http://www.dubbo.nsw.gov.au/BusinessandIndustry/AirportFacilities.html

132 ABS 2011, *Regional Population Growth 3218.0.*

133 Google maps 2011. Available at: http://maps.google.com.au/maps?f=d&source=s_d&saddr=Bathurst+Airport,+Bathurst,+New+South+Wales&daddr=Sydney,+New+South+Wales&geocode=FQ1BAv4dC33rCCFO1_fIuZwjrw%3BFZsz-_0dszwDCSnFAZBWlpcSazFgqDIWaH0BBA&hl=en&mra=ls&sll=-33.495598,149.72168&sspn=2.029335,4.916382&ie=UTF8&z=9

134 Bathurst Regional Council 2011, *Bathurst Regional Airport*. Available at: http://www.bathurst.nsw.gov.au/engineering/technical-services/bathurst-regional-airport.html

135 ABS 2011, *Regional Population Growth 3218.0.*

136 Google maps 2011. Available at: http://maps.google.com.au/maps?f=d&source=s_d&saddr=Parkes+Airport,+Parkes,+New+South+Wales&daddr=Sydney,+New+South+Wales&geocode=FepYBv4dxNrVCCGgSGBpboonLA%3BFZsz-_0dszwDCSnFAZBWlpcSazFgqDIWaH0BBA&hl=en&mra=ls&sll=-33.023285,149.889235&sspn=2.040352,4.916382&ie=UTF8&ll=-33.495598,149.72168&spn=2.029335,4.916382&z=8

Example option	***Alice Springs as the only international airport in Australia***
Description of option	In debate regarding broader airport capacity in Australia, constructing an international airport in Alice Springs and using this as the only international airport has been proposed on a number of occasions. Recently, Professor Bill Gammage AM of the Australian National University proposed an option that would see Alice Springs used as the sole international air hub in Australia and that passengers then take domestic flights to their final destination in Australia.[139] Currently Alice Springs has one domestic airport which is located 15 km from the centre of Alice Springs.[140] The airport has two runways and no curfew.[141] There is currently no international airport in Alice Springs.
Findings of previous analysis	A public report of the details of Professor Gammage's proposed option was not able to be located. But broadly Professor Gammage argued that using Alice Springs as the international airport hub would diffuse passenger loads and reduce travel through capital city airports such as Sydney (Kingsford-Smith) Airport.[142] Professor Gammage also identified other benefits of the site as: • The city's flat land • Lower start up costs due to the large amounts of Commonwealth land in the area • Fine weather for most of the year and little risk of fog or flood • Work opportunities for the local population.[143]
Recent developments	**Patterns of travel** This option could alleviate capacity in the Sydney region, if it reduced the level of hubbing currently occurring through Sydney (Kingsford-Smith) Airport to other locations in Australia. However, increasingly international passengers are able to fly directly to cities other than Sydney, reducing the need to hub through Sydney (Kingsford-Smith) Airport. As a result, this option would principally convert a previous international flight to/from Sydney (Kingsford-Smith) Airport, Canberra Airport or Newcastle Airport, into a domestic flight from Alice Springs. Currently at Sydney (Kingsford-Smith) Airport, aircraft average loads for international flights are larger than domestic loads,[144] and if this trend was maintained to distribute passengers from Alice Springs around Australia on domestic flights, then the volume of aircraft movements may well increase under this option. **Comparable examples** There are no comparable examples of a country having one international 'gateway' airport. The United States (US) has a number of 'hub' international airports such as Chicago O'Hare International Airport, Dallas Fort Worth and Atlanta Hartsfield. (These three US airports each have between 500,000–700,000 passenger movements per year). However, there are a number of significant and obvious differences between this option and these US airports. First, these airports are intended to complement, not replace other international airports. Second, they act as a hub for significantly more destinations that an international airport at Alice Springs would.

[137] Parks Shire Council 2011, *Parkes Regional Airport*. Available at: http://www.parkes.nsw.gov.au/roads/1204/11536.html

[138] Parkes Shire Council 2011, *Parkes Airport Development*. Available at: http://www.parkes.nsw.gov.au/economic/7022/5767.html

[139] Koutsoukis, Jason 2007, *An air hub called Alice springs to mind*, The Age, 18 February.

[140] Alice Springs Airport 2011, *Airport Location*. Available at: http://www.alicespringsairport.com.au/to-and-from-airport/airport-location

[141] Alice Springs Airport 2009, *Master Plan: Final 2009*.

[142] Koutsoukis, Jason 2007, *An air hub called Alice springs to mind*, The Age, 18 February.

[143] *Ibid.*

[144] Booz & Company 2010, *Draft Final Report*: *Forecast growth estimates for aviation activity in the Sydney region* 30 November 2010, prepared as a part of the Joint Study on Aviation Capacity for the Sydney Region. [Fine name: Sydney Traffic Model Outputs_081010.xls]

Example option	*Alice Springs as the only international airport in Australia*
	Implications for airports and cities This option would have widespread effects on aviation, infrastructure and employment across the country. All other international airports across Australia would become domestic airports. It would also directly impact the level of retail revenue and duty free for many international airports, and renegotiating changes with existing airport owners could be challenging.
Potential to provide new/additional capacity in the Sydney region	Given the current trends in passenger travel it is considered that re-routing services from Sydney to Alice Springs would principally result in an increase in domestic services from Alice Springs to Sydney (Kingsford-Smith) Airport, and hence would not contribute to additional capacity in the Sydney region

Example option	*Spread Sydney (Kingsford-Smith) Airport international flights to Melbourne and/or Brisbane Airports*
Description of option	Options have been previously raised to spread international flights that currently arrive at or depart from Sydney (Kingsford-Smith) Airport to other locations, such as Melbourne or Brisbane. The following studies have assessed such options: • *MANS Study: Commonwealth Members' Recommendations* (1975) • *Draft EIS: Second Sydney Airport Proposal* (1997).
Findings of previous analysis	The MANS study initially examined the possibility of spreading large numbers of international passenger movements to other 'gateway' airports, such as Melbourne and Brisbane.[145] However, after initial analysis and before the release of the options paper, this option was ruled out by the *MANS Study: Commonwealth Members' Recommendations*.[146] This option was also considered in the *Draft EIS: Second Sydney Airport Proposal*, which said that such options would not by themselves 'suppress demand for air travel to Sydney as it would be unlikely that alternative access to Sydney would be regarded as being convenient'.[147] It was also concluded that such an option would only 'artificially reduce the demand for additional airport travel in Sydney' and could have significant adverse economic impacts. For these reasons this option was not considered for further analysis.[148]
Other issues for consideration	**Recent trends in flight departures and arrivals** Over recent decades there has been a trend for international flights to increasingly arrive at destinations other than Sydney, particularly Melbourne and Brisbane. For example, since 2002 the proportion of total international passengers arriving in and departing from Sydney has decreased, whereas Brisbane and Melbourne have increased. In 2002, 48% of international departures and arrivals occurred from Sydney (Kingsford-Smith) Airport, 20% from Melbourne and 15% from Brisbane.[149] In 2010, 43% of international departures and arrivals were from and to Sydney (Kingsford-Smith) Airport, 21% from Melbourne and 16% from Brisbane.[150] This

145 MANS Study 1975, *Abstract Report: Commonwealth Members' Recommendations*, p.13

146 *Ibid.*, p13.

147 Commonwealth Department of Transport and Regional Development, 1997. *Draft Environmental Impact Statement: Second Sydney Airport Proposal*, Volume 1, p6-10.

148 *Ibid.*, p6-10.

149 Bureau of Infrastructure, Transport and Regional Economics 2010, *Statistical Report: International Aviation Activity 2009-10*, p14.

150 *Ibid.*, p14.

Example option	*Spread Sydney (Kingsford-Smith) Airport international flights to Melbourne and/or Brisbane Airports*
	suggests that international flights are already increasingly being spread across the major international airports in Australia.
Potential to provide new/additional capacity in the Sydney region	To some extent this already occurs as carriers seek access to Australian airports and are able to find options that involve flights direct to airports other than Sydney (Kingsford-Smith) Airport. Any option that seeks to force such an arrangement is likely to have little impact on Sydney region capacity.

5. Other solutions

Other solutions to Sydney's aviation capacity requirements that have previously been considered have included:

- Construction of an offshore airport
- Development of an airport on island in the Sydney region
- Development of an airport in Sydney's CBD
- Building or using an existing airport as a freight only airport
- Development of a greenfield airport in the Sydney region.

Summary of findings

Overall, it is concluded that, with the exception of developing a land-based greenfield airport in the Sydney region, other solutions previously suggested such as those that are offshore, in highly build up urban areas, or serve only one small segment of demand, do not provide efficient or economic solutions to Sydney's long term aviation needs.

Offshore or island airport development

A number of offshore and sheltered water areas have been previously examined by the Australian Government. These have included offshore airports in the vicinity of Sydney (Kingsford-Smith) Airport, as well as some in other areas along the coast of NSW.

However, previous analysis has ruled out offshore airport options. Expense and potential environmental impact of land reclamation would be challenges of such developments. Furthermore, passenger access would be expensive to establish and operate, with difficult and costly linkages to the existing networks.

Offshore airports in the vicinity of Sydney (Kingsford-Smith) Airport have been proposed to enable development in the vicinity of an airport site that does not require displacement of or noise impacts to urban areas. In addition to experiencing the issues expected for other offshore airports, an offshore airport located in the relative vicinity of Sydney (Kingsford-Smith) Airport would also impact on current airspace arrangements due to potential interactions with the existing airport.

Development of airport facilities on an island such as Kooragang Island Airport would also face similar issues.

CBD airport development

Options have been raised by proponents for a corporate jet airport to be constructed in the CBD of Sydney, with the view that this would alleviate some pressure from Sydney (Kingsford-Smith) Airport. However, given the already proximate location of Sydney (Kingsford-Smith) Airport and the challenge identifying a site in heavily populated CBD areas as well as the potential noise impacts, suggests this type of development would face a number of challenges.

Land-based greenfield airport development

A range of land-based greenfield sites have been considered in previous Commonwealth Government studies or proposed by proponents. The changes in land use and airport demand trends since the time of previous studies, indicate that new analysis of such options will be required as part of the Joint Study's consideration of capacity options for the region.

It is therefore recommended that the Steering Consider development of a greenfield site in the Sydney region as part of the Joint Study.

Examples considered

Example option	***Offshore airport***
Description of option	Since the 1970s a range of options for offshore airports have been raised. The following studies considered locations for an offshore airport in Sydney to assist in meeting aviation demand: • Benefit/Cost Study of Alternative Airport Proposals for Sydney (1971-1974) • Study by the Commonwealth Department of Works on an offshore airport for the Commonwealth State Committee- Second Sydney Airport (1972) • MANS Study Airport Planning Report (1978) *The Second Sydney Airport Draft EIS* briefly considered an option to relocate Sydney (Kingsford-Smith) Airport to an offshore site off Botany Bay. The option was initially detailed in a report by Tierney and Partners for the Pacific Airport Group, '*The Solution to Sydney's Air Traffic Problems: Project Kingfisher*'.[151] The Project Kingfisher Report included cost estimates, detailed town planning and design development as well as consideration of environmental and noise impacts. The option was for a Sydney offshore airport to replace Sydney (Kingsford-Smith) Airport and be constructed 1 km off the coast, in the waters immediately to the north of the mouth of Botany Bay.[152] The airport would consist of a concrete platform supporting runways, taxiways and aprons, terminal for passengers and cargo and other facilities.[153] All facilities and infrastructure would be linked to the land by a multi-lane bridge. The platform would be supported by piers, founded on the seas floor of the continental shelf. Offshore airports and runways have also been proposed for a number of sites overseas including in the Tokyo Bay and Point Loma in San Diego.[154] There is also an offshore airport in Osaka Bay, Kansai International Airport, and in Hong Kong, Hong Kong International Airport.
Findings of previous analysis	A number of offshore and sheltered water areas were examined in the *Benefit/Cost Study of Alternative Airport Proposals for Sydney* which assessed options on the basis of their cost, viability and environmental impacts.[155] The two primary offshore sites (one in Broken Bay and one off Wollongong) were concluded to have too great a depth of water to be viable.[156] In the *MANS Study Airport Planning Report* the possibility of offshore sites were also examined from the perspective of cost. Ten oceanic sites (Little Beach, Avalon, Narrabeen, Dee Why, Vaucluse, Long Bay, Kurnell, Bate Bay, Marley Beach and a site 6.5 km from Sydney Heads) and two sheltered sites (Botany Bay and Tuggerah Lakes) were examined.[157] It was found that costs for oceanic sites ranged from $18 billion to $30 billion (in present value) and that the least expensive offshore site preparation costs would be 2.5 times the cost of preparation for the site at Badgerys Creek.[158] Due to the high costs these options were eliminated.

[151] Pacific Airport Group 1996, *The Solution to Sydney's Air Traffic Problems: Project Kingfisher*, p. 2

[152] *Ibid.*

[153] *Ibid.*

[154] Schwartz, Ariel 2009, *Ocean Works International: San Diego's Offshore Airport?* Available at: http://www.fastcompany.com/blog/ariel-schwartz/sustainability/oceanworks-international-san-diegos-offshore-airport
Ministry of Land, Infrastructure and Transport 2001, *Outline of the Tokyo International Airport Offshore Development Project*, Available at: http://www.mlit.go.jp/english/civil_aviation/okiten.html

[155] Department of Aviation 1985, *Second Sydney Airport Site Selection Programme: Draft Environmental Impact Statement*, p. 69

[156] *Ibid.*, p. 70

[157] Airport Planning Consultative Group 1978, *MANS Study: Airport Planning Report*, p. 12

[158] *Ibid.*, p. 12

Example option	*Offshore airport*
	The two 'sheltered' offshore sites were considered. However, it was found there was no advantage to these offshore sites than the adjacent onshore sites, which would cost significantly less. On this basis the sheltered offshore sites were also eliminated.[159] The proposal by Pacific Airport Group (PAG) claimed that there were a range of benefits to an offshore airport including minimal noise, reduced aircraft pollution over Sydney, central location and negligible land acquisitions.[160] The option included the construction of two runways (one 4,000 m and the other 3,000 m) but also highlighted that an additional runway could be added to the plan.[161] It was also proposed that to overcome access issues, ANZAC Parade could be upgraded. It was estimated that the option would cost just over $13bn (in present value).[162] *The Second Sydney Airport Draft EIS* did not examine in detail offshore airport options, but did look at both the cost of the PAG proposal as well as the environmental effects.[163] It was decided to not examine offshore options in detail because of the cost of constructing such an airport, the associated infrastructure, the engineering facilities necessary and the compensations airlines would seek for relocation.[164] Additionally, it was argued that the environmental impacts would be significant.[165]
Recent developments	Airbiz input to this paper suggests that 'from an airspace perspective (an offshore airport) is feasible'.[166] They note that there are major examples overseas of major greenfield airports being constructed offshore through full or partial reclamation, for example in Hong Kong.[167] However, it was also noted that whilst there may not be significant airport planning issues with an offshore airport, there are very significant engineering, access, environment and cost issues.[168] They also suggest that 'the catalyst and justification for the very significant investment is lack of suitable on-shore sites and the mitigation of noise impacts with primary flight paths over water'.[169] Airbiz considered the flight path interaction between an offshore airport and Sydney (Kingsford-Smith) Airport, highlighting that the further apart the two airports were constructed, the less flight path interaction there would be.[170] The example of Gatwick and Heathrow airports was sited. The two airports are approximately 48 km apart and 'the airspace interaction between these two airports is complex and constrained'.[171] WorleyParsons/AMPC indicate that, assuming an offshore airport in the relative vicinity of Sydney (Kingsford-Smith) Airport, the runway heading at the offshore airport could be parallel to the coast, the runway headings would converge on the existing runway 16L/34R at Sydney (Kingsford-Smith) Airport and would be close to perpendicular to the existing runway 07/25 leading to airspace conflicts and need for coordinated control, possibly/probably with impacts on the capacity at one or both airports. As there is no detailed analysis as to how an offshore and Sydney (Kingsford-Smith) Airport would be able to function operationally in terms of airspace

159 *Ibid.*, p. 12

160 Pacific Airport Group 1996, *The Solution to Sydney's Air Traffic Problems: Project Kingfisher*, p. 49

161 *Ibid.*

162 *Ibid.*

163 Commonwealth Department of Transport and Regional Development 1997, *Draft Environmental Impact Statement: Second Sydney Airport Proposal, Volume 1*, p. 46

164 *Ibid.*

165 *Ibid.*

166 Airbiz, 2011. *Analysis of other options.*, prepared for the Sydney Region Aviation Capacity Study, p. 2

167 *Ibid.*

168 *Ibid.*

169 *Ibid.*

170 *Ibid.*

171 *Ibid.*

Example option	*Offshore airport*
	capability, this would require further consideration by Airservices Australia and/or the OAR. WorleyParsons/AMPC suggest that an offshore airport site is likely to be constructed on piles over water. The terminal/building area could be on the airport platform and would need to be roughly similar in overall area to the combined domestic and international precincts at Sydney (Kingsford-Smith) Airport. As the cost per square metre is very high for an offshore airport, provision of support facilities (e.g. car parking, business parks, offices and hotels) may be difficult to achieve. In addition, the sitting of the airport on an elevated platform 1 km off shore may raise issues for safety/emergency response with regards to recovery of aircraft, limitations on any access road and services provision (including water, sewer, power and fuel) for emergency egress/access, and risk of damage due collisions by shipping. Due to the immediate approach areas being over water, and the proximity of Port Botany, shipping which might otherwise be treated as transient obstacles may need to be taken into account for OLS purposes. Issues relating to both Sydney (Kingsford-Smith) Airport and an offshore airport operating could include that out of wind arrival operations may have to be accommodated on Runway 07/25 at Sydney (Kingsford-Smith) Airport as they are currently (assuming that only one runway direction is provided at a Sydney offshore airport). As the approaches to runways at an offshore airport would be over water a key attraction of the option is reduced noise impacts. There may still be some aircraft noise associated with flight tracks to and from the airport. In addition, the presence of the new airport will likely have impacts on the operation of Sydney (Kingsford-Smith) Airport which may have other impacts on noise (e.g. limitations on the use of runway 07/25, or the need to change the operating altitudes aircraft to both airports to manage airspace interaction). Offshore from Sydney's beaches, typical seabed slopes are in the order of 1:50 to about 50 m depth. Therefore, at a distance of 500 m offshore, the typical depth is 10 m. Rocky areas are generally steeper (e.g. about 1:25 offshore of North Head and North Bondi, and about 1:20 offshore of South Coogee and Little Bay), although there are exceptions (e.g. Newport and Mona Vale at 1:50, and Long Reef at 1:80). Any offshore structure would be likely to affect wave transformation in some manner. Impacts could be reduced by elevating the underside of the deck of the structure to above typical wave heights (1.5 m average significant wave height, with 100 year ARI wave height in the order of 9m), including considerations of elevated water levels and sea level rise. If waves hit the side of the structure, then this would cause dissipation of wave energy and the structure would essentially be acting as an offshore breakwater, which could affect: • Loadings on the structure • Cross shore processes at beaches (a beach sheltered landward of the structure may have a reduced wave climate, and hence may accrete) • Longshore sediment transport (altered wave angles could change the alignment of beaches, and reduction in wave energy in one area could reduce the supply of sediment to another, thus leading to long term recession) • Quality of surfing conditions • The safety of rock platforms (e.g. used for fishing). The typical wave direction offshore of Sydney is from the south south east (SSE) (30%) and south (19%). For storm waves (significant wave height above 3 m), 48% of waves come from the south and 26% from the SSE. About 66% of all waves and 84% of storm waves come from the SE to south octant. Therefore, the most significant wave transformation effects of an offshore structure would most likely be experienced to the north west of the structure. Impacts are likely to be minimised if the shoreline that would be affected was rocky. The further the distance of the structure offshore, the less likely that it would affect shoreline wave energy, although note that wave diffraction would allow energy to pass around the structure. If the deck was below wave run up levels, it would be necessary to protect the sides of the structure with elevated crests to prevent wave overtopping impacts on airport operations. Any

Example option	*Offshore airport*
	connecting bridge to an offshore airport would also need to be elevated above wave action. In terms of surface transport access to an offshore airport, provision of all weather transport road and rail links to an airport platform would require similar construction to that of the platform itself and be subject to essentially the same issues for safe construction and operation. Linkages to the existing major road and rail systems would be very difficult and expensive as none of these are well set up to address a major source of demand 1 km offshore and to connect with transport links to that source. Given the possible risks to road users in severe weather, it may be necessary to limit offshore road traffic to service vehicles only and require all workers and users to use some form of people mover system. This would need to have a fixed onshore terminal point of significant scale at which users and workers could park and would be well-connected to the major transport system that give access broadly to the city and CBD in particular. Logically, the only place that would be able to support such a facility would be the existing airport site. This raises the issues of baggage transfers. While tunnels for outfalls have been constructed offshore from Sydney, the scale of work for transport tunnels and the need to connect from the seabed to an airport platform 55 m - 60 m above appears extremely difficult in engineering terms and prohibitively expensive. For a railway it would require a length of 5 kilometres at 1:80 grade which exceeds the distance the airport is proposed to be offshore. The only other alternative would be for only the runway itself to be offshore, which seems impractical given the distances aircraft would have to taxi and the costs and risks of constructing such a taxi way. [172] *Consideration of Project Kingfisher specifically* Project Kingfisher relates to an offshore airport in Botany Bay. At a distance of 1 km offshore from Botany Bay, water depths are in the order of 48 m and it would not be practical to create an earth fill platform in such a depth of water as has generally been done for other airports constructed off shore. Accordingly, a structural platform founded on very long piles would be required. Seabed conditions would be an important consideration in terms of pile design. Available seabed mapping indicates that the exposed seabed is rock reef for a distance of about 900 m offshore of Cape Banks (the northern entrance to Botany Bay) and extending for over 3 km north to Malabar Beach (and 1 km south). It is therefore likely that piles would need to be socketed into rock in this area. As each pile would be laterally unsupported over much of its 48 m length, piles would need to be relatively lightly loaded and hence large numbers of piles would be required. Alternatively, structural forms similar to offshore oil production platforms would be needed but on an unprecedented scale to provide a platform of the scale of 1500 ha. As noted above, to be able to withstand maximum waves overtopping under storm conditions, the platform would have to be set at about 9 metres above mean sea level. Given the long length of rocky shoreline to the north of Botany Bay, the Project Kingfisher site could be considered to be one of the most suitable in Sydney in terms of minimal impacts on sandy shoreline processes (as would the area between Bondi Beach and South Head, and between Maroubra Beach and Coogee Beach). From an environmental perspective, effect on the seabed from construction could be offset by the large increase in marine habitat afforded by the piles. [173] *Coastal Lake options* An 'offshore' airport could be constructed within an enclosed coastal water body such as Tuggerah, Budgewoi and Munmorah Lakes, Lake Macquarie and Lake Illawarra, in a similar manner to Chep Lap Kok and Kansai as water depths are generally only a few metres in these

[172] WorleyParsons and AMPC, 2011.

[173] WorleyParsons and AMPC, 2011.

Example option	*Offshore airport*
	lakes. The area of these water bodies is of sufficient scale to accommodate a limited service airport servicing all RPT segments, and, in some cases, a full service airport serving all RPT segments. These locations would connect with the transport system reasonably well. However, airport construction within these lakes would cause massive environmental changes and would likely be opposed just by land owners whose property adjoins the water from but by a wide range of waterway users and environmental interests. [174]
Potential to provide new/additional capacity in the Sydney region	Previous analysis has ruled out options such as this, with expense as a major consideration. More recent examples of floating airports exist in Japan, where costs have reached ~$20 billion for the Kansai International Airport in Osaka Bay.[175] Were cost not a factor it is possible that an offshore airport could provide capacity depending on its location and configuration. An offshore airport is technically feasible in a civil engineering sense, though likely to be costly compared to a site onshore. Design, construction and maintenance would be more costly than an onshore facility due to its exposure to climate and the environment both in capital terms and recurrent terms. Also, operationally, an offshore airport located, for example, 1 km offshore of Sydney's coastline would likely have a number of difficulties that could reduce the relative aviation capacity in the Sydney region due to adverse airspace management interactions with Sydney (Kingsford-Smith) Airport. Passenger access could be expensive to establish and operate, with difficult and costly linkages to the existing networks.[176]

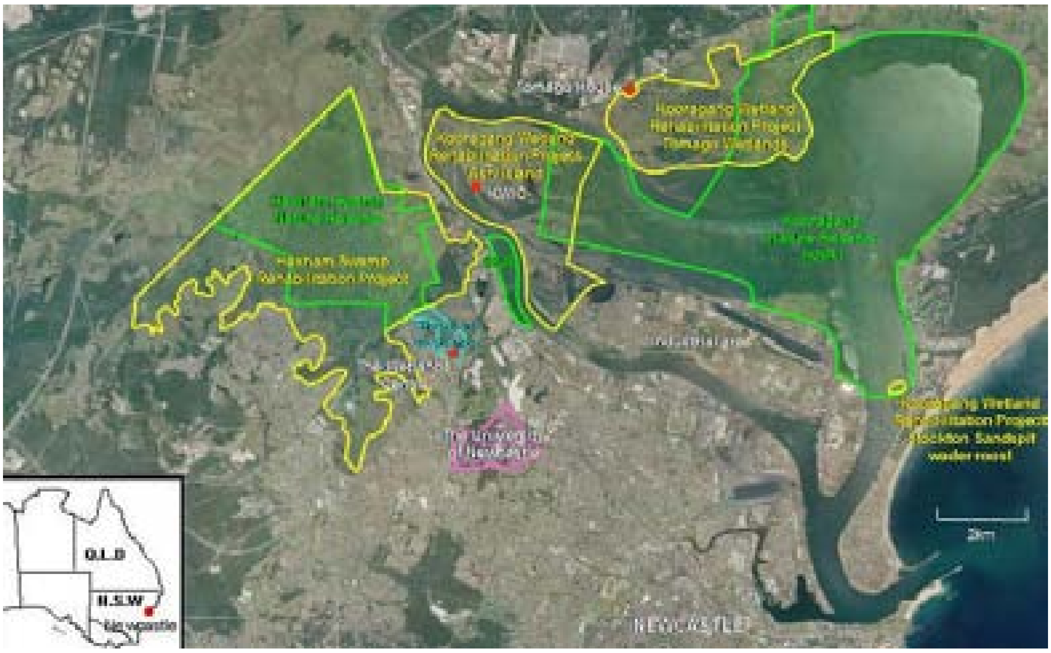
[174] WorleyParsons and AMPC, 2011.

[175] Abirshamkar, Morioka 2009, *Kansai International Airport*, Department of Civil and Environmental Engineering University of Hawaii, p. 2

[176] WorleyParsons and AMPC, 2011.

Example option	*Kooragang Island Airport*
Description of option	Over many decades options have been raised to build an international airport on Kooragang Island off Newcastle. In 2008, the NSW premier proposed a second international airport be constructed in or around Newcastle, with Kooragang Island raised as a potential site.[177] Kooragang Island is over 150 km from the Sydney CBD and over 2 hours by car from Sydney CBD.[178] Kooragang Island is located within the Newcastle City Council which has a population of 156,112 people and covers an area of 4,05.3 km².[179] The LGA has a population density of 133.5 people/km².
Findings of previous analysis	None identified
Recent developments	There are currently plans for a significant port expansion that will affect the availability of land on the Island. There are also existing wind turbines. As a result available land appears insufficient to allow these developments as well as an airport.
Potential to provide new/additional capacity in the Sydney region	Current planning for the area does not allow for the development of the site as an airport. Furthermore its distance from Sydney makes it an unsuitable location.

Image 13: Kooragang Island and surrounding areas



Source: Hunter-Central Rivers Catchment Management Authority, 2011. *Location of Kooragang Wetlands*. Available at: www.hcr.cma.nsw.gov.au/kooragang/AU_WWA_sites.htm

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[177] ABC News 2008, *Iemma calls for Newcastle international airport*, July 18.

[178] Google maps 2011. Available at: http://maps.google.com.au/maps?f=d&source=s_d&saddr=Sydney&daddr=Kooragang+Island,+Kooragang,+New+South+Wales&hl=en&geocode=FZsz-_0dszwDCSnFAZBWlpcSazFgqDIWaH0BBA%3BFQKLCv4dMmQLCSlPX-bF0mpzazEjwFg8QUO-Gg&mra=ls&sll=-33.759842,150.99382&sspn=0.505784,1.229095&ie=UTF8&z=8

[179] ABS 2010, *Regional Population Growth*, Cat No. 3218.0

Example	***CBD airport, e.g. for corporate jet market***
Description of option	Options have been proposed for a corporate jet airport to be constructed in the CBD of Sydney, with the view that this would alleviate some pressure from Sydney (Kingsford-Smith) Airport. Cities such as London and Toronto have CBD airports and are often cited as successful examples. London has a single runway airport for multi-engine, fixed-wing aircraft with certifications to fly 5.5 degree approaches (necessary for noise abatement reasons). This is compared to a normal descent angle of 3 degrees for the final approach.
Recent developments	The success of the London City Airport is largely due to the competitive advantage the airport has in terms of proximity to the CBD. The London City Airport is 15 km from the CBD,[180] this is compared to Heathrow Airport which is 22 km from the London CBD,[181] Gatwick which is 45 km, Stansted which is 48 km[182] and Luton which is 50 km.[183] Sydney (Kingsford-Smith) Airport is approximately 12 km from the CBD[184] and therefore, a CBD airport in Sydney wouldn't have the same competitive advantage in terms of distance that the London City Airport does. There are no suggested locations for a CBD airport. In addition, a CBD airport will have noise impacts if developed in densely populated areas.
Potential to provide new/additional capacity in the Sydney region	By comparison to other international airports Sydney (Kingsford-Smith) Airport is a CBD airport. It is unlikely that many corporate passengers would show a strong preference for travel from a CBD airport over Sydney (Kingsford-Smith) Airport. There are currently a limited number of corporate jets that depart and arrive from the Sydney (Kingsford-Smith) Airport. Relocation of these services to a CBD location would provide minimal capacity relief.

180 Google maps 2011. Available at: http://maps.google.com.au/maps?f=d&source=s_d&saddr=Westminster,+London,+United+Kingdom&daddr=London+City+Airport,+London,+United+Kingdom&geocode=FXjUEQMd5BL-_yl13iGvC6DYRzGZKtXdWjqWUg%3BFULhEQMdlcIAACk1j5sOiKjYRzHzNKgM768PXg&hl=en&mra=pd&sll=51.500152,-0.126236&sspn=0.757422,2.458191&ie=UTF8&ll=51.509597,-0.024719&spn=0.094659,0.307274&z=12

181 Google maps 2011. Available at: http://maps.google.com.au/maps?f=d&source=s_d&saddr=Westminster,+London,+United+Kingdom&daddr=Heathrow+Airport,+United+Kingdom&geocode=FXjUEQMd5BL-_yl13iGvC6DYRzGZKtXdWjqWUg%3BFcNoEQMdxhv5_yFnQfZDVVPnjw&hl=en&mra=ls&sll=51.509597,-0.024719&sspn=0.094659,0.307274&ie=UTF8&z=11

182 Google maps 2011. Available at: http://maps.google.com.au/maps?f=d&source=s_d&saddr=Westminster,+London,+United+Kingdom&daddr=Gatwick+Airport,+United+Kingdom&geocode=FXjUEQMd5BL-_yl13iGvC6DYRzGZKtXdWjqWUg%3BFTGXDAMd_mf9_yH_c4kBv6TdWQ&hl=en&mra=ls&sll=51.487095,-0.289945&sspn=0.189412,0.614548&ie=UTF8&z=10

183 Google maps 2011. Available at: http://maps.google.com.au/maps?f=d&source=s_d&saddr=Westminster,+London,+United+Kingdom&daddr=Luton+Airport,+United+Kingdom&geocode=FXjUEQMd5BL-_yl13iGvC6DYRzGZKtXdWjqWUg%3BFfaeFwMdbkX6_yEVolQxQA7PDA&hl=en&mra=ls&sll=51.329295,-0.14205&sspn=0.380135,1.229095&ie=UTF8&z=9

184 Google maps 2011. Available at: http://maps.google.com.au/maps?f=d&source=s_d&saddr=Kingsford+Smith+Airport,+Sydney,+New+South+Wales&daddr=-33.903025,151.17953+to:Sydney&geocode=FR9O-vodLbMCCSFwcO_5aH0BDw%3BFU-u-vodCtECCSknPTnCSbASazFBtozmZ30BEw%3BFZsz-_0dszwDCSnFAZBWlpcSazFgqDIWaH0BBA&hl=en&mra=ls&sll=-33.907765,151.185655&sspn=0.126227,0.307274&ie=UTF8&z=12&via=1

Example	*Freight only airport*
Description of option	Throughout the 1990s there were a series of proposals for a dedicated freight airport in Sydney to be built or for an existing site to be used solely for freight, to alleviate capacity constraints at Sydney (Kingsford-Smith) Airport. For example, at a 1993 conference titled *Badgerys Creek International Airport* a key focus was the option of using the site at Badgerys Creek as an international air freight airport.[185] The possibility of bringing forward investment in the development of international air freight services in order to provide capacity relief to Sydney (Kingsford-Smith) Airport was assessed in a 1993 Report by Access Economics. [186]
Findings of previous analysis	The Access Economics report recommended against the early development of an air freight facility as it concluded that it would not be commercially viable.[187]
Recent developments	Currently 80% of airfreight to Sydney (Kingsford-Smith) Airport is carried as cargo in the holds of passenger aircraft and the remaining 20% is moved by dedicated freight aircraft.[188] In 2008 there were 7,800 movements of dedicated freight carriers to Sydney (Kingsford-Smith) Airport and 299,000 aircraft movements in total.[189] Therefore, airfreight movements take up a very small proportion of total movements to Sydney (Kingsford-Smith) Airport and moving air freight to another airport would provide limited capacity relief. As the majority of freight is transported in the belly of passenger flights, a key consideration of a freight only airport's efficiency. If a package is first transported on a freight only plane and then needs to be carried in the belly of a passenger flights to its final destination, the package would have to be transported between the freight only airport and Sydney (Kingsford-Smith) Airport. This is likely to add extra coordination issues, and slow transportation time. It is for this reason that freight only terminals at passenger airports are preferable to freight only airports.
Potential to provide new/additional capacity in the Sydney region	This option would only provide limited additional capacity at Sydney (Kingsford-Smith) Airport, which is unlikely to be sufficient to meet future needs. A large proportion of freight is transported in the belly of passenger services and a freight only airport would only service dedicated freight aircraft, which do not account for a large number of aircraft movements. For example, forecasts indicate that by 2029 there will be 427,200 aircraft movements to Sydney (Kingsford-Smith) Airport, only 10,400 of which will be dedicated freight aircraft movements.[190]

[185] Webb, R and R Billing 2005, *Second Sydney Airport: A Chronology,* Economics, Commerce and Industrial Relations Group.

[186] *Ibid.*

[187] *Ibid.*

[188] Sydney Airport Corporation 2009, *Sydney Airport Master Plan 2009*, p. 74.

[189] *Ibid,* p. 2

[190] Sydney Airport Corporation 2009, *Sydney Airport Master Plan 2009*, p. 74 and p. 2.

Appendix A

Options for extending Sydney (Kingsford-Smith) Airport

Extend shorter of the parallel runways from 2.44 km to 3.9 km

Extending the airport north towards Mascot

Extending the airport south into the bay

Additional cross runway or a second east west runway

East-west runway to the north

East-west runway to the south towards Mascot

Source: Sydney Airport Community Forum, 2012. *Understanding the runway system*. Avaliable at: http://sacf.infrastructure.gov.au/airport/runways/index.aspx

East-west runway to the south over the bay

East-west runway to the south into the bay and filling in the embayment area

A third north-south runway west of 16R/34L, building along the Canal

Building into the bay

Source: Sydney Airport Community Forum, 2012. *Understanding the runway system.* Avaliable at: http://sacf.infrastructure.gov.au/airport/runways/index.aspx

Infilling embayment between 16/34 runways

Source: Sydney Airport Community Forum, 2012. *Understanding the runway system*. Avaliable at: http://sacf.infrastructure.gov.au/airport/runways/index.aspx

Appendix B

WorleyParsons/AMPC technical review of the Sydney (Kingsford-Smith) Airport South Proposal

This appendix contains the WorleyParsons/AMPC analysis of the Sydney (Kingsford-Smith) Airport South Proposal as provided to the Department of Infrastructure on 27 September 2011.[191]

Background

The Sydney (Kingsford-Smith) Airport South Proposal (sometimes referred to as KSA South and/or Kurnell/Towra Point) has existed in some form since around 1946. Table B.1 provides details of the earlier proposals and decisions taken.

Table B.1 – Previous KSA South and/or Kurnell/Towra Point Proposals

Milestones	Details	Source documents
1946 Investigation into international airport sites	A study is undertaken to determine the best site for the development of an international airport in Sydney. Sites studied include Towra Point, Bankstown and Mascot. Between 1946 and 1968, Commonwealth, NSW and local governments discuss the Towra Point site, which is eventually ruled out because of environmental difficulties.	Department of Aviation. Second Sydney Airport. Site selection Programme Draft Environmental Impact Statement. Ultimo, NSW, Kinhill Stearns, April 1985.
4 November 1964 NSW wants Towra Point in Botany Bay to be the location of the second airport	It is reported that a study undertaken by the NSW government recommends establishing a second airport at Towra Point in Botany Bay. The study recommends that the airport should be built by 1980 when it predicts services at Kingsford-Smith Airport (KSA) would be at maximum capacity.	'Site for new jet airport is right on our doorstep', Daily Telegraph, 4 November 1965.

Source: http://www.aph.gov.au/library/pubs/chron/2003-04/04chr02.htm

The 1999/2000 Proposal

The proponent of the 1999/2000 proposal was IAC Aviation Technical Services Pty Ltd. The late Dr KNE Bradfield was part of the group advocating the proposal. Dr Bradfield was also instrumental in the original 1946 proposal.

The Concept B layout of the 1999/2000 proposal is shown in Figure B.1 and includes:

- Two 760 m centreline spaced parallel runways of up to 4,000 m each aligned about 5-100 off the 16/34 runway alignment at Sydney (Kingsford-Smith) Airport

[191] WorleyParsons, 2011. *Sydney Regional Aviation Capacity Study, Botany Bay/Kurnell- New Runway/Airport Options*. Provided to the Department of Infrastructure and Transport 27 September 2011. Note: no amendments have been made by PwC to the WorleyParsons/AMPC analysis.

- Provision for a road bridge across Botany Bay linking the two airports, and
- Terminals located either on the eastern or western sides of the runway complex.

Concepts A and C (not shown) were also assessed but found to be less suitable than Concept B.

Figure B.1 – Concept B

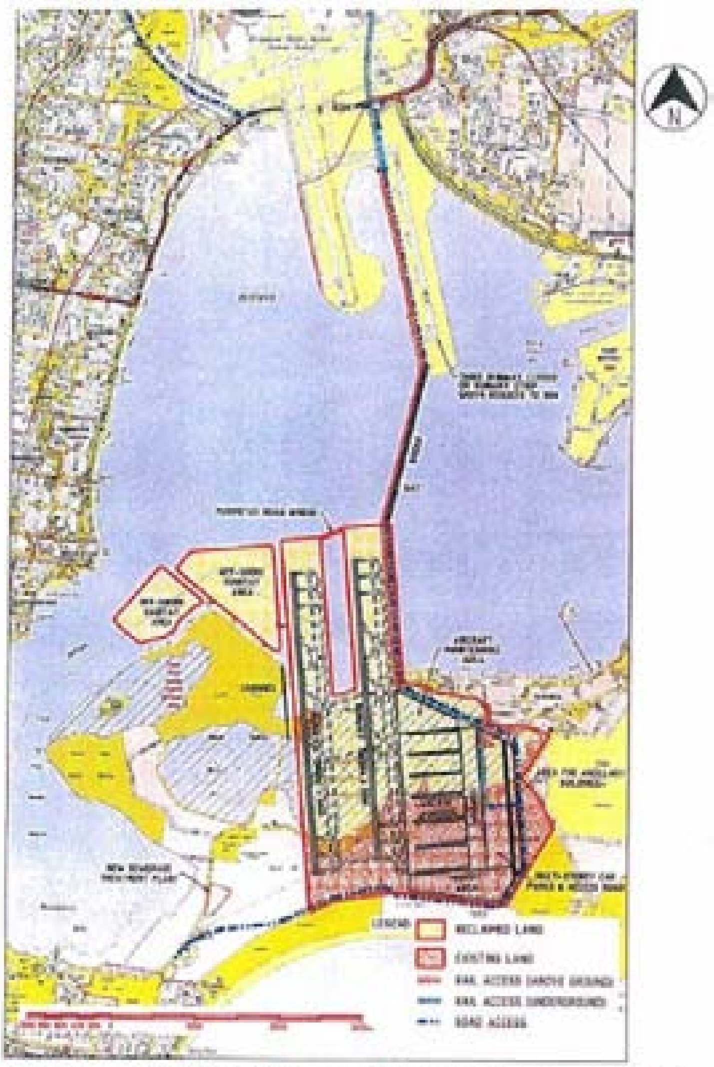

FIGURE 5 KINGSFORD SMITH AIRPORT SOUTH CONCEPT B

The proposal is based on relocating international and domestic traffic to the new site and retaining Sydney (Kingsford-Smith) Airport for regional and GA traffic. Runway 16L/34R at Sydney (Kingsford-Smith) Airport is proposed to be closed. Airspace management is claimed to be feasible with each site having its own control tower. It is stated the combined capacity arising from the proposal would be double that of Sydney (Kingsford-Smith) Airport though not explained as to how this doubling of capacity arises.

The main environmental benefit claimed is an improvement in off airport noise impacts on residential areas due to the displacement of the runways to the south compared to the current situation at Sydney (Kingsford-Smith) Airport. Other acknowledged environmental issues are the potential impacts of further reclamation within Botany and Quibray Bays. It is stated the environmentally sensitive Towra Spit area would not be required for use and that this is one of the differences compared to the earlier airport proposals for the area.

Consultants SKM prepared indicative cost estimates (assumed to be for Concept B in 1999/2000 dollars) which resulted in an estimate of $3.82 billion.

Since the proposal was advocated, the NSW Government has embarked upon the expansion of Port Botany on the eastern side of Runway 16L/34R at Sydney (Kingsford-Smith) Airport, so this would need to be taken into account in any further examination of the proposal.

Issues from an aviation management perspective

Commentary

The following commentary utilises similar factors to those adopted for the Greenfield assessments for comparison purposes and also addresses capacity and efficiency issues. The new airport site is referred to as Sydney South whilst the current Sydney (Kingsford-Smith) Airport is referred to as Sydney North.

Accessibility

- The site would meet the 90 minute accessibility criterion from Ermington
- Public road access to Kurnell could be provided by a deviation of Captain Cook Drive, and
- A new bridge across Botany Bay could provide a landside/airside link between the two sites (road and rail).

Earthworks and obstacles limitation surfaces

- About half of the site would need to be on reclaimed land from Botany Bay
- The existing land areas to be used are by inspection predominately relatively flat (sandhills would need to be re-profiled)
- Therefore, earthworks would be expected to comply with the criterion adopted for the Greenfield sites, and
- Due to the immediate approach areas being over water it would be expected that Obstacle Limitation Surface (OLS) compliance would be achieved in these areas. However, an obstacle survey would be required to assess the full extent of the relevant approach areas and other OLS components.

Aircraft Noise Impacts

- The proposal would still result in aircraft noise impacts to the north of Sydney North and the areas under the flight paths would be slightly different due to the different runway alignment of Sydney South
- However, due to the southern displacement of the site, typical aircraft on approach would be about 600ft higher compared to those landing on Runway 16R at Sydney North assuming an overflight of the same area. This would result in a lesser noise impact being experienced although there would still be the combined effect of flights emanating from Sydney North – albeit that these would be the smaller, less noisy aircraft
- Take-off noise to the north may be similarly improved but cannot be quantified in the same way as landings at this level of analysis, due to the variability in departure flight paths and aircraft performance
- Noise to and from the north at Sydney North would also be improved due to operations only being conducted by regional and GA aircraft as would noise to the east and west of Sydney North from Runway 07/25 operations
- Noise to and from the south is based on avoiding the urban areas of Cronulla and Kurnell in terms of overflights, i.e. flight paths would be over water, and
- The eastern option for the terminal area shown in Figure 1 directly abuts the Kurnell residential area and there would be noise impacts from ground operations as well as lateral noise from airborne and surface operations.

Airspace

- There is no detailed analysis as to how both airports would be able to function operationally in terms of airspace capability other than an assumption of coordinated air traffic control, and
- On the basis of the other Greenfield airspace assessments, it is considered a primary KPI ranking of 'Major' interaction with Sydney North would be applicable. As a result, this situation would require further consideration by Airservices Australia and/or the OAR.

Capacity

- Of necessity, the runway separation of Sydney South is limited to 760 m. This separation permits independent parallel departures and segregated parallel operations but not independent parallel approaches. It therefore has a lower inherent capacity compared to Sydney North's parallel runway configuration (1,035 m separation)
- The proponent believes the combined capacity of the airports would be about double that of Sydney North or around 680,000 aircraft movements per annum in total
- However, this needs to be considered in terms of future demand based on the relative proportions of traffic as it is assumed to apply to operations at each airport
- In 2010, SACL reported total aircraft movements at Sydney North of just under 309,000, broken down as follows:

International	59,285	(19.2%)
Domestic	162,130	(52.5%)
Regional	63,120	(20.4%)
Freight	7,160	(2.3%)
GA	17,219	(5.6%)

- Assuming these relative traffic proportions remain, Sydney North would need to accommodate about 26% of all operations with Sydney South accommodating the majority of around 74%
- There would therefore be an imbalance in traffic between the two sites rather than the 50/50 assumed by the proponent
- The Booz and Co traffic forecasts (not seen by the Project Team) would need to be assessed against the proposed airport traffic split to ascertain if the claimed capacity of Sydney South would meet the future demand requirements, and
- The terminal/building area on Figure B.1 appears to be roughly similar in overall area to the combined domestic and international precincts at Sydney North. There are no projections of gate demand and or indication of capacity so it is not possible to identify if this area would be sufficient for future needs.

Efficiency

- The proposal does not appear to fully address a number of potential inefficiencies that would arise under a two-airport operating scenario
- Sydney South out of wind arrival operations would have to be accommodated on Runway 07/25 at Sydney North as they are currently (or diverted to other ports). While this component of movements is a relatively small proportion at around 2% annually, it is highly seasonal and typically peaks during August and September due to strong westerly winds. These conditions can also persist for a number of hours over successive days
- This raises the issue of passenger, baggage and freight facilitation which presumably would be required to take place at Sydney North (Sydney (Kingsford-Smith) Airport) with transfers undertaken airside to Sydney South. Aircraft would later need to be retrieved to Sydney South when conditions permit
- In these out of wind conditions, departures from Sydney South would need to be held on the ground

- The major carriers make use of a mix of turbo-prop and jet aircraft on regional and Canberra (considered inter-state) routes, and
- The two-airport operating scenario would be likely to create a significant scheduling challenge assuming current aircraft fleet composition. For example, QantasLink turbo-prop aircraft operating say Canberra–Sydney to Sydney South but needing to be at Sydney North for the next departure to a regional port. This gives rise to cost and capacity implications.

Issues from a coastal and marine perspective

Wave energy in Botany Bay

The most effects on wave energy caused by reclamation for Sydney South would be due to the reclamation protruding about 1.8 km into Botany Bay to the north of Quibray Bay. This may cause reflected wave energy to impact on Silver Beach at Kurnell, which may lead to adjustment of beach profiles with loss of sand offshore due to cross shore (onshore offshore) processes. The reclamation would cause some sheltering of Silver Beach from wind wave action from the west to north west. This is likely to result in an increase in the net rates of littoral drift transport along Silver Beach to the west, which is likely to exacerbate erosion rates.

The eastern runway reclamation would be expected to capture longshore transport of littoral drift along Silver Beach from east to west, essentially acting as a non-bypassing groyne. Sediment thus may build up against the reclamation over the long term, which is probably a benefit in terms of beach amenity at Silver Beach. However, the groyne effect of the runway reclamation may induce a curvature in the alignment of Silver Beach, exacerbating erosion in the centre of the newly formed embayment.

The reclamation would shelter Towra Point from wave energy, which would have a significant effect on the alignment of the beach as well as on the hydrodynamic environment of the near shore seabed, which comprises extensive seagrass meadows. It is likely that fine silts and muds emanating from the Georges River during floods are likely to accumulate over the 'Offshore Habitat Area', resulting in significant changes to the benthic ecology.

Due to altered wave energy patterns (e.g. wave reflections, diffraction and effects on refraction), the reclamation may also cause an alteration to longshore sediment transport processes at Lady Robinsons Beach. Whether this would be a negative or positive effect is a complex issue as it depends on changes to wave angles and interactions with structures such as groynes. A detailed study would be required to assess the impacts.

The reclamation would be expected to cause some sheltering to the Sandringham area (south of Dolls Point) and Dolls Point itself from swell wave action. Both of these areas have suffered from erosion in recent months, so this sheltering may reduce the potential for erosion (a benefit to beach amenity). That stated, there is additional complexity with regard to alteration of longshore sediment transport patterns that may reduce the supply of sediment into these areas, thus causing negative effects. A new detailed study would be required to assess the specific impacts.

Foreshore structures may also be affected by altered wave climates, with adverse affects possible where wave energy increases lead to structural instability, or changed sediment transport causes scour that undermines a structure.

Although there may be effects on coastal processes that may cause impacts at some locations, it is considered likely that these impacts could be managed through appropriate structural and non structural coastline management measures, although some of these may need to be ongoing (e.g. beach nourishment or redistribution of sand within particular compartments).

Dredging

The area of the proposed reclamation is generally relatively shallow, in the order of 2 m to 4 m depth. Depths to the north of the proposed reclamation are in the order of 4 m to 5 m. It is uncertain what the source of material for the reclamation is proposed to be but, if dredging of the surrounding bay was considered as a source, it should be noted that alteration to depths in Botany Bay would be expected to alter coastal processes.

This alteration would be similar to the effects described above for the reclamation itself, such as potential wave reflections off the holes, diffraction and altered refraction causing changes to cross shore and longshore sediment transport processes at areas such as Lady Robinsons Beach (and potential impacts on shoreline structures). Indeed, previous dredging for reclamation of Sydney (Kingsford-Smith) Airport caused impacts on shoreline areas.

Again, a detailed study would be required to assess the specific impacts and to devise suitable coastline management measures.

Altered hydrodynamics

The extent of the reclamation into Botany Bay may alter estuarine circulation and hence water quality and sedimentation in areas such as Woolooware Bay. Flood flows from the Georges River may also be affected. These effects could be assessed using numerical modelling tools.

Figure 5 of the Options Report appears to indicate that Weeney Bay would be cut off from the estuary and, essentially, would become a lake. This would have significant issues with regard to flushing, water quality and aquatic flora and fauna in the area. It is expected that some means of connecting Weeney Bay to the estuary would need to be considered.

Interaction with the Sydney Desalination Pipeline crossing Botany Bay

The Sydney Desalination Pipeline crosses Botany Bay from Silver Beach to Kyeemagh. The reclamation layout shown in Figure 5 of the Options Report (in particular, the northern portion of the eastern runway) may be over or close to part of the pipeline route. The pipeline location would also affect the available locations for any dredging if this was proposed to provide reclamation material.

As noted in the Options Report, the desalination plant in Kurnell may also be a constraint to the extent of a Sydney South airport.

Sea Level Rise

In setting the reclamation level, there would need to be allowance for sea level rise over an appropriately long planning period. Based on the NSW Sea Level Rise Policy Statement (DECCW 2009), sea level rise planning benchmarks of 0.4 m at 2050 and 0.9 m at 2100 (relative to 1990) have been adopted in NSW. The increase in level would be in addition to elevated water levels from severe storms including high astronomical tide, storm surge, and any superimposed wave action.

Road access to KSAS from south

The existing Captain Cook Drive road from to Woolooware and Cronulla to Kurnell is low lying in some sections, and therefore may be impassable at times of elevated water levels, particular under sea level rise. This road may need to be elevated in parts to maintain a permanent access route to Sydney South, if road access to the site from the south was proposed.

Cronulla Sand Dune

It is noted in the IAC Report that the sandhills at Kurnell (also known as the 'Kurnell Heritage Dune') are proposed to be reduced in height. WorleyParsons has recently designed vegetation stabilisation works for the dune, and the site is registered on the NSW State Heritage Register under 'Cronulla Sand Dune and Wanda Beach Coastal Landscape'. An extract from this listing is as follows:

> *'as the last major exposed dune in a landscape degraded by 70 years of sand mining it has landmark and aesthetic qualities that are held in high esteem by the community'.*

This heritage listing may have implications with regard to the approval of this dune lowering.

Impacts on surrounding areas would also need to be considered. Australand owns land to the south west of the dune and, as part of previous agreements and rezonings, numerous environmental conservation and public recreation areas surround the dune area.

Proximity to Bate Bay

The Sydney South airport development would need to be setback an appropriate distance from Bate Bay to account for coastal erosion, long term recession due to net sediment loss and long term recession due to sea level rise over a suitably long planning period.

Navigation

Any low level bridge connecting Sydney North and Sydney South would need to be sufficiently elevated to not restrict navigation for vessels that use the western portion of Botany Bay, the Georges River and Cooks River. Some potential restriction to recreational sailing is noted in the IAC Report.

Issues from a transport perspective

The Proposal is based on a joint 2 km long road and rail bridged crossing of Botany Bay to connect to the then disused (or modified) runway 34R/16L at Sydney North. In regard to the road crossing, this would then have to be linked to the existing M5 and Eastern Distributor arterial road system in the form of a full grade separated intersection in the vicinity of the existing junction of Foreshore Road and General Homes Drive. This would be certainly complex and expensive but probably achievable. However, if runway 34R/16L stays in any form of service, there would be a major conflict of the road and the taxiways giving access to the runway which would require the new road to be sunk below the taxiway. There would also appear to be a direct impact on Airservices Australia's Aviation Rescue and Fire Fighting precinct. Additionally, it would appear to be impractical to keep runway 34R/16L in full operation use while these transport links were constructed over the full length of the runway even on the surface and this would have a major effect on Sydney (Kingsford-Smith) Airport's operating capacity before Sydney South could be brought on line.

The rail link paralleling the access road is proposed to junction with the existing airport rail link south of Mascot station. At this point, the existing railway is a in a single tube double track soft ground tunnel. The Airport Rail Line is not a standalone railway and is now an integral part of the Sydney Metropolitan railway system. Any proposed additional services overlaid on this line would have to be investigated to determine whether there is capacity to accommodate them. Additionally, as these trains would probably be operating on an 'out and back' type of operation, a place would have to be found to act as a turnback.

Connecting the new Sydney South line to the existing airport line in a flat junction would be an extremely challenging engineering task, given the ground conditions and the operating railway and even more so if a grade separated connection - which is most likely – is required.

Improvement in the major road system in the Sutherland Shire in the form of at least dual carriageway upgrade of Captain Cook Drive would also be needed to provide access for airport staff and users from the south of the city.

Design of the bridged crossing of Botany Bay would have to take account of several pipelines and consideration would need to be given to the potential for ship impact on the structure. Given its exposed location, consideration of the effects of extreme weather on road and rail safety would also be needed. The alternative of an immersed tube crossing would have a direct effect on pipelines for fuel and for desalinated water and would be very expensive.

General Environmental Issues

There would be a number of other environmental issues associated with the development of a major airport at Sydney South. These issues include but are not limited to:

- The visual impacts of the airport itself (airfield infrastructure and terminal buildings) and a bridge across Botany Bay (as opposed to a tunnel)
- Impacts on Kurnell residents
- Impacts on seagrasses and related economic impact on commercial fishing in Botany Bay, and
- Hazards due to the proximity of the Sydney south site and related aircraft operations to the Caltex refinery.

Conclusions

On the basis of the available information, the following conclusions can be drawn:

- The general area proposed for Sydney South has previously been rejected on environmental grounds by the governments of the day - it seems most unlikely that a more favourable view towards development on an environmentally sensitive site would be held today as compared to then

- The 1999/2000 Sydney South proposal would provide some noise benefits to residential areas to the north and south but may impact more adversely on the Kurnell residential area in terms of ground-based and lateral noise sources
- There is no detailed analysis of airspace issues but it is considered these would be 'major' adverse effects
- The capacity of the proposed runway configuration for Sydney South is less than that available at Sydney North
- Irrespective of capacity potential, it is likely there would be a significant imbalance of traffic between the two sites rather than the 50/50 assumed by the proponent, and this may not necessarily meet the forecast demand (needs to be tested against the Booz and Co projections)
- The terminal area proposed for Sydney South may not be of sufficient size to meet demand (but there is no information to enable an assessment to confirm or otherwise)
- There appear to be a number of inefficiencies in the proposed operating scenarios of each airport which go to questions of operating costs and potentially capacity
- Transportation links would be very expensive and may be impractical to achieve given continued operation of Sydney (Kingsford-Smith) Airport and capacity issues on existing systems
- Infilling of Botany Bay may cause unacceptably adverse hydrodynamic changes
- Environmental effects of yet more filling of Botany Bay may be not be acceptable, and
- Hazard and risk due to the proximity of the Caltex refinery has not been considered by the proponent.

Based on a cost of $3.82 billion in 2000 and an inflation factor of 1.35 (Source: Reserve Bank), the updated estimate would be about $5.2 billion. This compares with WorleyParsons/AMPC +/- 30% estimates of about $17.5 billion[192] (inclusive of risk contingencies, preliminaries margins and fees) for an airport of similar scale constructed in rather less challenging conditions on land. This suggests that the 2000 cost estimate may be a substantial under estimate of total airport development costs.

The net position would appear to be that, by virtue of the loss of most runway useability at Sydney (Kingsford-Smith) Airport, no significant increase in aviation capacity over what currently is available at Sydney (Kingsford-Smith) Airport is achieved for an investment outlay of around $17 billion.

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[192] For a full service international RPT airport.

Appendix C

WorleyParsons/AMPC technical review of new runway/airport options in Botany Bay/Kurnell

This appendix contains WorleyParsons and AMPC (the Project Team) analysis of the possibility to locate airport infrastructure that could add aviation capacity in the Botany Bay / Towra Point locality, as provided to the Department of Infrastructure on 27 September 2011.[193]

Options for Consideration

WorleyParsons and AMPC's review of the proposal for a major international scale airport at Kurnell (Sydney (Kingsford-Smith) Airport South) made by IAC Aviation Technical Services Pty Ltd in 1999/2000 as an input to the technical paper which relates to Sydney (Kingsford-Smith) Airport South is contained in Appendix B. Many aspects of this review – notably those that relate to environmental impact - are germane to those additional airport concepts which we discuss in this technical paper.

As is noted in Appendix B, this proposal is basically incompatible with the continued operation of the 16/34 runways at Sydney (Kingsford-Smith) Airport and, as such, is effectively a displacement of the existing airport to the southern side of Botany Bay. As such, this proposal does not appear to fulfil the objectives of the Sydney Region Aviation Capacity Joint Study in regard to the future aviation needs of Sydney in that it does not add aviation capacity except possibly:

- By providing parallel runways of the same length which may assist in arrivals and departures of long haul aircraft;
- In a circumstance where longer hours of operation and more operation per hour were to be permitted.

Accordingly, WorleyParsons and AMPC have sought to develop example forms of adding capacity which might be compatible with the existing airport continuing to operate at 80 movements per hour. These forms are of two kinds:

- Add infrastructure capacity to the existing airport – technically, this may be considered to exceed the 80 movements per hour cap but it has been considered for completeness;
- Add new capacity overall in the Sydney region in some form in another part of this locality

One option addressing the former and two addressing the latter have been developed. These are:

- **Sydney (Kingsford-Smith) Airport fourth Runway:** A 2,600 m long Code 4E runway within Botany Bay, which is parallel to the existing 16/34[194] runways at Sydney (Kingsford-Smith) Airport. This is further outlined below;
- **Kurnell Option 1:** A Full service RPT airport[195] located at Kurnell (incorporating 4,000 m long Code 4F and 2,600 m Code 4E runways), which are parallel to the existing 16/34 runways at Sydney (Kingsford-Smith) Airport. This option is further outlined below; and

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[193] WorleyParsons/AMPC, 2011. *Botany Bay/Kurnell- New Runway/Airport Options.* Provided to the Department of Infrastructure and Transport 27 September 2011. Note: no amendments have been made by PwC to the WorleyParsons/AMPC analysis.

[194] Runways are identified by magnetic compass headings rounded off to the nearest 10 degrees – 16 means an aircraft would be pointing to a compass heading of 160 degrees and 34 means that it would be pointing in the opposite direction i.e. rotated through 180 degrees. Where there are parallel runways at an airport these are designated as R – right or left according to which way an aircraft would be pointing.

[195] A full scale airport providing for all types of RPT aviation with parallel runways

- **Kurnell Option 2:** A Limited service RPT airport[196] located at Kurnell (incorporating a 2,600 m long Code 4E runway), which is near parallel with the existing 07/25 runway at Sydney (Kingsford-Smith) Airport. The length of runway this runway is limited to 2,600 m by the Botany Bay National Park to the east and Woolooware Bay to the west. This is further outlined below;

It should be noted that these options has been developed without the benefit of a detailed discussion with any of the relevant agencies – Airservices Australia, CASA or OAM or with Sydney (Kingsford-Smith) Airport. All or any of these bodies may have reasons to object to any one of these options either in total or in part.

In regard to their effect on the environment, the latter two options share a number of the impacts previously identified with the Sydney South proposal by IAC Aviation Technical Services. The former is similar to the 3rd runway though it would impose far greater adverse effects on urban areas.

Summary assessment

In regard to their likely effect on aviation capacity:

- The Sydney (Kingsford-Smith) Airport fourth Runway option theoretically could provide an increase in runway capacity but with a significant effect on exposure to aircraft noise (both existing distribution of aircraft noise over the greater Sydney Region due less use of Runway 07/25 and new exposure of urban areas west and north of the airport to aircraft noise)
- The Kurnell 1 option is not likely to provide the degree of sum total of total aviation capacity that may be available where the sites are not co-located and so interdependent, and
- The Kurnell 2 option is not likely to result in any significant increase in runway capacity due to operational dependences between Kurnell and Sydney (Kingsford-Smith) Airport.

All options, including that by IAC Aviation Technical Services, will have significant environmental impacts and, inter alia, in the case of those affecting Towra Point, would impinge on international treaties entered into by the Commonwealth and NSW governments. WorleyParsons and AMPC believe that the extent of environmental values and legislative protections of Towra Point– as shown and listed at the end of Appendix C - under both Commonwealth and NSW law would be, of themselves, sufficient to exclude this locality from further consideration.

Therefore, in WorleyParsons' view, none of these options provide a useful solution to Sydney's long term aviation needs. This is due to their interaction with and/or reduction in capacity to some extent or another at Sydney (Kingsford-Smith) Airport, by being in a location which is even less accessible than is the current Sydney (Kingsford-Smith) Airport to their likely sources of passengers, by increasing, not decreasing, the numbers of people exposed to aircraft noise in and around Sydney (Kingsford-Smith) Airport and the magnitude of their likely environmental impact on lands and ecosystems which the Commonwealth has undertaken, in various forms of legislation, to protect.

Sydney (Kingsford-Smith) Airport fourth runway

The Sydney (Kingsford-Smith) Airport fourth Runway option (Figure C.1) assumes the runway would effectively form an addition to Sydney (Kingsford-Smith) Airport's runway infrastructure and be linked both landside and airside as shown. The separation with Runway 16R/34L is shown as 1,650 m but could be as close as 1,035 m and still potentially capable of independent operations subject to deeper consideration of such operational design matters as missed approach protection, stagger distance between the two runways and the like .The provision of this runway may be capable of delivering a throughput of around 40 movements/hour, when operating concurrently with Sydney (Kingsford-Smith) Airport's parallel runway operations i.e. potentially 120 movements/hour overall. It must be acknowledged this runs contrary to current Government policy which restricts Sydney (Kingsford-Smith) Airport, and not just its runways, to 80 movements/hour.

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[196] A Type 3 airport is a limited service airport servicing all RPT carriers with one runway with some level of international capability and primarily aimed at low cost carriers.

In this concept, the runway has been positioned to avoid direct effect on existing urban areas and part of the area between it and the existing 16R/34L runway postulated as being able to accommodate airport aviation related enterprises. However, it would not be possible to avoid major indirect effects such as aircraft noise on existing urban areas. If the runway were to be positioned further south it is considered that it would begin to block water flow from Georges River and would also impact on Towra Point.

Figure C.1 – fourth Runway at Sydney (Kingsford-Smith) Airport

Advantages include:

- Ignoring the movement cap, this option may potentially provide about a 50% increase in capacity
- It provides a logical extension to Sydney (Kingsford-Smith) Airport making best use of existing infrastructure and established transport infrastructure, employee and passenger travel patterns
- It might be a relatively lower capital cost option to help meet short-term demand for more runway capacity
- For movements to/ from the south, noise impacts are mainly over water
- It would be attractive to the existing carriers as it would delays the need to have split operations to another airport, and
- It would generate a large area of large which could be used as an airport business park in a location which is of high value due to its proximity to the airport, the CBD and other industrial zones.

Disadvantages include:

- The potential capacity increase is contrary to current Government policy

- With a total capacity of up to 120 movements per hour, airlines could be expected to take up all available slots and, as a result, increased pressure would be applied to terminals and other aspects of Sydney (Kingsford-Smith) Airport infrastructure requiring more investment in these facilities which may be difficult to provide; It does not provide an additional Code 4F 4,000 m runway although it may free up sufficient capacity on the existing 16R/34L Code 4F runway to meet forecast demand
- Large urban areas north and west in Kogarah and beyond at the northern end of the runway would become newly exposed to aircraft noise
- The capacity increase achieved may not meet forecast demand i.e. need for a new airport would be delayed but still required
- The runway would probably be inoperable with current runway crossing modes under the Long Term Operating Plan (leading to Sydney –wide aircraft noise impact changes with more noise in the 16/34 runway directions and less on the 07/25 runway directions)
- There probably would be increased aircraft noise impacts over Kurnell village as aircraft departing 16R may not be able to turn to the west
- It would not increase capacity in those weather conditions requiring use of Runway 07/25
- There would likely be major impact on the coastal processes of Lady Robinsons Beach and in Botany bay more generally
- There would be a further reduction of Botany Bay seabed habitat and seagrass beds
- No environmentally acceptable source of dredged fill within an economically viable distance may be able to be found, and
- Recreational usage of the Bay would be further curtailed.

Cost Estimate

A rough estimate of cost can be derived by escalating the cost of the third runway project as likewise, this project would require no additional terminal and associated infrastructure. This project was estimated at $273 million in 1991 and applying a 67% increase based on a Reserve Bank's escalation calculation gives a cost of at least $500 million in today's values.

Summary

A fourth runway at Sydney (Kingsford-Smith) Airport would add to aviation capacity in the Sydney Region and would be deliverable in an engineering sense. However, it would increase aircraft noise over urban areas and impose noise on areas which are not normally exposed to it under the current operating regimes. It would also cause major environmental effects on the ecology and physical processes in Botany Bay. It would increase the infilling of the bay and reduce its water surface for recreational purposes.

Kurnell Option 1

In contrast to the proposal by IAC Aviation Technical Services, the Kurnell Option 1 (Figure C.2) would be a fully self contained airport located on the south side of Botany Bay and having no direct landside and airside connectivity with Sydney (Kingsford-Smith) Airport. This enables the runways to be aligned with Sydney (Kingsford-Smith) Airport's 16/34 direction and positioned with horizontal separation in order to try to maximise operations. It also means that there would be no physical loss of existing airport infrastructure. If disposed further the west or to the north, the airport platform would cause major change in the flow regime of the Georges River.

By having direct landside and airside connectivity means that all airport facilities currently available at Sydney (Kingsford-Smith) Airport would have to be duplicated at the Towra Point Airport including:

- Aprons
- Navaids

- Terminals
- Refuelling facilities and storage
- Car parking
- Airport administration facilities, and
- Land side transportation.

It is assumed both airports would accommodate the same classes of traffic i.e. long haul international, regional international, and full domestic including intrastate regional. Accordingly, it would have similar airline operational issues to the Sydney South proposal and also the Kurnell 2 Option.

Total runway capacity for the two airports would be maximised when operating concurrently with the 16/34 direction. However, when operated concurrently with Sydney (Kingsford-Smith) Airport's 16/34 parallel runway operations, there are likely to be dependency issues which may have significant capacity implications at both airports. Therefore, the sum of total capacity may be less than the sum of the existing Sydney (Kingsford-Smith) Airport and another Full service RPT airport where these are geographically separate and not airspace related.

While this proposal is shown as a Full service sized airport with parallel runways, it could be configured on the same 16/34 orientation as a smaller single runway airport. While of a lesser scale, such an airport would still have most of the disadvantages listed below.

Advantages

- It may be possible to achieve a 1,035 m separation between the eastern runway and Sydney (Kingsford-Smith) Airport's 16R/34L suggesting simultaneous operations, while ignoring stagger distances, missed approach protection and other possible dependencies, and
- Noise impacts to the south are mainly over water.

Disadvantages

- Due to interactions with Sydney (Kingsford-Smith) Airport, it may not be a particularly cost-effective solution to meet some passenger demand requirements, compared to a Full service RPT airport site located in a different part of the Sydney region
- It is probably inoperable with current runway crossing modes under the Long Term Operating Plan (leading to Sydney –wide aircraft noise impact changes with more noise in the 16/34 runway directions and less on the 07/25 runway directions)
- It would result in new and substantial tracts of urban land becoming exposed to noise to the north and west of Sydney (Kingsford-Smith) Airport and generally more noise along the current broad flight paths flown by existing aircraft to access Sydney (Kingsford-Smith) Airport
- The location is inaccessible without major upgrades to both road and rail landside transportation systems and, should these be extensions to existing systems, then access for most current airports users from the north and eastern part of the city and from the CBD would appear to be very circuitous
- Even with upgrading of road systems, it would still not be well connected to the major road network for passengers or for airfreight
- Access in to and out of the Caltex Oil Terminal, the desalination plant, Captain Cook's landing place and Botany Bay National Park and the village of Kurnell would be difficult to provide
- It would result in the almost complete destruction of the Towra point wetlands as well as having massive effect on the physical and ecological environments of Botany Bay and Bate Bay
- It would result in the destruction of the marine protected areas adjacent to Towra Point that comprise extensive seagrass meadows

- Sheltering of Silver Beach from westerly wind waves would result in an increase in the net westerly transport of littoral drift, thereby exacerbating erosion
- The airport platform would require major engineering construction to ensure that it is protected from storm surge and wave attack from the southeast where it encroaches onto Wanda Beach and into Bate Bay, and
- The cost of creating a platform of which to construct an airport would be very high given the need for dredged fill – this may need to come from a remote location as there may be no more dredge sites in Botany Bay available.

Cost estimate

Based on typical full service RPT airport costs which we have researched for onshore airports, the cost would of the order of $17.5 billion included road and rail connections contingencies and project delivery costs. In comparison, Hong Kong's Chep Lap Kok maximum scale airport is cited as having cost around US$22 billion[197] in 1998. Kansai Airport Osaka is also cited as having cost US$20 billion[198] Chūbu Centrair International Airport in Japan – which is a Type 1 or single runway equivalent is cited as having had a budget of US$7.3 billion in 2000. All of these are airports constructed on manmade islands which is effectively what would be required at Kurnell.

These suggest that the cost of the Kurnell 1 option would be at least of the order of AUD$20 – 22 billion.

Summary

A full service scale airport located at Towra Point is technically feasible in terms of its relationship to the existing Sydney (Kingsford-Smith) Airport and constructability. Its extreme proximity to Sydney (Kingsford-Smith) Airport would mean that they would effectively operate as one airport which may lead to a lesser capacity than the sum of their individual capacities.

From an airline and airport management perspective it would be inefficient to have two airport so close and yet fully separate.

It would destroy lands which have a high environmental and conservation status and would cause the Commonwealth to breach several treaties which relate to coastal wetlands and bird migration. It also would be likely to render massive and environmentally unacceptable effects on Botany Bay and the Georges River.

There are also issues relating to access to the major transportation network in Sydney.

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[197] http://en.wikipedia.org/wiki/Airport_Core_Programme

[198] http://en.wikipedia.org/wiki/Kansai_International_Airport

Figure C.2 – Full service international airport at Towra Point

Kurnell Option 2

Figure C.3 – Limited service RPT airport at Kurnell

The Kurnell Option 2 (Figure C.3) is configured as a Limited service RPT airport on the southern side of Botany Bay. It would be a

Sydney (Kingsford-Smith) Airport, completely standalone airport, having no direct landside and airside connectivity with Figure C.3 – Limited service RPT airport at Kurnell

The runway is proposed to be aligned approximately east-west which is nearly parallel to the 07/25 .cross runway at Sydney (Kingsford-Smith) Airport. This alignment was chosen in order to contain the airport within the landform at Kurnell to the maximum extent. Accordingly, capacity would be maximised when operating concurrently with Sydney (Kingsford-Smith) Airport's Runway 07/25 i.e. notionally up to 80 movements/hour overall. This is a theoretical throughput, as it would depend on actual demand. The actual fleet mix which would operate at this airport may be contrary to the types of traffic actually able to use the runway. In this context, it has similar airline operational issues to the previously reviewed proposal by IAC Aviation Technical Services - that is the potential for an aircraft to be at Kurnell when it is actually needed at Sydney (Kingsford-Smith) Airport and vice versa to conduct a subsequent operation.

When operated concurrently with Sydney's 16/34 parallel runway operations, there are likely to be dependency issues which may have significant capacity implications at both airports. It should also be noted that historical wind data suggests a generally north-south runway alignment – i.e. like a 16/34 runway - will have a higher usability than an east-west – e.g. 07/25 – alignment in this location.

Advantages

- Operations to and from the east are over either industrial lands or over water which are more compatible in terms of noise impacts

- This airport could be used take all corporate jet, RAAF VIP and the like and helicopter activity from Sydney (Kingsford-Smith) Airport thereby maximising full availability of 80 movements/hour for airline use and use of the runways for those aircraft that require them, and
- By operating in conjunction with Sydney (Kingsford-Smith) Airport's runway 07/25, this airport may provide system capacity for up to 80 movements/hour, in those weather conditions requiring an east-west runway alignment.

Disadvantages

- There would be inter-dependencies with Sydney (Kingsford-Smith) Airport's runway 16/34 operations which would lead to potentially significant capacity limitation
- A Limited service RPT airport at Kurnell with an east/west runway alignment would likely only operate safely when Sydney (Kingsford-Smith) Airport is also operating on its east/west runway. In the future, Sydney (Kingsford-Smith) Airport will operate most of the time on its north/south parallel runways and that would probably render inoperable an (east/west) airport at Kurnell
- Operational difficulties would be likely to arise where aircraft and people could be at Kurnell when they are wanted or need to be at Sydney (Kingsford-Smith) Airport
- Urban areas to the west in the Sutherland Shire would become newly exposed to aircraft noise
- Close to but not physically connected to Sydney – operational issues if some airlines/aircraft need to use both airports; Airlines would have duplicate facilities which would close enough to be a nuisance and distant enough to be a problem
- Weather conditions could require some use of 16/34 direction at Sydney (Kingsford-Smith) Airport in any event as would operations requiring a 4,000 m runway; this could severely reduce the operational capacity of this airport
- Due to interaction with Sydney (Kingsford-Smith) Airport, it may not be a particularly cost-effective solution to meet some demand requirements, compared to a more distant limited service RPT airport site
- Although much lesser than for a full service airport serving all demand segments, adverse direct physical effects on the Towra Point wetlands and environs as well as on the major sand dune systems which are located at the back of the northern end of Cronulla beach
- Exposure of airport platform to south easterly storm weather necessitating breakwater armouring construction and effects on North Cronulla Beach
- Relative remoteness for users of LCC services and a generally lesser standard of accessibility than exists to Sydney (Kingsford-Smith) Airport from the west particularly. Another Limited service RPT airport site may have much better accessibility for users
- Expansion from a limited service RPT airport to a full service RPT airport would be difficult and generate even greater impacts on environmental assets and urban areas.

Cost Estimate

Although mostly on land, it is likely that the site at Kurnell would require considerable amounts of imported or dredged fill to create a platform on which an airport and its facilities could be constructed. This is because of the low lying nature of much the site would make it susceptible to flooding and in the future to sea level changes. Dredged fill – if a source could in fact be located - would be expensive and could be expected to be of a similar order to that for the fourth runway concept described earlier. WorleyParsons/AMPC estimates for limited service RPT airports that are land-based but of a similar scale of new facilities and infrastructure have been of the order of $5 - $6 billion.[199]

Summary

A limited service RPT airport could physically be accommodated at Kurnell. It would be likely to have significant and adverse operational interaction with Sydney (Kingsford-Smith) Airport which may not allow it to operate at full capacity or conversely act as a major constraint on Sydney (Kingsford-Smith) Airport's operations. This would be an undesirable inefficiency for such a major investment.

In this configuration it would lesser impact on environmental assets than if constructed on a 16/34 alignment, perhaps as the 1st stage of the full service RPT airport discussed in the section above relating to Kurnell 1 Option. However, there would still be environmental effects at sufficient level to make this site unacceptable.

This site is accessible by the existing road system but not the major existing freeway system and is even more remote from the centroid of population of Sydney than is the existing airport.

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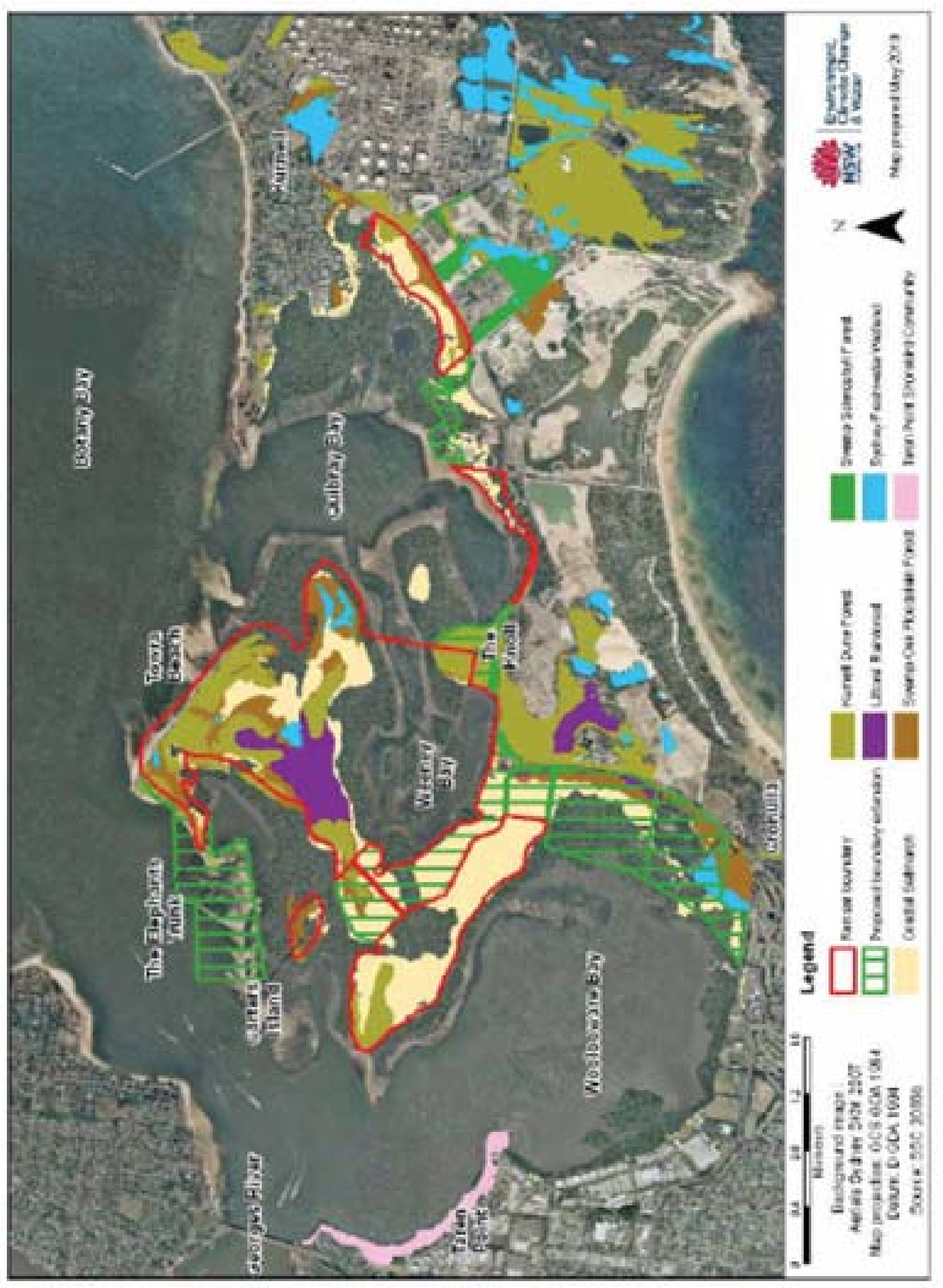
[199] WorleyParsons AMPC for the Department of Transport and Infrastructure, 2011

Towra Point Ramsar Wetlands

Figure C.4 – Existing Ramsar wetlands as well as proposed boundary extensions and the type and extent of endangered species found at Towra Point



Source: *Towra Point Ramsar Site* Department of Environment Climate Change and Water NSW June 2010 (http://sydney.cma.nsw.gov.au/bbcci/publications/Final_Towra_Pt_ECD.pdf)

Figure C.4 above (Figure 25 in *Towra Point Ramsar Site* prepared by Department of Environment Climate Change and Water NSW June 2010) shows the existing Ramsar wetlands as well as proposed boundary extensions and the type and extent of endangered species found at Towra Point. Section 1.3 of *Towra Point Ramsar Site* prepared by Department of Environment Climate Change and Water NSW June 2010 lists the international agreements and treaties, and the National and NSW legalisation and policies protecting Towra Point Nature reserve.

Figure C.4 – International agreements and treaties, and the National and State legislation and policies protecting Towra Point Nature reserve

The international agreements and treaties, and the national, state and local legislation and policies protecting Towra Point Nature Reserve are:

- the Ramsar Convention on Wetlands (Ramsar, Iran 1971), which aims to halt the worldwide loss and degradation of wetlands by conserving them through the application of wise use principles and management systems
- the Japan–Australia Migratory Bird Agreement (JAMBA, 1981), the agreement between the Government of Australia and the Government of Japan for the protection of migratory birds and birds in danger of extinction and their environment
- the Convention on the Conservation of Migratory Species of Wild Animals (Bonn, 1983), which aims to conserve terrestrial, marine and avian migratory species throughout their range
- the China–Australia Migratory Bird Agreement (CAMBA, 1988), the agreement between the Government of Australia and the Government of the People's Republic of China for the protection of migratory birds and their environment
- the Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA, 2006), the agreement between the Government of the Republic of Korea and the Government of Australia for the protection of migratory birds
- the Partnership for the Conservation of Migratory Waterbirds and the Sustainable Use of their Habitats in the East Asian–Australasian Flyway (2006). The development of this partnership has been led by the Government of Australia, the Government of Japan, and Wetlands International as an initiative of the World Summit on Sustainable Development. This partnership has succeeded the Asia-Pacific Migratory Waterbird Conservation Strategy 2001–2005 and is responsible for drafting a new Flyway Partnership Action Plan for 2006–2010. The main goal is to conserve species and their habitats through the establishment of networks of appropriately managed and internationally important sites for migratory waterbirds.

National obligations are covered by the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), which protects the environment, particularly matters of national environmental significance (protected matters).

State obligations are met under the following legislation:

- The *National Parks and Wildlife Act 1974* covers the protection of flora, fauna and cultural heritage sites in NSW, including wetlands. Towra Point Nature Reserve Plan of Management (NPWS 2001a) is implemented under this Act.
- The *Environmental Planning and Assessment Act 1979* concerns the protection and conservation of natural areas through ecologically sustainable planning and development.
- The *Fisheries Management Act 1994* (FM Act) works with the Threatened Species Conservation Act 1995 to protect threatened aquatic species and communities, including mangroves and seagrasses.
- The *Threatened Species Conservation Act 1995* (TSC Act) covers protection and management of threatened species, populations and communities.

At a local government level, the following environmental plans are relevant:

- Sydney Regional Environmental Plan No. 17 – Kurnell Peninsula specifies zoning and planning provisions for the Kurnell Peninsula including Towra Point
- Greater Metropolitan Regional Environmental Plan 1999 No. 2 – Georges River catchment aims to maintain and improve environmental quality of Georges River and its catchment.

Other supporting NSW plans and regulations assisting in the protection of Towra Point Nature Reserve are:

- *NSW Ramsar Plan 2006–09* (DEC 2006a)
- *Noxious Weeds Act 1993*
- *Native Vegetation Act 2003*.

Appendix D

Airbiz technical review of additional runway at Kurnell and offshore airport options

Additional Sydney (Kingsford-Smith) Airport runway at Kurnell/Towra Point

Aspects considered:

- What could the airspace implications be from this option?
- Are there any other technical issues that could make this option unfeasible?

Off shore airport

Aspects considered:

- What could the airspace implications be from this option?
- Could an offshore airport be feasibly located in sites such as Little Beach, Avalon, Narrabeen, Dee Why, Vaucluse, Long Bay, Kurnell, Bate Bay, Marley Beach and a site 6.5km from Sydney Heads, Botany Bay and Tuggerah Lakes (see word doc attached describing the MANS study review of these)?
- Are there any other technical issues that could make this option unfeasible?

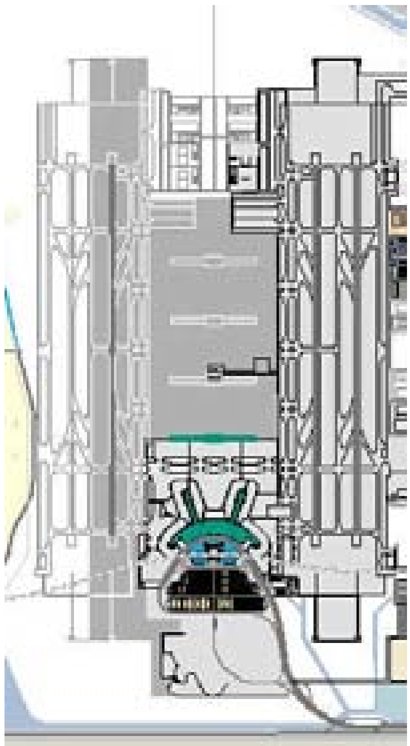
Additional KSA runway at Kurnell/Towra Point

The previously claimed capacity benefits of the Sydney (Kingsford-Smith) Airport South proposal ('Sydney (Kingsford-Smith) Airport South') covering 40 years growth (from 2000) are not substantiated by existing movement rates and growth predictions.

The limitations on design (i.e. runways only 760m apart and terminal building not between runways), creates an ongoing capacity limitation and doesn't represent value for money.

Contrary to claims that it will simplify *'the operation of aircraft'*, the limitations placed on operating landing and arriving aircraft over Botany Bay will complicate the operation with resultant reduction in capacity or aggressive alternate procedures with noise and emission implications.

It would make more sense from an airport planning (runway/airspace perspective) to close the existing Sydney (Kingsford-Smith) Airport runways and replace them with dual sets of parallel runways on the Kurnell/Towra Point site. Enough land were need to made available through resumption and reclamation to accommodate a set of wide space parallel runways each with a close spaced outer runway for a four runway system, with a central terminal area or a link back to the existing Sydney (Kingsford-Smith) Airport site as a terminal precinct. This runway arrangement is used for high capacity airports with adequate land reserves, such as Los Angeles main runway system and the planning for Incheon Airport at Seoul (4 x 4,000m runways as shown opposite).



Off shore airport

From an airspace perspective this is feasible. However, if located too close to Sydney (Kingsford-Smith) Airport then traffic congestion between the two airports will result in added noise issues and increased total flight emissions.

There are recent examples of major Greenfield airports in Asia being constructed offshore through full or partial reclamation (Hong Kong, Incheon, Macau, Kansai, Nagasaki and Chūbu).

Airport planning issues are usually secondary to the very significant engineering, access, environment and cost issues. This is on the assumption that runway orientation and meteorological conditions are accommodated at the preferred location. The catalyst and justification for the very significant investment is lack of suitable on-shore sites and the mitigation of noise impacts with primary flight paths over water.

More detailed comments

General commons on Sydney (Kingsford-Smith) Airport South- Proposed capacity

The 1999 IAC documentation proposes:

- That all International and Interstate flights will move to Sydney (Kingsford-Smith) Airport South and that only intrastate and GA operations would remain at Sydney (Kingsford-Smith) Airport
- Under the proposed runway development at Sydney (Kingsford-Smith) Airport South (parallel runways 760m apart) the nominated ultimate capacity could be 340,000 movements.

It must be noted that this capacity is less than to be expected from a parallel runway airport because the available land only allows for 760 metres between the runways. This distance is insufficient for independent parallel runway operations under Instrument conditions (i.e. landings and takeoffs on both runways) and limits the operation to dependent parallel operations (i.e. take offs from one runway and landings on the other).

A further constraint on capacity is the fact that the terminal building cannot be constructed between the runways but to the side. This necessitates aircraft having to cross an active runway to reach their operational runway and is a capacity constraint.

The 1999 documentation claims that the combination of Sydney (Kingsford-Smith) Airport (GA/intrastate) and Sydney (Kingsford-Smith) Airport South (international and interstate) will satisfy 40 years of growth.

An interpretation of the Australian airport movement data available from the Airservices Australia website indicates that existing international and interstate movements at Sydney for 2010 totalled approximately 291,000.

On this basis even at a modest 2% growth the projected capacity of 340,000 at Sydney (Kingsford-Smith) Airport South will be reached in about 8 years time (say 2020).

Given the lead time in constructing an airport to be built partially on reclaimed land, Sydney (Kingsford-Smith) Airport South would potentially be at capacity on day one.

The option then would be to move some interstate flights back to Sydney (Kingsford-Smith) Airport and this would immediately complicate any smooth integration of Sydney (Kingsford-Smith) Airport and Sydney (Kingsford-Smith) Airport South flight paths.

It is noted (see below) that the claims made about flight path integration are not necessarily supportable.

Option specific comments

Sydney (Kingsford-Smith) Airport South option

The 1999 IAC proposal makes high level statements about airspace management such as *'co-ordinated air traffic control should be no problem'* and gives some broad indication of the height of aircraft as they overfly KSA en-route to and from KSAS. There is a broad statement that *'The operation of aircraft to and from airports in the Sydney Basin will be simpler and safer'*.

Without defined runway directions at Sydney (Kingsford-Smith) Airport South or detailed modelling and simulation it is very difficult to support these statements.

The report claims the Sydney (Kingsford-Smith) Airport and Sydney (Kingsford-Smith) Airport South *'runway systems would be approximately five kms apart..'*, and proposes to close Runway 16L/34R at KSA to allow for a road bridge between the two airports. This leaves the only runway at Sydney (Kingsford-Smith) Airport as 16R/34L.

Some estimations of how high aircraft may be as they overfly Sydney (Kingsford-Smith) Airport are made and a conclusion reached that these flights would not impede Sydney (Kingsford-Smith) Airport's continued operation.

To get a better understanding of the interaction of flights operating at both airports the distance between the landing threshold on RWY 34R at Sydney (Kingsford-Smith) Airport and the upwind (departure) threshold at Sydney (Kingsford-Smith) Airport South needs to be considered. Using the diagram provided this can be determined as about 3km or just under 2 miles.

A flight landing on RWY 34L at Sydney (Kingsford-Smith) Airport will fly past the upwind threshold of Sydney (Kingsford-Smith) Airport South (either runway) at approximately 600'. A departure from KSAS (either runway) in a northerly direction will be at approximately 600' at the same location.

It is safe to say that whenever there is an arrival at Sydney (Kingsford-Smith) Airport on RWY 34L, there can be no departure from Sydney (Kingsford-Smith) Airport South. This has a further impact on capacity at both airports as the northerly operating direction is the predominant direction (around 65% of time).

A further example of flight path interaction would be when traffic is operating in the opposite direction, a Southerly flow. In IMC conditions flights to both airports would need to operate in a single traffic flow to allow a clear track for the possibility of a flight needing to go-round from its approach to 16R at KSA and immediately climb through the approach path of on arrival to Sydney (Kingsford-Smith) Airport South.

It is noted that it may be possible that some form of Required Navigation Procedure (RNP) curved approach to Sydney (Kingsford-Smith) Airport South may alleviate this issue, but a curved approach comes with noise implications for residents to the west of Botany Bay (e.g. Brighton, Rockdale etc.)

Rather than making *'The operation of aircraft to and from airports in the Sydney Basin …… simpler and safer'* it will potentially make it significantly more complex. Increased complexity invariable means reduced capacity.

Without detailed modelling and simulation the claims made in the 1999 report are not sustainable.

Off shore airport options

In broad terms the further from Sydney (Kingsford-Smith) Airport that an off shore option could be built then the less conflict would exist between Sydney (Kingsford-Smith) Airport flight paths and flight paths to a new airport.

Using London's Heathrow and Gatwick airports as a guide some indication of the likely flight path interaction is possible between Sydney (Kingsford-Smith) Airport and an off shore option.

Gatwick and Heathrow are approximately 30 miles apart. The airspace between these two airports is complex and constrained. Departing aircraft with a destination that nominally requires flight in the airspace between the airports are often held at low levels (noise issues) while ATC manoeuvre them under arriving flights.

The alternative to low level manoeuvring is for departing aircraft to fly significantly extra track miles to achieve a more optimal climb profile. Extra track miles equates to extra fuel burn and extra emissions.

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Sydney (Kingsford-Smith) Airport land transport capacity 2006-2036

C2

Sydney's Kingsford Smith Airport
Land transport capacity 2006 – 2036

Joint study on
aviation capacity for the
Sydney region

NSW GOVERNMENT | Transport for NSW

Table of contents

Executive Summary

This technical paper has been prepared by the NSW Government as part of the Australian and NSW Government's Joint Study on aviation capacity for the Sydney region.

It presents analysis of the impact of growth at Kingsford Smith Airport (Sydney Airport) over the next 20 years on the surrounding land transport network and identifies constraints and pinch points in both the road and rail networks that will emerge as air passenger numbers grow. The analysis shows that some initial measures need to be taken in the short term (within the next five years) to address some of these constraints and it also highlights the need for planning in the medium and longer term to increase the capacity of the land transport network.

A range of immediate, short term, medium term and long term options have been identified based on ideas and proposals canvassed by a variety of stakeholders in the past. They are not based on Government policy. A preliminary high level assessment of twenty-four of these has been undertaken for this technical paper. The preliminary assessment suggests that a number of these options have benefit cost ratios greater than one (i.e. the benefits outweigh the costs) although most of the immediate and short term options would only provide an incremental benefit and funding sources need to be identified if they are to be supported. Further, the analysis is preliminary and more detailed demand modelling, and economic and financial impact analysis will be useful to further assess and refine options. In the medium to long term, investment in infrastructure that substantively increases land transport capacity is necessary.

For the purpose of this preliminary analysis, it is assumed that forecast growth for Sydney airport is not affected by potential additional aviation capacity becoming available at another site in the Sydney region over the next 10 to 20 years nor is land transport access to other sites considered. Further, the possible re-alignment of the Sydney Airport terminals on an airline alliance basis rather than the existing domestic and international terminals as proposed for consultation by SACL has not been taken into account.[1]

Sydney Airport is part of Sydney's global economic corridor – a cluster of economic centres that stretches from Sydney Airport and Port Botany through the Sydney CBD and North Sydney to St Leonards, Chatswood and North Ryde to Macquarie Park. Land transport for the airport is influenced by its proximity to Port Botany as well as traffic volumes along the global economic corridor.

This technical paper focuses specifically on land transport to Sydney airport rather than the broader Sydney Airport/Port Botany precinct. Much more detailed analysis and planning is required to develop an integrated package of land transport solutions to meet forecast growth for the whole precinct. This more detailed analysis of options and planning could be progressed as part of the proposed development of a *Port Botany and Sydney Airport Transport Improvement Program* as set out in the NSW Government's November 2011 submission to Infrastructure Australia.[2]

The report is structured as two parts:

- Part 1: Identification of land transport capacity issues at Sydney Airport to 2036
- Part 2: Identification and preliminary assessment of options to provide the land transport capacity needed for growth at Sydney Airport.

[1] The potential for this reconfiguration of terminals was announced by SACL in December 2011 subsequent to the analysis that has been undertaken for this technical paper.

[2] NSW Government (2011) *Port Botany and Sydney Airport Transport Improvement Program – Submission to Infrastructure Australia.*

Part 1

Forecast passenger growth at Sydney Airport

Forecasts of passenger growth at Sydney Airport are variable.[3] The SACL forecast in its Master Plan is that the number of passengers per annum at Sydney Airport will more than double from 31.9 million passengers in 2007 to 79 million by 2029—an average annual growth rate of 3.9 per cent and 4.8 per cent for domestic and international passengers respectively. As part of the Joint Study, the Australian Government has separately commissioned Booz & Company to produce growth rates. These suggest lower rates of growth are more likely.

The impact on the land transport network depends on which growth scenario is adopted. For most of the analysis in this report, a medium scenario for the next 20 years of around 3 per cent growth per annum for domestic activity and approximately 4 per cent for international has been adopted.[4] This is broadly consistent with Booz & Company's unconstrained scenario for 2010-2030. For this scenario, growth forecasts assumed no limitations on movements per hour, or theoretically unlimited supply of aviation infrastructure. This scenario was adopted to avoid the risk of underestimating the potential impact of growth in passenger numbers on the land transport network if the lower forecasts in the constrained scenario were used.

Some analysis of the impacts of SACL's higher growth rate as well as lower growth scenarios has also been undertaken. This is important because historically rates of growth have been volatile and it is difficult to be definitive about future growth rates and their impacts so a range of results is presented in some instances.

Impact of passenger growth on road traffic

Passenger growth at the Airport is and will continue to be a key contributor to the cumulative impact on the road and rail network in the Port Botany-Airport-Sydney CBD transport corridor. 89 per cent of Sydney Airport person trips are by road, including cars, buses and minibuses (SACL Airport Ground Travel Plan, 2006).

Under the medium growth scenario, total traffic in the precinct could grow by an additional 13,200 vehicle trips per hour in the am peak by 2036 although not all of this growth is attributed to the airport.[5] This amount of traffic is equivalent to 6 additional motorway lanes.

A Strategic Travel Model[6] was used to predict the likely impact of the growth in traffic on the transport network. This indicates that during the am peak, the average travel speed on key roads in the airport precinct will reduce to less than 20km/hr.

Although airport traffic is forecast to grow significantly, background traffic along the Global Economic Corridor will also grow. Modelling indicates that the roads in the immediate airport precinct will carry an increased proportion of airport traffic as trips to other destinations are forced elsewhere due to congestion and delays.

A key pinch point: the Domestic Terminal Loop

A key pinch point in the airport precinct is the domestic terminal loop road. It has an estimated capacity of 3,000 vehicles per hour. At this volume, substantial congestion will occur with minimal space between

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[3] SACL 2009, Sydney Airport Master Plan and technical paper prepared by Booz & Company.

[4] Refer to Booz forecast paper

[5] To arrive at these estimates, International and Domestic passenger growth rates were applied to the 2005/06 base traffic and added to traffic counts within the airport precinct for the Jet base and Link Rd. The analysis assumes no change in the mode of transport used to travel to and from the Airport.

[6] The land use, infrastructure and freight assumptions used in the STM were based on the December 2010 version of the model, incorporating the small area forecasts published by BTS in October 2009. Refer to the BTS website www.bts.gov.nsw.au for more information. An adjustment was made to the model to provide a more accurate representation of the trips generated by air passengers. Only the airport travel zones were modified.

vehicles and speeds reducing to very slow levels.[7] This loop has been chosen as an example and focal point of the analysis because it is one of the most constrained points. Analysis of other pinch points would reveal additional pressure points in the precinct.

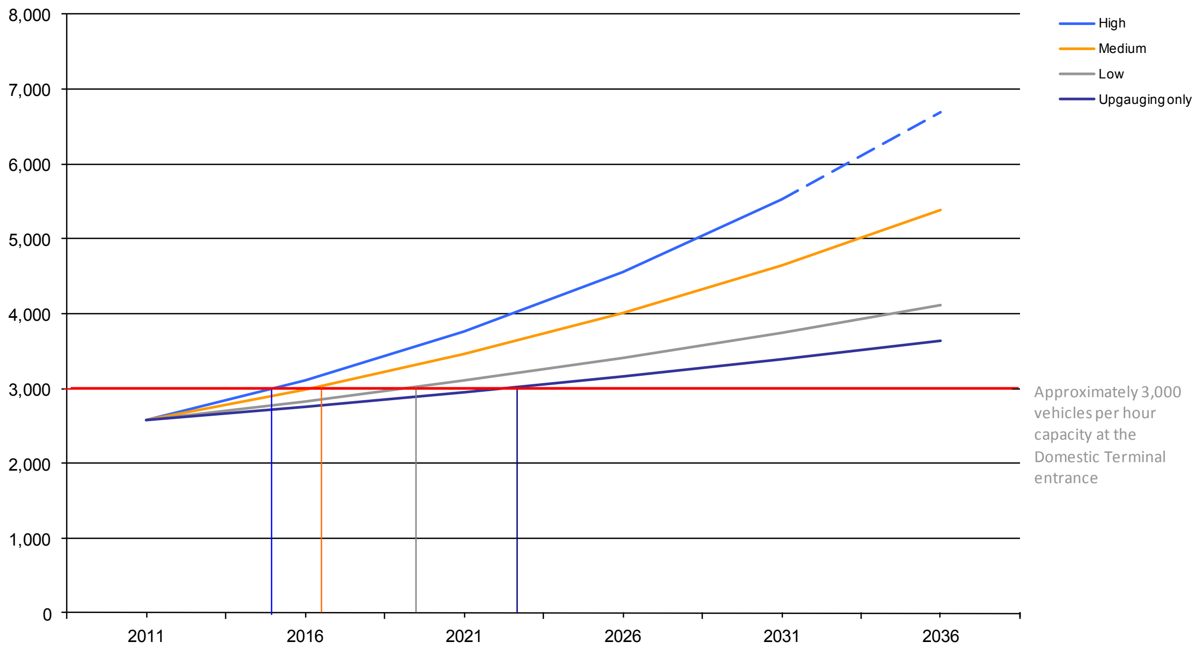
In 2011 this road has an estimated volume of traffic in the busiest period (7-9am) of 2,570 vehicles per hour. The point at which vehicle volumes will reach 3,000 per hour depends on the rate of growth in passenger numbers and a range of other factors such as the extent of any mode shift to public transport and whether changes, such as SACL's proposed reconfiguration of the existing domestic and international terminals as airline alliance-based precincts, are implemented.

Assuming a medium scenario, capacity will be reached in 2017 but this is uncertain and modelling of lower and higher growth forecasts indicates it could be as early as 2015 or as late as 2023 (refer Figure 1).

At this capacity, congestion could result in a slowing in the growth rate of vehicles using the Domestic Terminal Loop during peak periods.

SACL announced in December 2011 it will consult stakeholders on a proposal to reconfigure its terminals on the basis of airline alliance rather than retaining separate terminals for domestic and international flights. This could change the spread of traffic and pinch points in the precinct. The potential impact of this re-alignment on pinch points has not been taken into account in this analysis, which was completed prior to the announcement.

Figure 1 Capacity of the domestic terminal loop to accommodate passenger growth at Sydney Airport



Rail Infrastructure Capacity

Sydney Airport is also served by rail which accounts for 11 per cent of airport trips (SACL Airport Ground Travel Plan, 2006). Trains on the East Hills Line of the CityRail network originate from Macarthur or

[7] This level of congestion is defined as 'Service Level F' (using Austroad Standards)

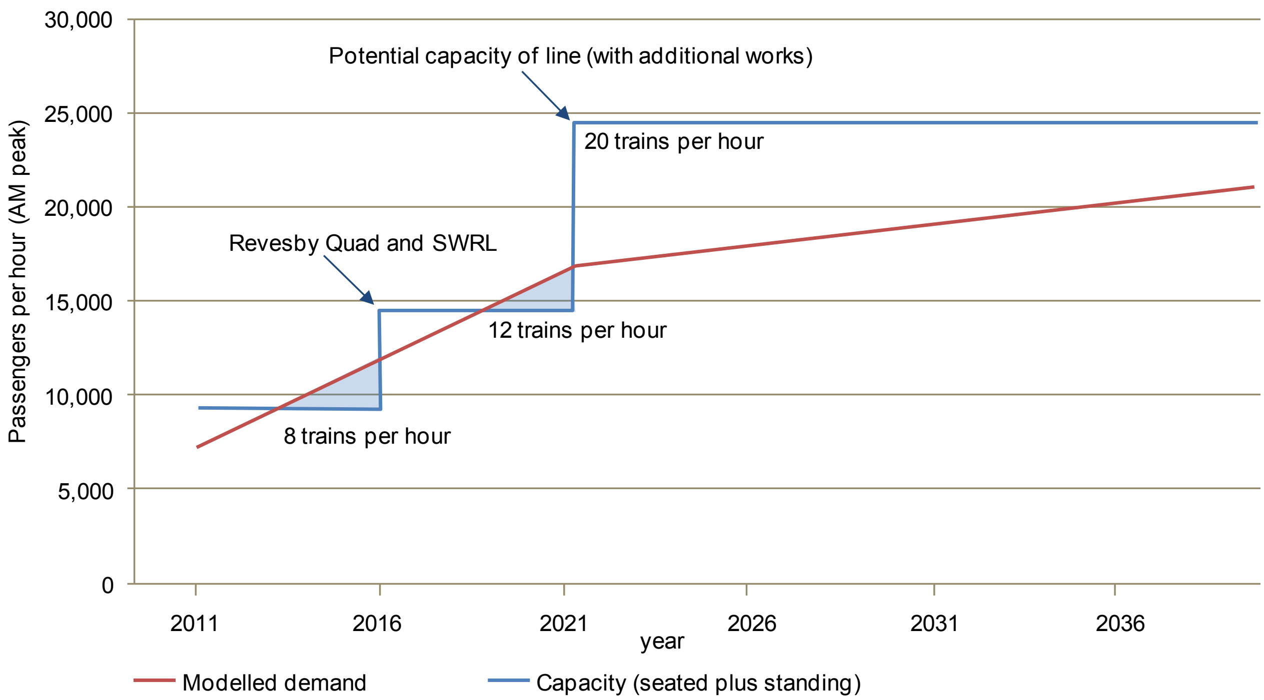
Revesby and pass through the privately operated Airport Rail Link Stations. This rail corridor is well positioned to serve increased numbers of passengers – it has more available capacity than any other line on the CityRail network.

The key physical constraint on growth on this rail line over the next five years is the availability of rollingstock and train paths to provide additional services as patronage grows, particularly in the am peak.

There is already some crowding in the am peak on CBD bound trains. Some of these services are already full (but with some standing room available) before they reach the International Terminal. This period is also the peak period for passenger arrivals at the airport. Based on current growth levels, between 2013 and 2018 all of these CBD-bound am peak services will be full unless additional rolling stock and train paths can be allocated to the Airport Rail Link.

There are currently 8 trains per hour in the peak on the Airport Line. A sequence of rail projects including the Kingsgrove-Revesby quadruplication, completion of the South West Rail Link and construction of the Revesby turnback will provide capacity for additional services on this line. If additional rollingstock is allocated to the line, it is anticipated an additional 4 trains per hour in the peak will commence in 2016 when the South West Rail Link opens. This will temporarily relieve crowding in peak periods but in the longer term, additional services will be required as shown in Figure 2.

Figure 2 Potential Airport Rail Link capacity compared to modelled demand in the am peak



The Airport Link Company operates four Airport Rail Link Stations (Green Square, Mascot, Airport Domestic, Airport International). Passengers travelling to or from the Airport stations are charged a station access fee in addition to their regular train fare which increases the cost of this option relative to road transport options. The station access fee is currently an additional $11.80 for single tickets or an additional $18.00 on a weekly ticket which does create a price disincentive to use rail relative to other modes.

The NSW Government is developing a Long Term Transport Master Plan in 2012. Long term rail options for the Greater Sydney Metropolitan Areas will be considered as part of development of this plan and it is anticipated that these will seek to address capacity constraints across the network over the next 20 years.[8] Overall, capacity of the line itself is not considered a constraint to increased use by passengers travelling to or from airport stations on the East Hills line but the number of services provided on the line and rollingstock available for additional services in peak periods is a constraint. There are greater capacity constraints on other lines from which passengers may connect to travel to the airport.

Road based public transport capacity

According to SACL's 2006 Airport Ground Travel Plan, public buses, taxis and mini buses together account for 39 per cent of all trips to the airport.

Taxis account for 25 per cent but there are limited opportunities to grow these services because of space constraints at the airport and increasing congestion.

Public buses account for only 4 per cent of trips with only one service, generally three times an hour. There is potential to increase bus services and to target particular markets including the more than 50 per cent of airport workers living south of the airport.[9] However, under the terms of the contract for the Airport Rail Link, the NSW Government is liable to compensate Airport Link Company for any material changes to the timing and level of Airport Link revenues and events that discriminate against it. These provisions are perceived to preclude measures to improve public transport services to the airport which may compete with the rail link unless compensation is paid. Further, to provide a viable alternative to other land transport options, additional bus services would need to be complemented by bus priority measures that alleviate the impacts of general traffic congestion on bus services.

Mini-buses make up the majority of bus services to the airport. Although not well advertised they account for 10 per cent of person trips. Improvements to marketing and accessibility of these services may assist in reducing congestion.

Part 2

Options to enhance land transport capacity

PwC was engaged to undertake preliminary analysis to identify and assess options for accommodating growth in demand for land transport to and from Sydney Airport. Although the analysis is preliminary, it does provide direction for further targeted analysis and verification.

The process involved:

- Generating a set of 24 airport land transport options based on ideas and suggestions that a variety of stakeholders have put forward in the past
- Grouping the options into immediate, short term, medium term and long term options
- Applying a rapid qualitative assessment to the options using criteria to score and rank them (multi-criteria analysis) – the criteria related to airport user requirements, impact on the broader network, alignment with government objectives, development implications, impact on local residents and environment and heritage impacts
- Selecting some of the higher ranked options in each group for preliminary economic appraisal or reporting on the findings of existing analysis for some of these.

Table 1 provides a summary of the options considered, the results of the initial qualitative assessment and identifies the options for which further analysis was undertaken.

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[8] Transport for NSW (2011) *Rail options for the Sydney Greater Metropolitan area – Draft options paper*, November 2011

[9] BTS (2006) Journey to work data

Table 1: Decision process for determining whether an option was taken to the CBA Stage

Rank	Option Title	MCA Score (un-weighted excluding cost)*	To be evaluated at this stage of the process?	Preliminary CBA option reference in this report
Timing: Immediate (0-1 year)				
1	Removal of Station Access Fee (SAF) at international and domestic terminal stations	14.5	Yes - preliminary CBA results included in this report	A
2	Public Transport Customer Information Campaign	9.0	Yes - preliminary CBA results included in this report	B
3	Removal of SAF from airport workers monthly rail ticket	8.8	Yes - Note: not examined separately as included in preliminary CBA of option A	-
4	Reduction of "Meeter and Greeter" trips by restricting curb side and air side access	7.5	No - increased use of parking facilities currently being considered / implemented by SACL	-
5	Installation of "RTA live" traffic cameras at international and domestic terminals	6.8	Yes - option likely to provide benefits for precinct but not significantly improve capacity. Qualitative evaluation only provided as part of this report	-
6	Staff Ride Share Information Campaign	6.8	No - not considered further because of low ranking amongst immediate options	-
7	Increased Transport Management Centre Traffic Light Involvement at airport precinct	6.0	No - consultation with SACL revealed that this is being undertaken already	-
8	Bicycles provided to Sydney Airport Staff	3.8	No - not considered further because of low MCA score	-
Timing: Short Term (2-5 years)				
1	Transit Mall to facilitate better access to and greater use of minibuses/buses	8.5	Yes - preliminary CBA results included in this report	C
2	Pedestrian Link from Martin Place to St James Station to facilitate CBD access to airport line services	8.5	Yes - preliminary CBA results included in this report	E
3	Faster Taxi Loading and taxi multi-hiring in airport precinct	6.8	No - unable to be considered in the short term due to the split deck between arrivals and departures. SACL is considering a new carpark structure for taxis in the long term.	-
4	Public Buses to Sydney Airport from St George/Sutherland area and from the North Shore	6.5	Yes - preliminary CBA results included in this report	D
5	Airport precinct access charge	4.5	No - Could be considered as a funding method but not considered further as part of this study	-
6	Sydney Airport Arterial Road Upgrades	4.5	Yes – qualitative evaluation only as part of this report. Further traffic analysis of these options are currently being undertaken. Initial indications are these works provide short-term capacity enhancements but are not sufficient to accommodate future traffic growth.	-
7	Park and Ride to be situated at railway station close to KSA	4.3	No - not considered further because of low MCA score	-

Rank	Option Title	MCA Score (un-weighted excluding cost)*	To be evaluated at this stage of the process?	Preliminary CBA option reference in this report
8	Parking Space Levy on parking within the airport	4.0	No - Could be considered as a funding method but not considered further as part of this study	-
9	Check in points off airport for rail users - Central Station	2.3	No - not considered further because of low MCA score	-
Timing: Medium Term (5-15 years)				
1	Increased Rail Services in the network	14.0	Yes - Being evaluated separately by Transport for NSW as part of the Long Term Transport Master Plan.	-
2	M4 Extension	8.5	Yes - Roads and Traffic Authority (RTA/RMS) have undertaken CBA of both of these projects separate to this study. This report includes qualitative evaluation of RTA/RMS modelling results as they apply to airport users	-
3	M5 East Expansion	6.0		-
4	Introduction of high occupancy vehicle lanes in the airport precinct	0.3	No - Not to be evaluated separately as part of this study, although may be considered as part of KSA Arterial Road Upgrades	-
Timing: Long Term (15+ years)				
1	High Speed Rail from Sydney to Melbourne via Canberra	5.0	Long term options are likely to be considered beyond KSA transport option analysis and will not be assessed further as part of this study	-
2	Ecotransit light rail from CBD extending south past KSA	3.0		-
3	Build/upgrade of the F6	-1.5		-

* Multi-criteria analysis involves assessing the options using criteria to score and rank them. The criteria used in the multi-criteria analysis are listed in Table 14

Five main options were assessed using a preliminary appraisal framework to generate estimates of their net present value and a benefit cost ratio (BCR). For the purpose of this study, each of the options was devised to provide benefits primarily to airport users, rather than the wider network.

In addition, a summary of the results from cost benefit analyses undertaken for another two options separate to this study are included in this report: the M5 East Expansion and the M4 Extension. The analysis of these options is not directly comparable to the options included in the study because of the different processes used to assess them. However, using the existing analysis avoids duplication of previous work. Qualitative analysis for some options for which costs and benefits could not be quantified was also undertaken.

The level of service across the rail network will be considered as part of the development of the Long Term Transport Plan. Increased rail capacity is an important option and although detail is not presented in this report, analysis will be undertaken as part of broader network planning.

The preliminary results are summarised in Table 2.

Table 2: Summary results of the Preliminary Cost Benefit Analysis

Options	Immediate term			Short term					Medium term	
Summary results	Option A1 : 100% SAF removal	Option B: Info campaign	A + B	Option C : Transit Mall	Option D (i) : St George bus	Option D (ii) : North shore bus	Option E : CBD pedestrian link	C + D	M5 East expansion	M4 extension
Timeframe	0 - 12 months			1 - 5 years					10 years	
Total Costs	$582m	$8m	$591m	$67m	$10m	$13m	$311m	$90m	$3,600m	$7,600m
Total Benefits	$815m	$42m	$859m	$69m	$20m	$18m	$48m	$107m	$5,600m	$25,300m
Preliminary NPV	$233m	$34m	$268m	$2m	$10m	$5m	-$263m	$17m	$2,000m	$17,700m
Preliminary BCR	1.4	5.2	1.5	1.0	2.0	1.3	0.2	1.2	1.5	3.3

Note: these figures are indicative only and would be subject to further development if any option were to be supported.

Option A – Removal of the Station Access Fee (SAF) at Domestic and International rail stations

Apart from the motorway options, the removal of the SAF is estimated to have the greatest net benefit ($233 million). 100% removal of the SAF is estimated to result in a mode shift of approximately 3,350 trips per day in 2011 onto the Airport Rail Link.[10] However, it has a relatively large cost for a non-capital item (a preliminary estimate of close to $600 million in net present value terms over 30 years in 2011 dollars) , with about two thirds of the benefit estimated as accruing to existing rail passengers who will enjoy cheaper fares. Further, removal of the SAF could bring forward the point at which existing services reach capacity and the need for additional services and rollingstock on this line may be required earlier than previously anticipated with consequential impacts across the rest of the rail network. This potential additional cost was not included in the analysis but could be substantial.

Option B - Public Transport Information Campaign

A Public Transport Information Campaign has a high BCR of 5.2 (that is for every $1 in costs it is estimated there is $5.20 in benefits) although the benefits are only incremental. It is likely to be even more effective if implemented in conjunction with removal of the SAF.

Option C – Transit Mall and Option D – Public Buses

Transit Malls at both the domestic and international terminals would provide a space where airport users could access higher occupancy vehicles such as buses and mini-buses. Additional bus routes could be introduced to provide direct connections to the airport from the south (where more than 50 per cent of airport workers live) and from the north shore.

The Transit Mall delivers a preliminary BCR of 1.0. Option D was split into two parts - a public bus from St George/Sutherland which had a preliminary BCR of 2.0 and a public bus from the Lower North Shore which had a preliminary BCR of 1.3 although the cost of any potential liability to the Airport Rail Link operators has not been included in the analysis.

[10] The rapid economic appraisal generalised the costs and benefits of removing the SAF to society in total. It does not assess the impact of these “costs” on specific stakeholders, nor can be it be used as a basis for determining the value of the rail link for procurement purposes. Additional analysis of the financial impact of removing the SAF would need to be undertaken if further consideration is given to this option.

Option E – Underground pedestrian link from Martin Place to the Airport Rail Link

The option of an underground pedestrian link between Martin Place and St James train stations to link passengers from the Eastern suburbs line and from higher density employment areas of the CBD more directly to airport train services has a BCR of less than one because of its high capital cost. In addition, only the benefits for airport users were captured in the analysis. This initiative would have broader benefits for other users in and around the CBD and regardless of the low BCR in this limited analysis could merit further consideration that takes into account all benefits whether or not they are related to airport transport.

Motorway options

Based on earlier analysis by the RTA, the medium term (10 plus years) motorway options - the M5 East Expansion and M4 Extension have BCRs of 1.5 and 3.3 respectively and NPVs of $2 billion and $17.7 billion respectively. These options have the greatest net present values but are also very high cost. In both cases, the benefits are primarily driven by travel time savings.

Sydney Airport arterial road projects

A number of arterial road projects are outlined in the Sydney Airport Master Plan 2009[11] or have been identified by Roads and Maritime Services. These projects would provide benefits in the short and medium terms at pinch points and improve the flow of traffic at key intersections but they do not provide sufficient capacity to accommodate the projected traffic demand. They were not subject to preliminary cost benefit analysis. However, further work is being undertaken using precinct specific modelling to inform an appraisal of these projects and to prioritise them. Preliminary results of this analysis are expected in March/April 2012 and more detailed analysis will follow. Large scale projects (like the motorway options) are ultimately needed to accommodate growth in demand.

[11] SACL (2009) Sydney Airport Master Plan 2009

1. Introduction

In December 2009, the Australian Government released the National Aviation Policy White Paper. One of the actions in the Paper was for the Australian and NSW Governments to work together on a Joint Study of aviation capacity for the Sydney region.

The Joint Study will consider the short and long term aviation infrastructure and supporting surface transport requirements of the Sydney region, and identify strategies and locations to meet future needs. In particular, the Study will:

- Consider the immediate aviation infrastructure requirements for the Sydney region, the capacity of the existing aviation infrastructure and the capacity of the land transport network linkages to meet forecast demand.
- Determine the medium and long term aviation infrastructure requirements for the Sydney region and the capability of the existing aviation assets serving the region to meet the forecast market demand in passenger, freight and general aviation. This includes consideration of:
  - Current airport capacity;
  - The implications of future long-term demand forecasts for aviation services;
  - Aligning the planning of future economic infrastructure with potential future land uses and employment forecasts for the region;
  - The location and nature of future urban growth in the Sydney region; and
  - Key linkages between existing aviation infrastructure and other transport networks.

The Joint Study will inform the development of an **Aviation Strategic Plan**, which will inform future infrastructure planning and investment by government and industry, and enable the proper integration of future airport operations with surrounding state land use planning and surface transport networks.

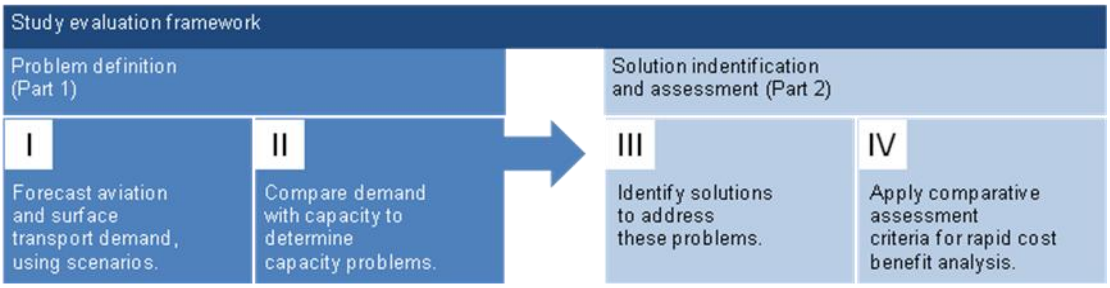
This report has been prepared by the NSW Government for the Australian Government to assist with detailed consideration of land transport capacity and constraints at Kingsford Smith Airport (Sydney Airport) as an input into the Aviation Strategic Plan. The Report is a summary document and is comprised of two parts:

PART 1: Identification of land transport capacity issues at Sydney Airport: In this part the impacts of air passenger growth on road and rail networks serving the airport are considered. The capacity of these networks to accommodate growth is modelled and constraints on capacity are identified.

PART 2 Identification and preliminary assessment of options to accommodate growth: This part outlines potential immediate, short, medium and long term options for accommodating forecast growth on land transport networks and presents the results of a preliminary assessment of these options. It provides some initial direction for the more detailed work needed to generate an integrated transport solution for the precinct.

Figure 3 outlines the evaluation framework for this study.

Figure 3: Evaluation framework for this study



PART 1

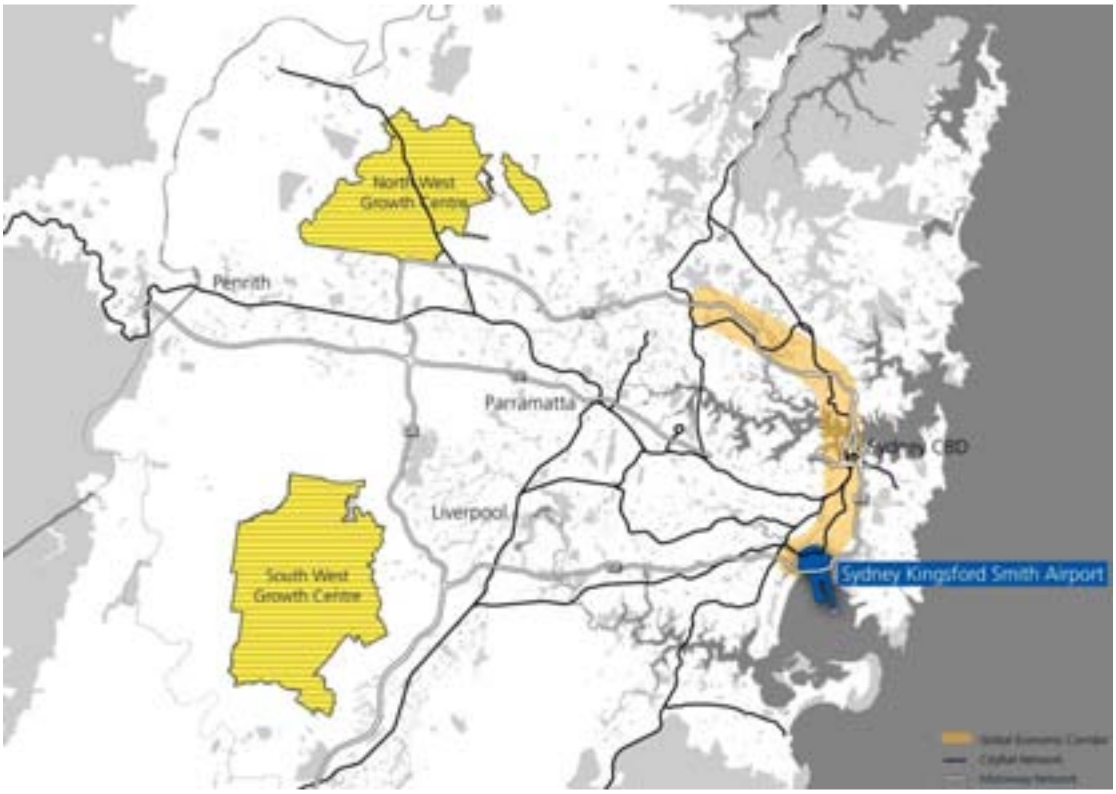
2. Forecast Aviation & Surface Transport Demand

2.1. Strategic Context

Sydney Airport is part of Sydney's global economic corridor – a cluster of economic centres that stretches from Sydney Airport and Port Botany through the Sydney CBD and North Sydney to St Leonards, Chatswood and North Ryde to Macquarie Park (see Figure 4).

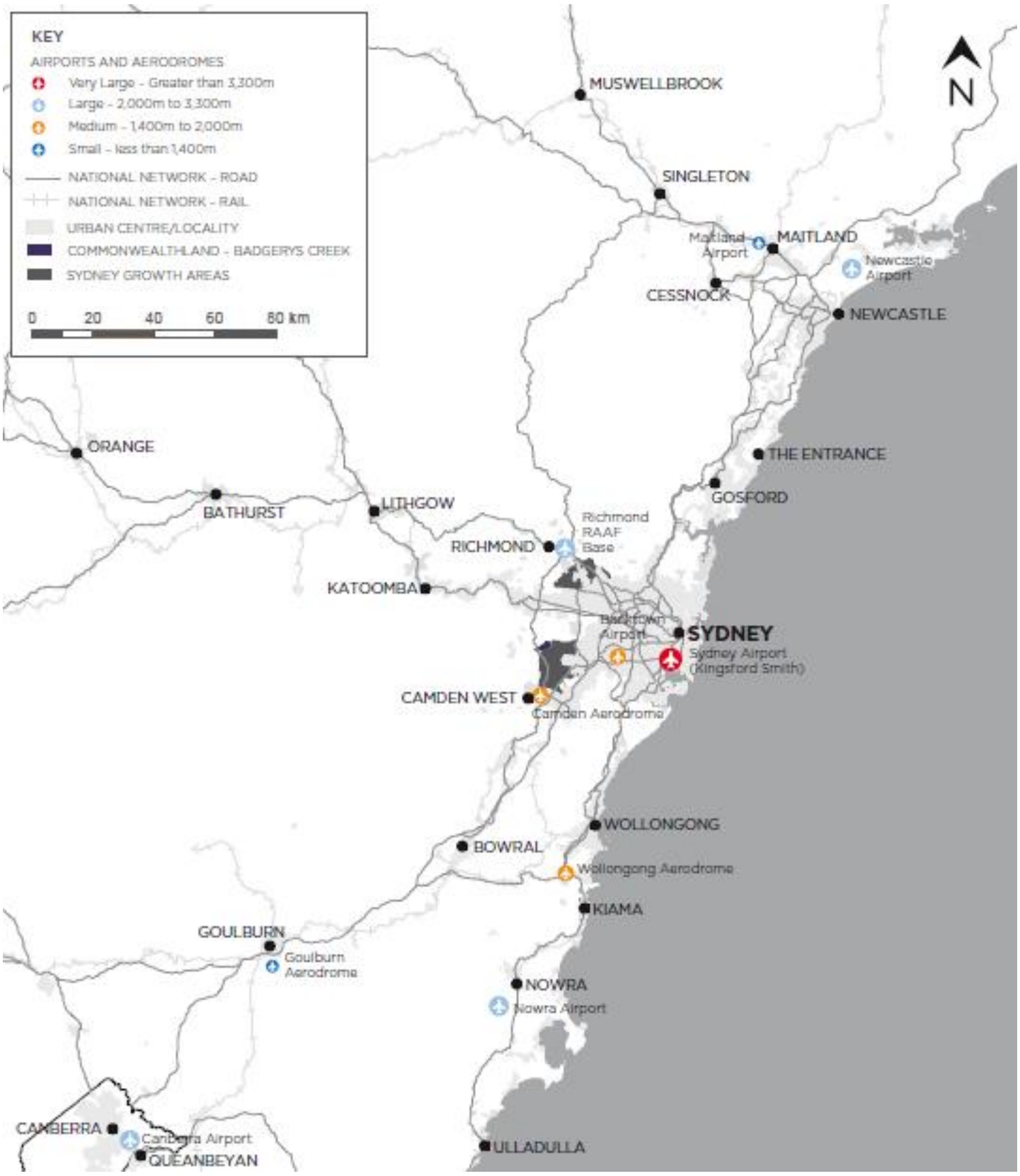
It is located 9km south of the Central Business District (CBD), north-west of Port Botany on Botany Bay. As the aviation gateway to Sydney, it enjoys many advantages from its close proximity to the Sydney CBD, economic centres, and global tourist attractions. The parallel runways extending into Botany Bay have enabled the development of a full international airport with a relatively small land footprint.

Figure 4 Strategic location of Sydney airport



The Airport is one of 16 airports located in the area being considered by the Joint Study on Aviation Capacity. Figure 5 shows its size and location relative to the other airports.

Figure 5. Airports in the Sydney region



The airport is connected to employment centres and beyond by five main transport corridors as shown in Figure 6:

- Bondi Junction and surrounds
- The Sydney CBD and beyond to the North
- Burwood and beyond to the west
- Liverpool and beyond to Goulburn and Canberra
- Sutherland and beyond to the Illawarra region

Figure 6: Connecting transport corridors to Sydney Airport

Source: NSW Metropolitan Plan.

The airport's proximity to significant transport demand generators including the CBD, Port Botany and dense residential areas, means that considerable transport infrastructure is required to support increasing land transport demand in the airport precinct, through the Global Economic Corridor to the CBD and beyond. Growth in container volumes at the port, as well as residential and employment growth will all contribute to increasing the land transport demand in the precinct.

Apart from growth in activity at the airport, some of the forecast trends that will affect future transport demand in the precinct are:

- Employment in the Sydney CBD will increase from 274,474 jobs in 2006 to 357,847 jobs in 2036 while employment in the Sydney Greater Metropolitan Area will increase from 2.5 million jobs in 2006 to 3.3 million jobs in 2036.[12] This equates to an employment growth rate across Sydney of 0.9% per annum.

- The South West Sydney subregion is expected to accommodate 464,000 more people, or about one quarter of the additional people forecast to live in the Greater Metropolitan Area by 2036.[13]

- Truck trips to the Port/Airport precinct are forecast to increase by 50% over 30 years based on a rail mode share 28% for freight movements.[14]

- In addition to the passenger load from commuters travelling through the airport to access the CBD, high rates of growth will occur along the corridor between the airport and the CBD (served by Mascot and Green Square) due to urban redevelopment. Several new and/or emerging centres are forecast to grow over the next 25 years including Green Square, Redfern/Waterloo, Mascot, Randwick and Randwick South.

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[12] Bureau of Transport Statistics, Travel Zone Employment Forecasts, Subregional tables, October 2009.

[13] Bureau of Transport Statistics, Travel Population Projections, October 2009.

[14] Bureau of Transport Statistics, Transfigures, Freight movements in Sydney, July 2010.

The following tables summarise the latest small area population and employment forecasts for Sydney and the freight movement forecasts for trips into Port Botany and the Airport between 2006 and 2036.

Table 3 Employment forecasts by centre

Forecast employment growth by Centre	2006	2036	Additional jobs
Central Sydney – Redfern	6,592	20,087	13,495
Central Sydney - Surry Hills Kings Cross	36,208	45,804	9,595
Central Sydney - Sydney CBD	274,473	357,847	83,374
Port Botany	15,718	22,455	6,737
Randwick	15,700	23,389	7,689
South Sydney Industrial Area	59,812	76,490	16,678
Sydney Airport	14,732	20,414	5,682
TOTAL in centres	423,236	566,486	143,250

Source: BTS employment forecasts by centre, March 2010, BTS 10/052

Table 4 Population growth forecasts for South West Sydney and Sydney Greater Metropolitan Area

	2006	2036	Additional jobs
South West sub-region	410,516	874,843	464,327
TOTAL Growth Sydney Greater Metropolitan Area	5,214,203	7,187,137	1,972,934

Source: BTS population forecasts, October 2009 release

Table 5 Forecast growth in truck trips to Port Botany and Sydney Airport

	2006	2036	Additional trips
Truck trips to Port Botany and the Airport	19,928	29,678	9,750

BTS Freight Movement Model, October 2010, BTS 10/337

2.2. *Aspects of aviation capacity affecting demand for land transport*

Increased utilisation of capacity at Sydney Airport will generate demands on the land transport network. The Joint Study is examining three key aspects of aviation capacity:

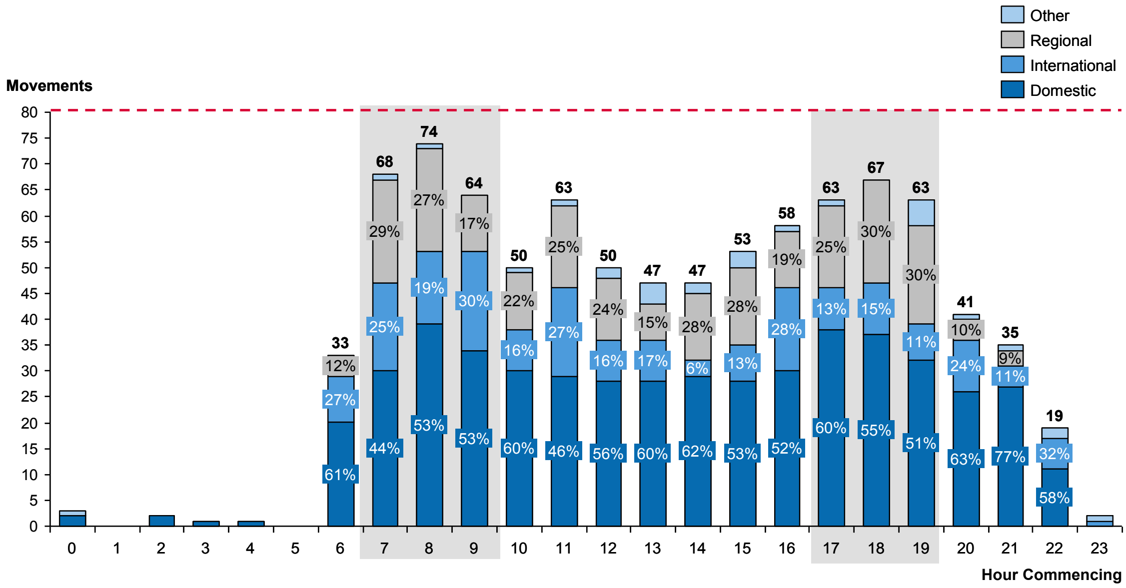
- Air space capacity – the number of aircraft landing and take-off slots available per hour over the hours of the operation of the airport.
- Terminal capacity - the volume of arriving and departing aircraft and passengers that the terminal can process
- Land transport (access) capacity – the volume of people and vehicles that can be moved into and out of the airport precinct.

Although this technical paper is focused on land transport or access capacity, it is important to understand how characteristics of air space and terminal use can influence land transport capacity. Three key characteristics are pertinent:

1. Peaks in demand for air services coincide with the peaks in road and rail use
2. Domestic travel is predominant compared to international travel which contributes to greater pressures on domestic terminal access roads relative to international terminal access roads
3. Average plane size is small relative to international benchmarks and increased use of larger aircraft is likely to accommodate a proportion of demand growth, particularly in peak periods.

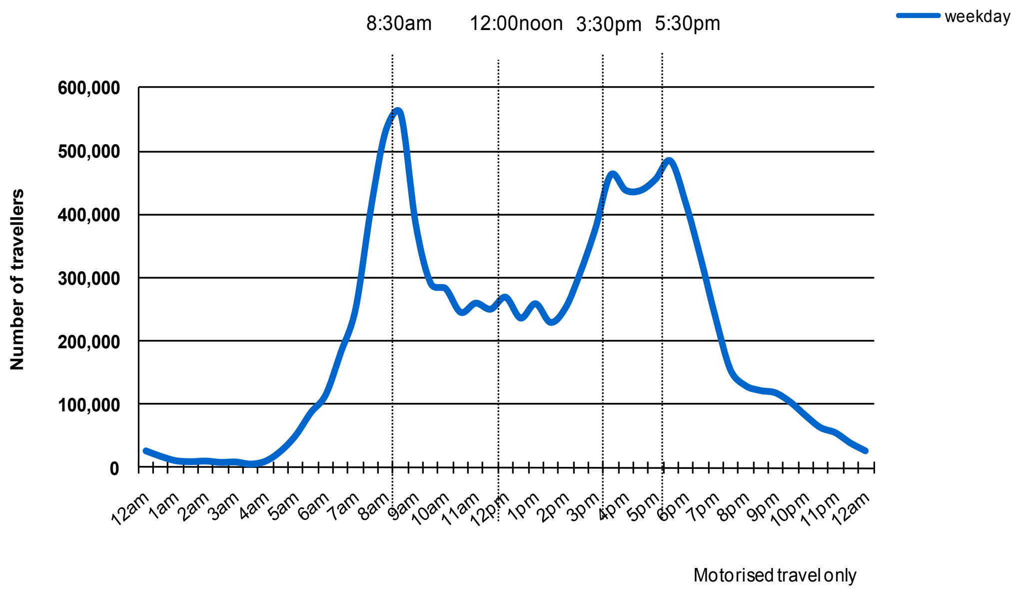
Figures 7 and 8 illustrate the similarities in the demand patterns for both air travel and general trips in Sydney. The peaks for air travel in the morning (7am to 9am) and evening (5pm to 7pm) shown in Figure 7 coincide with the peaks on the road and rail network across Sydney. Figure 7 also illustrates the dominance of domestic air travel throughout the 18 hour day, and particularly during the am and pm business day peak periods.

Figure 7 – Planning Day Hourly Aircraft Movements by Service Type, November 2010



Source: Booz and Company Aviation Forecasts, October 2011, page 43

Figure 8 Demand pattern for land based motorised trips in Sydney Statistical District



Source: Bureau of Transport Statisics, Household Travel Survey 2009/10, 3-10-1

Although International travel has a faster growth rate, domestic travel will continue to dominate over the timeframe considered by the Joint Study, the next 10 to 25 years (Booz and Company, October 2011). This contributes to pressure on access roads to the two domestic terminals at Sydney Airport.[15]

The average aircraft capacity at Sydney Airport is approximately 100 persons per plane. This is relatively low compared to international benchmarks. Current movement capacity is 80 planes per hour and these slots are close to fully allocated during peak periods. However, total passenger movements could increase with a shift to use of larger planes (known as upguaging) which means there is capacity for growth in airport passenger numbers in peak periods.

Aircraft sizes are also highly variable, particularly for the domestic market. For example the average aircraft size for regional travel is 45 seats, and for Australian Capital City travel between 150 and 200 seats. International planes are typically up to 300 seats. However, A380 airbuses can carry over 500 passengers.

All three of these characteristics will influence how aviation activity grows, and where peak periods in aviation overlap or complement the background peaks on the road and rail network.

[15] SACL announced on 5 December 2011 that it intends to commence stakeholder consultation on a plan to reconfigure the existing domestic and international terminals as airline alliance-based precincts by 2019. If this proposal is implemented, it is possible the dominant domestic market will be spread across the terminals. The analysis for this study was undertaken prior to this announcement and it was assumed the current configuration is retained.

2.3. *Existing Sydney Airport travel demand by market and origin*

In 2010, Sydney Airport was used by over 35 million passengers and it is estimated to generate between 100,000 -140,000 movements on an average weekday.[16]

More detailed information is available by market segment for 2006 data. Table 6 shows airport activity by market segment including passengers, employees and visitors on an average week day and weekend day in 2006.

Table 6 Activity at Sydney Airport

Activity	Weekday	Weekend day
Arriving passengers	31,694	28,984
Departing passengers	31,623	29,363
Meet and greet/visitors	13,779	12,488
Employee	12,112	9,609
Total	89,209	80,444

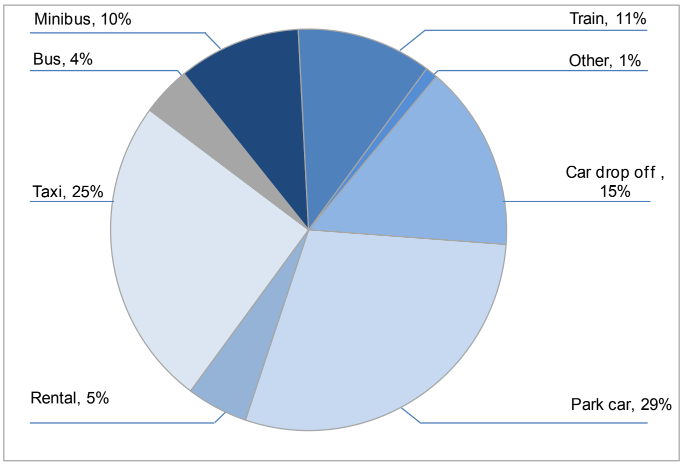
Source: SACL Airport Ground Travel Plan, 2006

Figures 9 to 11 show the mode shares for travel to Sydney: overall; for employees; and for air passengers in 2006.

In terms of overall mode share:

- 89% of total trips to the airport were by road, including 14% by buses and mini buses, 25% by taxis and 29% of trips that involved parking a car in an airport parking station
- 11% of trips were by train while 4% were by public bus.

Figure 9 Overall mode share for Sydney Airport (SACL, 2006)



[16] Sydney Airport (2011) *Annual Report Key Highlights 2010*.

Figure 10 Air passenger mode share for Sydney Airport (SACL, 2006)

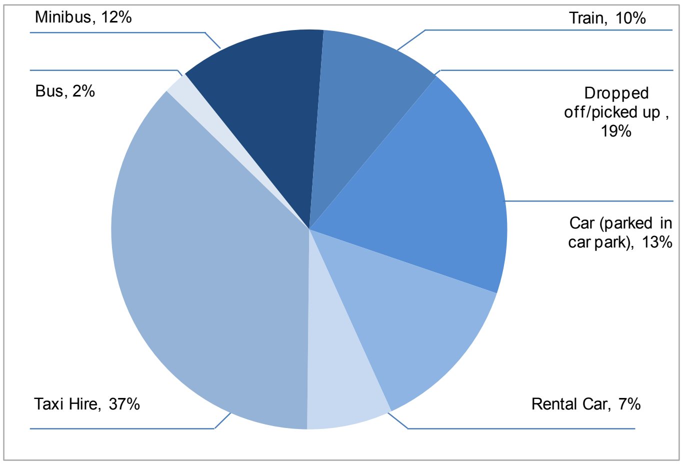
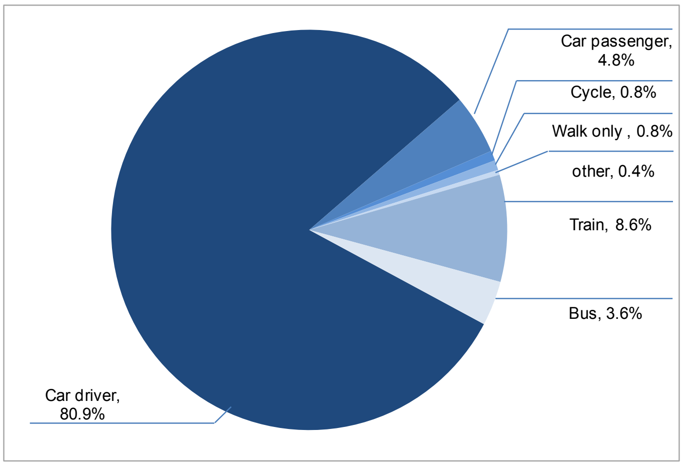


Figure 11 Employee mode share for Sydney Airport in 2006 (BTS Journey to work data)



Based on survey data, the distribution of trips to Sydney Airport is as follows:

- More than one third (36%) of trips originate in inner Sydney.
- 27% of trips originate in the northern and eastern suburbs.
- 10% originate in the southern suburbs, including the Illawarra region.
- The north west, west and south west account for 18% of trips.[17]

About 9% of those surveyed did not provide a response which accounts for the remainder.

Figures 12 and 13 illustrate the distribution of all trips and employee trips respectively to Sydney Airport on an average weekday (based on SACL's 2006 data).

[17] Sydney Airport Corporation Limited (2006). Airport Ground Travel Plan.

Figure 12 Distribution of all trips to KSA (average weekday) (SACL, 2006)

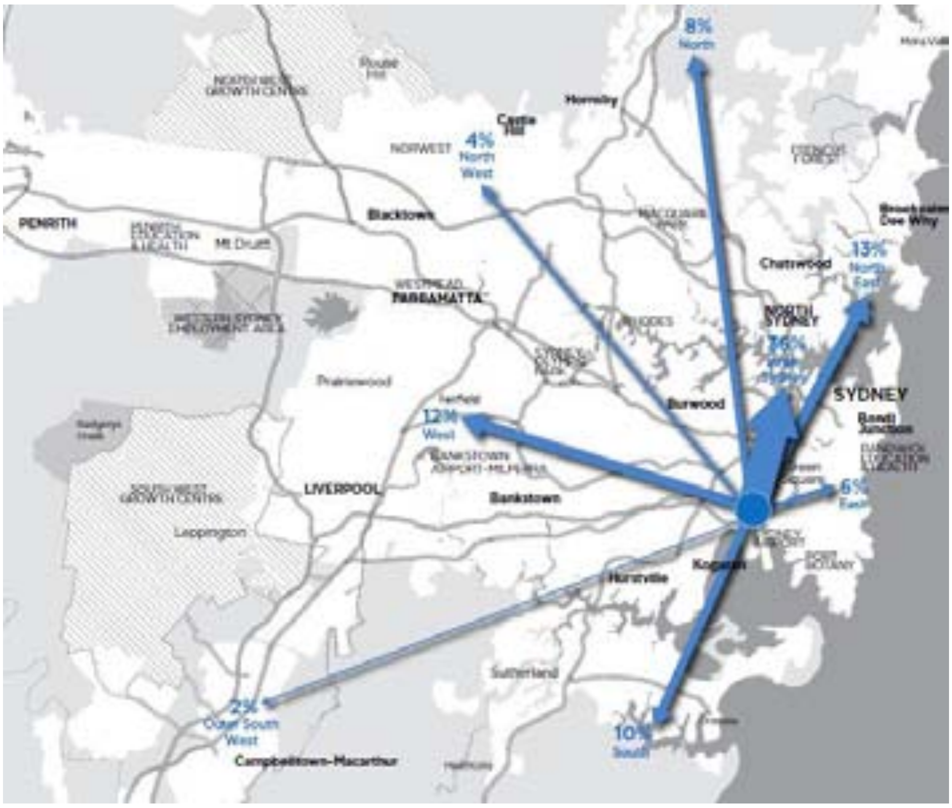


Figure 13 Distribution of employee trips to KSA (average weekday) (BTS Journey to Work data)

Figure 13 shows that a high proportion of employees (48%) live in areas south of the Airport (44.7% in Sydney South and 3.7% in the Illawarra region).[18]

It is estimated there are about 16,000 jobs located on the airport site with between 9,600 and 12,000 employees working on the site on an average day.[19] Some airport jobs are shift based with some commencing from 3am to meet the demand for aircraft arrivals at 6am and other shifts extending beyond midnight. These extended hours of operation present additional challenges to transport needs compared to those of a typical commercial centre particularly as start and finish times can fall outside the normal hours of public transport operation.

2.4. Forecast growth in air passengers

In 2009 SACL forecast that the number of passenger trips will reach 79 million per annum by 2029.[20] However, forecasts generated for the Joint Study by Booz and Company (Booz) for three alternative scenarios found that lower growth rates are more likely.

Transport for NSW has undertaken analysis on four scenarios, broadly reflecting the SACL and Booz and Company forecasts:

- High – the SACL forecasts incorporated in the 2009 Master Plan for Sydney Airport (4.8% per annum International and 3.9% per annum domestic)
- Medium – broadly reflecting the Booz & Company medium-term unconstrained forecast between 2010 and 2030, which assumes no limitations on movements per hour (approximately 4% International 3% domestic)
- Low – broadly consistent with the constrained growth profile forecast by Booz & Company, though beginning earlier than in that forecast (approximately 2.5% International and 2% Domestic)
- Upgauging only – a very low growth scenario assuming that growth at the airport can only occur by way of up-gauging or increases in passenger load per aircraft (approximately 1.4%)

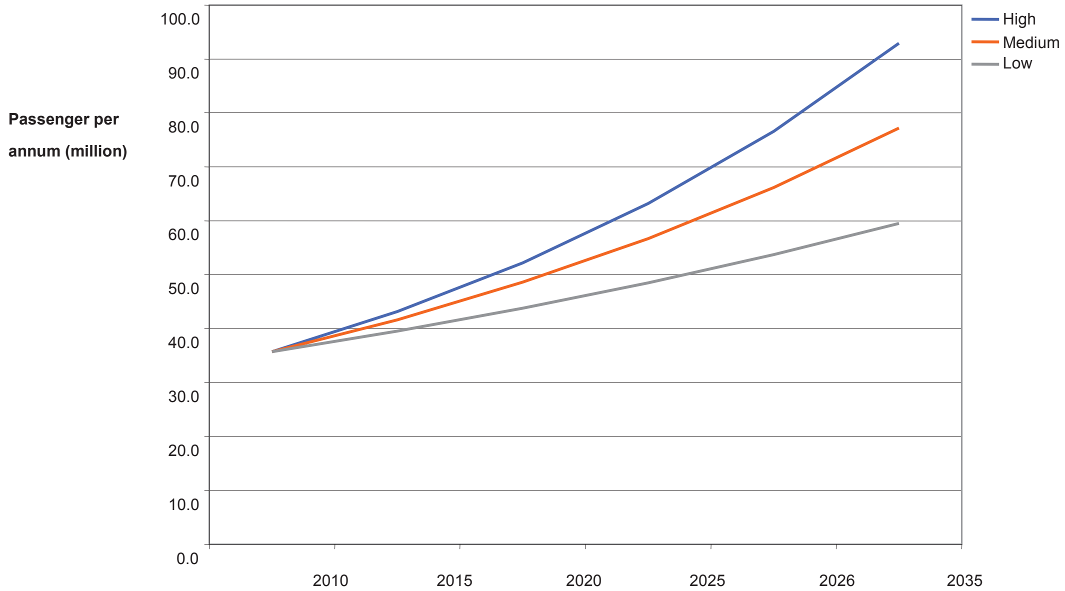
Figure 14 shows the growth under three of the scenarios. The upgauging only scenario is not shown as it only applies to the domestic terminal and in this report is only used for the purpose of assessing traffic constraints on domestic terminal access roads.

[18] BTS Journey to work data

[19] http://www.sydneyairport.com.au/corporate/community-environment-and-planning/ground-transport-information.aspx

[20] Sydney Airport Corporation Limited (2009) *Sydney Airport Master Plan 2009*

Figure 14 Passenger growth forecasts at Sydney Airport



The forecasts allow for:

- Peak spreading at Sydney (Kingsford-Smith) Airport at progressively higher levels of demand.
- Progressive loss of transfer/transit passengers to other major Australian airports associated with the strengthening of the international and domestic networks.

Historical trends in passenger growth are volatile and forecasting aviation activity is vulnerable to:

- Shocks such as economic events and natural disasters
- Long standing and recent changes to the aviation industry (examples include, the GFC, the demise of Ansett and the emergence of low cost carriers)
- Difficulties estimating in-bound International travel.

This volatility is illustrated in Table 7. In particular, the table highlights the impact of the GFC in 2008 and 2009 which resulted in much lower growth followed by much higher growth in 2010.

Table 7 Historical growth rates of air passengers, Sydney Airport

Year	International	Domestic
2006	3.7	4.9%
2007	5.2	6.5%
2008	1.7	4.1%
2009	0.8	-0.3%
2010	7.7	8.1%

Source: DOIT, 25 November 2011

For these reasons, it is important to recognise that no single forecast is definitive. Booz's work also highlighted several other factors that could impact upon forecast accuracy in the longer term, and carried out many sensitivity scenarios, modelling factors such as increases in carbon price, the impact of higher and lower air fares and the impact of higher and lower economic growth.

For the purpose of determining the distribution and road network performance impact of the forecast growth, the medium scenario was chosen for strategic travel modelling. It represents moderate growth compared to the other scenarios and avoids the risk of underestimating the impact of passenger growth on land transport that could occur if the constrained scenario was used. However, some of the analysis presented in this report also includes projections using higher and lower growth scenarios to illustrate the potential range of impacts given there is a range of possible scenarios.

2.5. *Impact of forecast passenger growth on road transport*

As a result of airport passenger growth, the number of vehicles per hour in and out of the airport precinct in the am peak is forecast to rise under high, medium and low scenarios as shown inTable 8. (The airport precinct is shown shaded in blue in Figure 15). Under a medium scenario, am peak traffic more than doubles between 2011 and 2036.

Table 8 Total AM peak traffic in and out of the airport precinct

Year	High	Medium	Low
2005	8,117	8,117	8,117
2011	10,196	9,838	9,088
2016	12,383	11,593	9,997
2021	15,089	13,706	11,008
2026	18,439	16,253	12,132
2031	22,588	19,326	13,383
2036	27,729	23,038	14,776

This analysis assumes no change in the mode of transport used to travel to and from the Airport. To arrive at these totals International and Domestic growth rates were applied to the

2005/06 base traffic and added to traffic counts at locations within the airport precinct to determine an overall road capacity requirement for the airport precinct in the am peak as follows:

- High: 17,500 vehicles or up to 9 lanes of additional motorway capacity
- Medium: 13,200 vehicles or up 6 lanes of motorway capacity
- Low: 5,700 vehicles per hour or up to 3 lanes of additional motorway capacity

3. *Capacity of land transport networks to meet demand*

3.1. The road network

The Airport is served by Southern Cross Drive to the CBD and the M5 East motorway to the west and south west (refer Figure 15). The M5 East carries a high volume of traffic and forms part of the Sydney Orbital. The M5 East is at or near capacity for large parts of the day and currently carries over 100,000 vehicles per day. Approximately ten per cent of trips are by heavy vehicles and the proportion of heavy vehicles can be higher during some parts of the day. The impact of heavy vehicle trips on capacity is high, particularly due to the steeper gradients in the west bound direction (for heavier trucks leaving Port Botany for example).

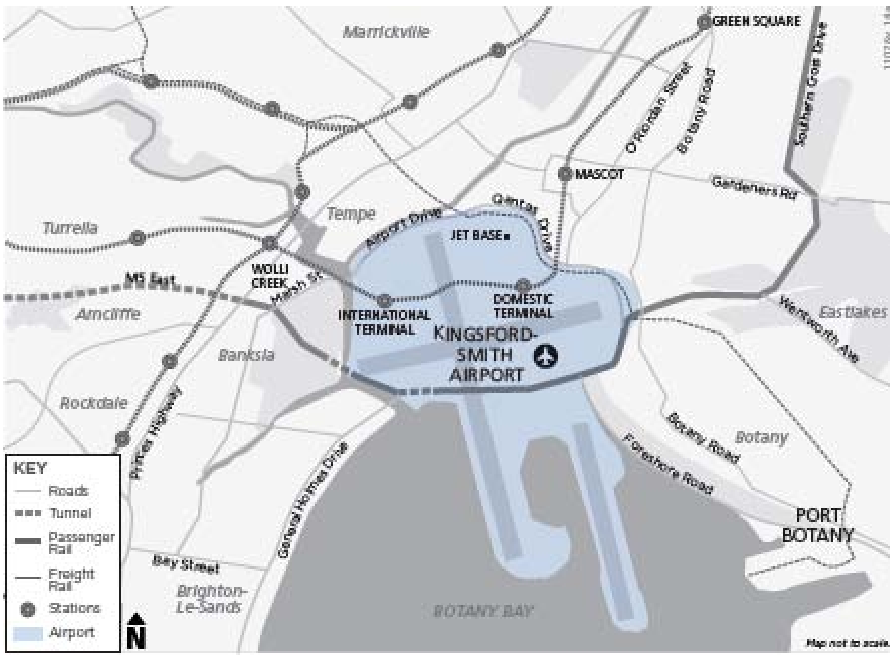
Peak hour tidal flow arrangements were implemented on General Holmes Drive with the opening of the M5 East. Despite this, the M5 East reaches capacity in the AM peak with congestion often continuing throughout the day. The high inter-peak demand on these roads implies that further opportunities to accommodate growth by peak spreading are limited compared to other land transport assets in Sydney.

The Eastern Distributor, Southern Cross Drive and General Holmes Drive provide access to and from the CBD, the north and the east. These roads are also prone to high levels of congestion, particularly in the am and pm peaks.

Other significant local roads are Marsh Street; the Princes Highway; Airport Drive (currently leased from the Commonwealth by SACL) which becomes Qantas Drive; O'Riordan Street; Botany Road; Joyce Drive; Wentworth Ave; Millpond Road.

The lease of Airport Drive to SACL means that investments to increase capacity on terminal approaches require strong collaboration between SACL and the NSW & Australian Governments.

Figure 15 Sydney airport local road network



3.1.1. Strategic Travel Modelling of traffic congestion in the Sydney Airport Precinct

TfNSW's Strategic Travel Model (STM) was used to compare the traffic congestion generated by trips to and from Sydney Airport against the impact of growth from other sources in the precinct, the corridor and road network generally.

In order to best assess the impacts of the Airport, adjustments were made to the STM to allow for its special attributes. An independent review of the methodology used by TfNSW confirmed that the best available data and methodology had been applied for this purpose. Further more detailed model development was recommended for further verification of the results.

3.1.2. Strategic Travel Model outputs

The Strategic Travel model was used to generate estimates of demand for the 2006 network as well as the 2016 network—the 2016 network is used as the base case for economic appraisal presented in Part 2 of this report and is assumed to include the road, rail and bus plans currently planned by the NSW Government to 2016.[21] The 2036 network demand is also shown although in this case it is assumed there are no major improvements to the road network between 2016 and 2036.

The percentage of airport trips on the network for the three time periods is shown in Table 9. The figures show that the share of airport trips on key roads in the precinct increases significantly over the period which is likely to force trips for other purposes onto alternative routes. In particular, the share of airport traffic south bound on O'Riordan Street reaches almost 100 per cent by 2036 and the share of northbound increases from 43.1 per cent in 2006 to 81.9 per cent in 2036 meaning trips for other purposes are forced onto different routes.

Table 9 Proportion of airport trips to general trips on selected roads in the airport precinct AM peak 7:00 to 9:00

	2006 infrastructure and land use		2016 infrastructure and land use		2036 land use and infrastructure	
North/south roads	North bound	South bound	North bound	South bound	North bound	South bound
Southern Cross Drive	10.9%	33.2%	13.4%	35.8%	21.5%	48.2%
General Holmes Drive Kyeemagh	2.0%	1.2%	2.7%	1.4%	6.2%	3.6%
Princes Highway	4.8%	13.7%	5.3%	15.1%	9.1%	27.1%
O'Riordan St	43.1%	87.2%	53.0%	88.2%	81.9%	99.3%

East/west roads	East bound	West bound	East bound	West bound	East bound	West bound
Foreshore Rd	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
General Holmes Drive tunnel	1.3%	1.4%	1.7%	5.9%	4.2%	24.2%
M5 East	12.6%	37.1%	15.4%	42.3%	25.5%	61.8%
Qantas/Airport Drive	42.0%	87.5%	51.7%	88.0%	86.0%	98.5%

Source: BTS STM request 11/372 (derived from BTS 11/019 and 11/119).

[21] These are the widening of the M5 East, M2 and Great Western Highway, an ongoing program of state road improvements and rail upgrades as part of construction of the South West Rail Link.

The increased traffic volumes will affect average speeds on key roads in the airport precinct.

Table 10 shows modelled speeds in 2006, 2016 and 2036 at key points in the road network. It shows speeds of less than 20 km per hour on key roads including O'Riordan St (which drops to less than10 km/hr), General Holmes Drive and the M5 East. The 2036 projections assume no change in infrastructure or travel mode from 2016, hence are theoretical outcomes in the unlikely scenario that nothing is changed.

Table 10 Average Link Speed (km/hr) AM Peak 7:00-9:00*

	2006 infrastructure and land use		2016 infrastructure and land use		2036 land use and 2016 infrastructure	
Road	North bound	South bound	North bound	South bound	North bound	South bound
Southern Cross Drive	31	53	28	49	23	41
General Holmes Drive Kyeemagh	23	39	22	38	20	34
Princes Highway	25	44	24	40	21	32
O'Riordan St	11	24	9	21	8	14
Road	East bound	West bound	East bound	West bound	East bound	West bound
Foreshore Rd	32	34	30	31	27	25
General Holmes Drive tunnel	17	42	16	38	14	29
M5 East	19	35	17	29	14	20
Qantas / Airport Drive	33	51	31	46	27	36

Source: BTS STM request 11/372 (derived from BTS 11/029 and 11/119)

* Average speeds shown are modelled speeds determined from volume delay functions in the RTA highway network.

Domestic Terminal loop - a 'pinch point'

The entrance to the Domestic Terminal loop road at the intersection of Airport / Qantas Drive, Joyce Drive and O'Riordan Street has been chosen as a critical trigger point to measure when land transport infrastructure could reach capacity under the three growth scenarios. This entrance was chosen over the International Terminal entrance as it is considered the most constrained and is forecast to experience the largest growth. However, this does not take into account the potential for the terminals to be reconfigured to be airline alliance based with international and domestic flights at all terminals, as proposed for consultation by SACL in December 2011, which potentially has the affect of spreading traffic volumes.

The domestic terminal loop road has an estimated capacity of approximately 3,000 vehicles per hour at the Domestic Terminal entrance. In 2011 this road has an estimated volume in the busiest period (7-9am) of 2,570/hour. The future point at which vehicle volumes growth reach 3,000/hour depends on a range of factors such as the rate of growth in airport passengers, any changes to volumes of vehicles associated with meeters and greeters and the extent of any mode shift to public transport.

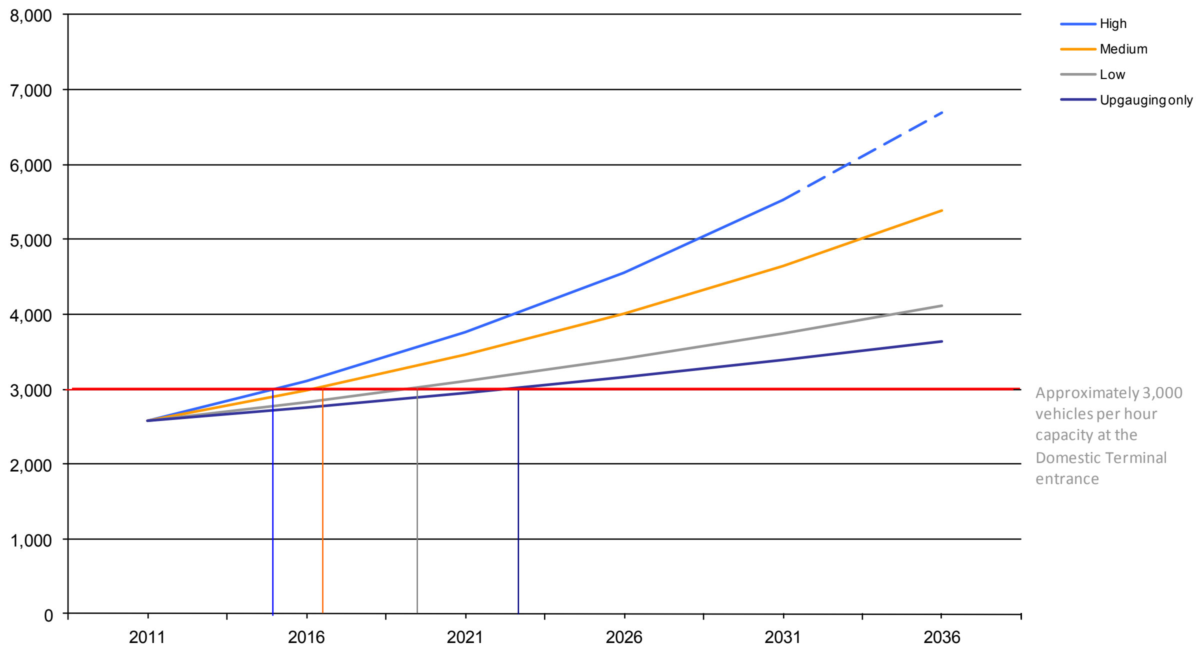
It is estimated this critical entrance will reach capacity in 2017 based on the medium passenger forecast scenario but as early as 2015 if the high scenario is used and 2023 if the upgauging only forecast is used. As the trigger point is reached, road users would experience extended delays and road congestion would directly impact passengers accessing domestic services via road based modes.

When the road reaches capacity, it is possible that congestion will result in a slowing in the growth rate of vehicles using the Domestic Terminal Loop during the AM peak as more people shift to using the train service or use the road at other times because of speed and reliability advantages.

Figure 16 shows the growth in demand for access to the Domestic Terminal roads (in bound only) compared to the road's 3,000 vehicle capacity.

Investments in capacity improvements on this road as well as measures that stimulate a mode shift to public transport are likely to be required within the next decade to enable efficient land transport access to Sydney airport's domestic terminals.

Figure 16 Domestic Terminal inbound traffic forecast 2011 to 2036 (AM peak 7:00 to 9:00)



3.2. *The rail network*

The CityRail network services Sydney's metropolitan and greater-metropolitan areas. It covers a geographically large area and has one of the most complex operating patterns of any train network in the world. Fifteen outer lines feed into eight inner lines which feed six CBD lines. Significant capacity constraints result from this convergence to six lines through the CBD.

The East Hills Line serves the Airport with trains originating from Macarthur or Revesby and passing through the Airport Rail Link Stations (International, Domestic, Mascot and Green Square), then travelling to the City circle (Museum, St James, Circular Quay, Wynyard and Town Hall), passing back through Central then proceeding west, some returning along the South Line to Campbelltown via Granville.

Figure 17 shows the simplified train paths on the CityRail network in the AM peak. Only the paths and directions of the CBD bound trains are shown, except where indicated for the City Circle. The number of trains per hour during the peak is indicated beside each line.

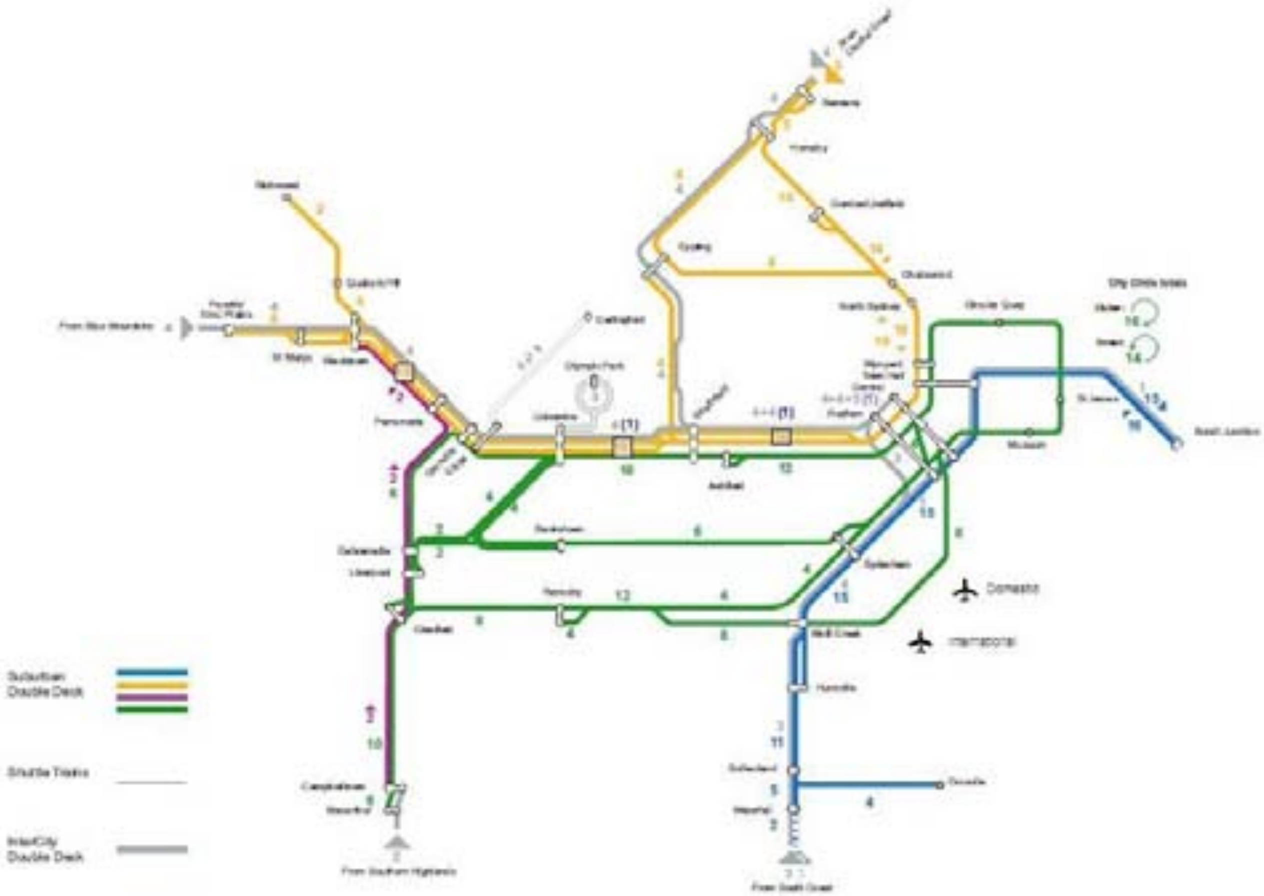
Rail services on the Airport Rail Link are highly integrated with the rest of the CityRail network. The Airport Rail Link is not a dedicated service but shares trains with the South Line, the East Hills Line and the Bankstown Line.

There are currently 8 trains per hour from the Airport to the CBD during the peak. Four originate in Macarthur and 4 originate in Revesby.

Theoretically, trains lines on the CityRail network have capacity for up to 20 trains an hour under current operating conditions. This capacity limit could only be reached on the Airport Rail Link with additional investment in infrastructure and modifications to the line. A key reason for this is that trains on this line operate in extended tunnels. Life and safety requirements mean a greater separation of trains is required in tunnels reducing the maximum frequency of trains per hour that could be achieved unless there were modifications to the tunnels. For example, more points of access may be needed in the case of a breakdown or emergency in a tunnel. Currently 8 trains per hour service the airport stations in the am peak (city bound).

The City Circle has capacity for 20 trains an hour in each direction and currently the 8 airport trains share this capacity with trains from Sydenham and Bankstown.

Figure 17 Simplified Train Paths on the CityRail network



* Note: this diagram represents the 2009 operating plan to be consistent with the modeling and capacity analysis conducted for this report rather than the most recent timetable.

3.2.1. The Airport Rail Link and Station Access Fee

The four Airport Rail Link stations are operated by a private service provider, the Airport Link Company. Passengers are charged a station access fee (in addition to the City Rail fare) to travel to and from the International and Domestic Terminal Stations. The station access fee was removed at Mascot and Green Square in March 2011. The station access fee is currently $11.80 for a single trip and is added to the standard CityRail fare. For example, CityRail charges a $4.00 fare from the CBD to the airport terminal stations. From the CBD the combined fare to either of the terminal stations is $15.80 as shown in Table 11. This creates a price disincentive for using rail compared to other transport modes. For example, the taxi fare for a group of two or more people travelling from the CBD to the Airport is likely to be cheaper.

Table 11: Rail fares for trips between the airport and Sydney's city stations

	CityRail	Station Access Fee	Single	Return	Weekly gate pass*
International	$4.00	$11.80	$15.80	$26.60	$18.00
Domestic	$4.00	$11.80	$15.80	$26.60	$18.00

* The $18 weekly gate pass can be purchased to complement any weekly CityRail ticket. For example a weekly ticket to Wolli Creek is $25 the equivalent airport ticket is $43.
Source: Airport Rail Link http://www.airportlink.com.au/price.php and "CityRail fare calculator" at http://www.cityrail.info/tickets/fare_calculator.htm

3.2.2. Available capacity on the airport rail link train services

When defining maximum rail capacity on any line in the CityRail network, the following general rules are applied:

- Maximum 20 trains per hour (three minutes must separate each train).
- Up to 900 seats per train (depending on rolling stock used).
- 18,000 seats per hour (900 seats on 20 trains with eight carriages).
- Total 24,000 persons per hour (total seated plus 300 standing passengers per train).

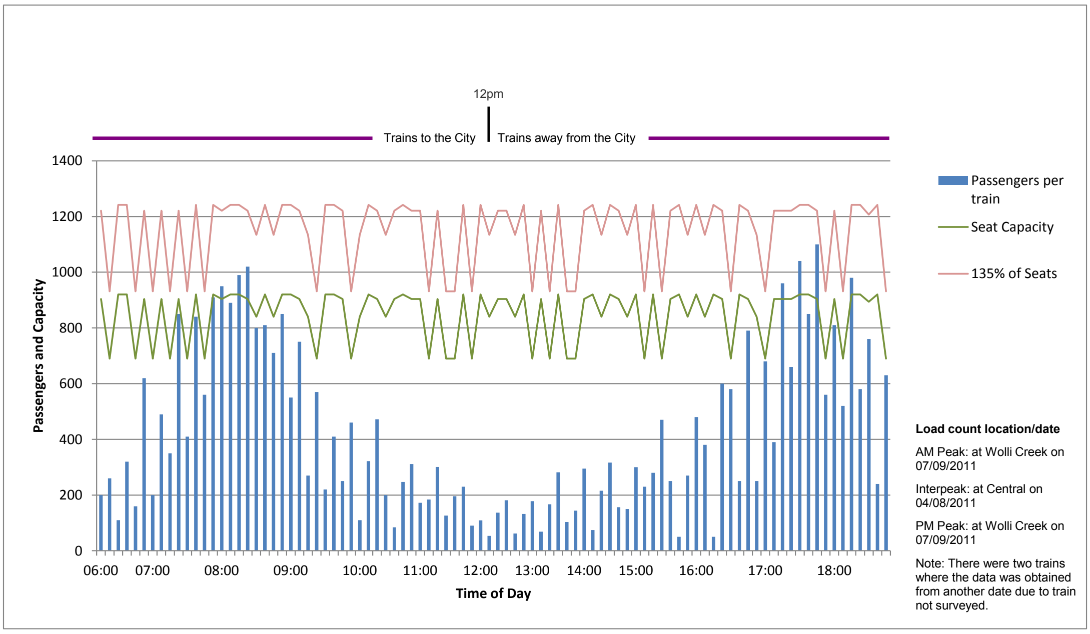
In practice, other considerations and constraints also apply including the constraints imposed as outer lines feed into fewer inner lines and life and safety requirements.

On any line during peak hour it is considered efficient to achieve line loadings of 110 per cent, rising to a limit of 135 per cent to make the best use of the infrastructure. This equates to 990 persons per train, which is considered optimal utilisation (110%). As the load approaches 1200 persons per train (135 per cent), conditions become sub-optimal (excessive crowding) and the three-minute frequency cannot be maintained due to the time taken at each station for passengers to board and alight the train. On an airport line, sub optimal conditions may be reached at a lower train load due to the additional passenger difficulties and delays brought about by luggage and unfamiliar surroundings.

Current train load studies indicate that trains originating from Macarthur approach 120 per cent capacity in the CBD bound direction for a short period of time during peak hour (between 7:30 and 8:30 am). Revesby starters operate with smaller loads during the am peak and throughout the day and provide the best opportunities for growth in the am peak for inbound (toward the CBD) airport passengers.

Figure 18 shows the capacity of each train service (seated and at 135 per cent of seating) and the loadings of each train. The zig zag patterns reflect the different capacity of six and eight car train sets and the different loadings of Macarthur and Revesby starters. Although none of the services exceed 135 per cent capacity, there are several in the morning and evening peaks that exceed seated capacity.

Figure 18 East Hills via Airport Line Train Loadings (6am to 7pm) by train

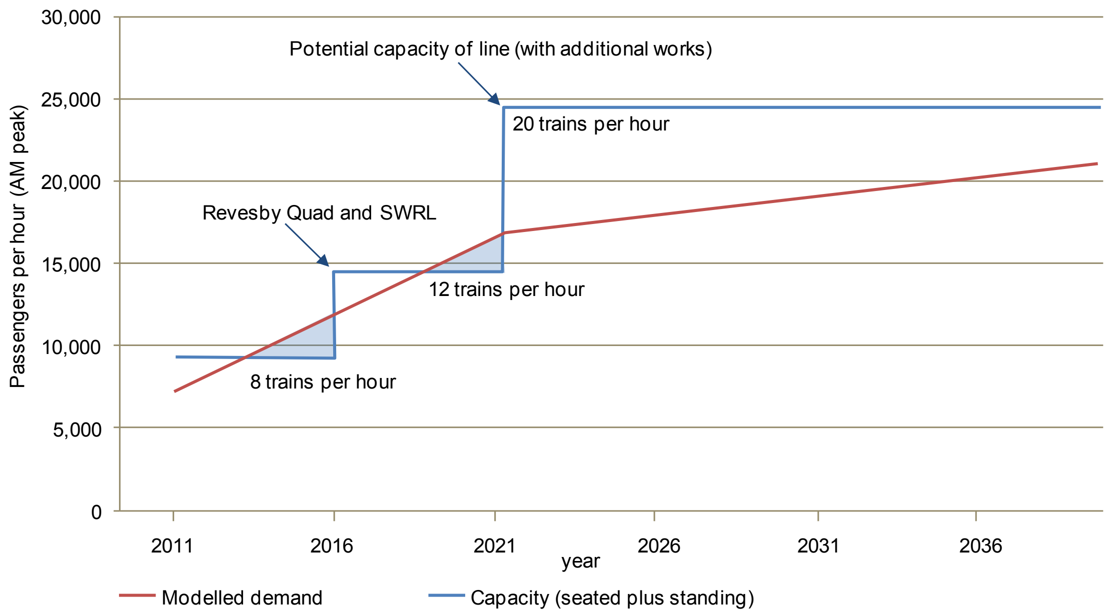


In the outbound direction (CBD to Airport) there is ample capacity for growth in the am peak.

A sequence of current rail projects including the Kingsgrove-Revesby quadruplication, completion of the South West Rail Link and construction of the Revesby turnback will provide capacity for additional services on this line. If additional rollingstock is allocated to the line, it is anticipated an additional 4 trains per hour in the peak will commence by 2016. This will temporarily relieve crowding in peak periods. However within several years of these extra services, further additional services will be required. This is shown in Figure 19. The potential capacity of 20 trains per line could only be reached with additional investments and as part of a plan for the whole network.

The NSW Government is developing a Long Term Transport Masterplan in 2012. Long term rail options for the Greater Sydney Metropolitan Areas will be considered as part of this plan and it is anticipated that these will seek to address capacity constraints across the network over the next 20 years. Overall, capacity of the line itself is not considered a constraint to increased use by passengers travelling to or from airport stations on the East Hills line if additional rollingstock and train paths are allocated to the line. There are greater constraints on other lines from which passengers may connect to travel to the airport.

Figure 19 Potential Airport Rail Link capacity compared to modelled demand in the am peak



3.2.3. Rail 'pinch point'

The inbound am peak 1 hour has been chosen as a trigger point for analysing the impacts of airport passenger growth on rail because the greatest constraints have been identified for services during this period.

A base case has been modelled assuming the current works will be complete by 2016 but that no further works or service changes occur beyond 2016. These current works include the completion of the South West Rail Link, Kingsgrove-Revesby quadruplication and construction of the Revesby turnback. It is also assumed additional rolling stock will be available to increase capacity by 50 per cent from eight to 12 trains per hour.

Table 12 Train capacity per hour to Sydney Airport assuming no change beyond 2016

Scenario	Passenger demand at Wolli Creek	Loading at Wolli Creek	Train paths via airport	Maximum capacity (seating plus standing)	Standing room capacity at international terminal (inbound)
2011 Base year	7,769	108%	8	9,600	1,831
2021 Do minimum	13,775	128%	12	14,400	625
2036 Do minimum	19,554	181%	12	14,400	-5,154

* note that all forecasts are for the 1 hour am peak, inbound.

Currently only 11 per cent of trips to Sydney Airport are by rail. Assuming a reasonable shift to rail over the next decade, even with the 50 per cent increase in capacity, by 2021 the Airport Rail Link CBD bound will again be full before it enters the Airport precinct in the AM peak hour due to the growth in demand along the south western segments of the rail corridor.

Under a do minimum case, by 2036 the forecast demand is well above the theoretical maximum capacity reaching 181 per cent. At this point overcrowding means trains cannot follow the timetable and passengers cannot safely enter and exit carriages at the Airport. There would also be a deterioration of service reliability upstream as people attempt to alight in the CBD.

As illustrated in Figure 19, the modelling results for 2011 and 2021 may also disguise periods within that decade where demand exceeds capacity. For example, if the Revesby Quadruplication opens in 2013 without new rolling stock, latent demand will not be met until 2016 when the South West Rail Link opens and additional services are added. There is a risk that if demand increases, the AM peak in bound trains will reach full capacity (seated and standing) before the new capacity can be released in 2016.

Despite this pinch point, ample capacity exists on the rail network at other periods of the day and in the CBD to Airport direction in the AM peak.

3.3. Road Based Public Transport

Road based public transport accounts for 39 per cent of trips to Kingsford Smith Airport.[22] Taxis account for 25 per cent of trips and the remaining 14 percent is made up of buses (4 per cent) and minibuses (10 per cent).

3.3.1. Public buses

There are two regular bus routes that service the airport; the 400 and the 410. However, only the 400 actually enters the terminals - the 410, which serves an almost identical route to the 400 only serves the Qantas Jet Base stop on the outer fringe of the precinct (refer Figure 15). The 400 has a frequency of 20 minutes in each direction over 17 hours, but road congestion, particularly within the terminals, often causes the 400 buses to cluster and run behind schedule.

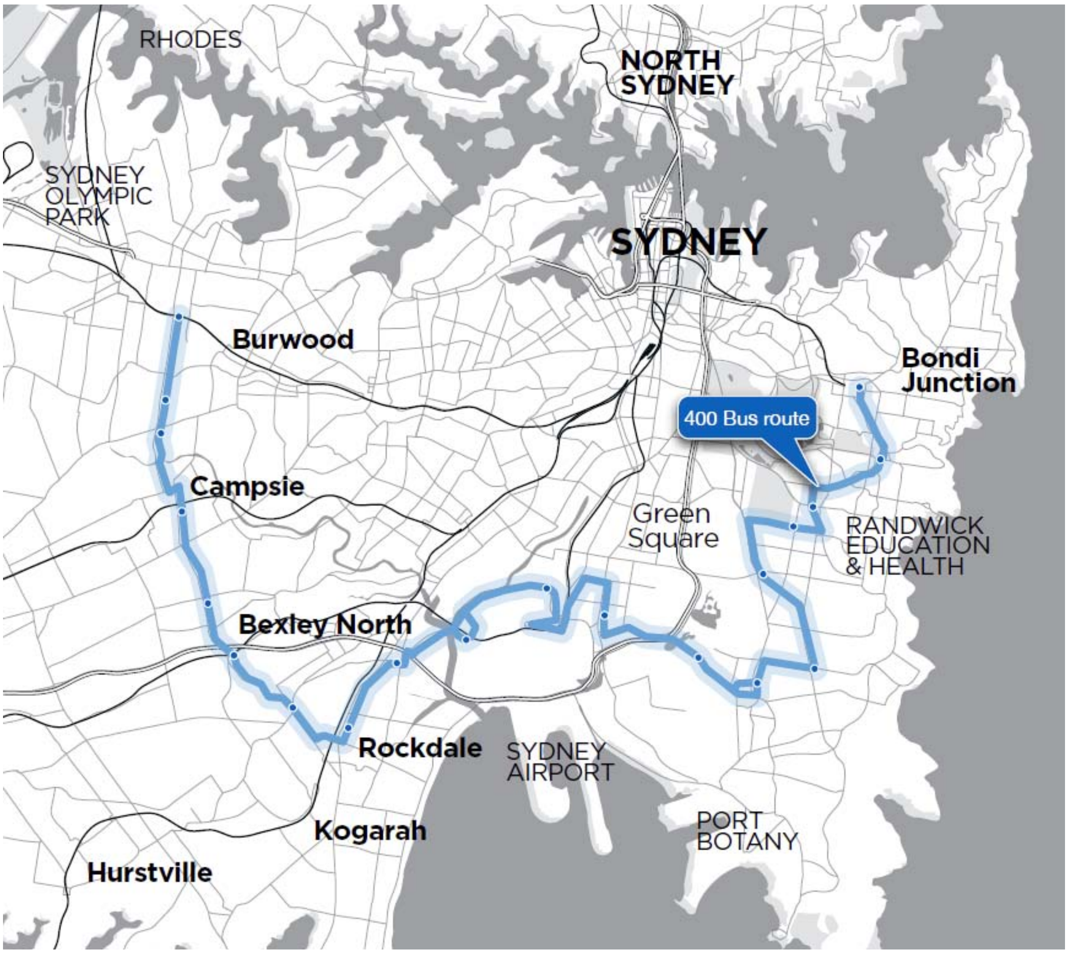
Figure 20 shows the route of the 400 bus which connects the two air terminals to five railways lines at Burwood, Campsie, Bexley North, Rockdale and Bondi Junction.

The 400 bus accounts for 4 per cent of all trips to the airport (but only 2 per cent of passenger trips). It carries a total of 5 million passengers per year but boarding counts indicate that demand at the Airport is only a small proportion of this total as there are many origins and destinations along this long route.

Contractual commitments with the operators of the Airport Rail Link can create a liability if new bus routes have the effect of reducing rail patronage to the Airport. Under the terms of the contract for the Airport Rail Link, the NSW Government is liable to compensate Airport Link Company for any material changes to the timing and level of Airport Link revenues and events that discriminate against it. These provisions are perceived to preclude measures to improve public bus services to the airport which may compete with the rail link unless compensation is paid. This liability would not be incurred if the contract was no longer in place.

[22] Sydney Airport Corporation Limited (2006).

Figure 20 400 bus route



3.3.2. Taxi trips

Taxis play an important and effective role in meeting the unique land transport task at Sydney airport. However, there are difficulties and constraints in the taxi system and there are limited opportunities for this mode to grow compared to other public transport modes at the airport in the long term.

Up to 300 taxis can be based in and around the airport daily and 25 per cent of all trips to and from the airport are by taxi, with 37 per cent of all passengers opting for taxi when heading to and from the airport. The large volumes of taxis in the terminals contribute to congestion within the airport precinct and there are often delays during peak periods.

SACL charges taxis a terminal entry fee of $3.50 which is passed on to the customer. Taxi pick up and drop off points are highly controlled to ensure pedestrian safety is not compromised by the very high movement of taxis into and out of the airport but the system of vehicle queuing can contribute to congestion.

Drop offs are affected less by congestion than pick ups. However, taxis must circulate through the airport to join the pick up queue to ensure operations and passenger safety at departure points are maintained at a high level. The impact of taxi circulation is particularly acute at the Domestic Terminal where space is limited.

SACL has made several improvements to taxi operations over the past decade. However, this mode is approaching optimum operating capacity, and often exceeds it and opportunities for growth are limited.

3.3.3. Mini buses

Mini buses make up the majority of bus services to Sydney Airport. Over 100 mini bus companies provide pre-booked services across Sydney, particularly the Northern Beaches, Newcastle and other centres with indirect public transport to the airport. Private sector bus fares range from approximately $14 (for a Central Station to Airport bus) to over $100 for a door to door outer suburban tourist service.

Mini buses are an attractive way to travel for some market segments as they provide a door to door service at a lower price than a taxi. Mini bus services generally are not very well advertised and, anecdotally, gain patronage by word of mouth. Trips made by mini buses account for 10 per cent of all trips to Sydney Airport.

Improvements to the marketing and accessibility of the mini bus services, and in consequence, demand for mini buses may assist in reducing congestion and delays for passengers and traffic impacts on the road network due to the use of private vehicles.

Mini buses provide for a high volume of trips in a simple and efficient demand based network that neatly complements the heavy rail network and taxi market. However, the activity of mini buses is not always positive as rogue traders can create a negative customer experience for passengers and/ or interfere with the efficient movement of other vehicles.

3.3.4. Hire cars

Hire cars include self driven short term hire cars and chauffer driven limousine style services. Pick up congestion (ie. at arrivals) is high, compared to the very low numbers of people moved by this mode. Vehicles are often double or triple parked while waiting for customers on the terminal roads as customers expect a door to door service.

3.4. Freight

Although the freight task at Sydney Airport is relatively small compared to the air passenger task, 50 per cent of Australia’s air freight is moved through Sydney Airport.[23] Further, the proximity of Port Botany is a critical factor affecting transport capacity to the airport.

3.4.1. Air freight at Sydney Airport

Sydney Airport handles 50 per cent of Australia's international air freight traffic and 30 per cent of domestic volumes as the primary point of arrival and departure. Transhipping, the transfer of goods from one aircraft to another, accounts for around 27 per cent of overall tonnage. Sydney Airport has the largest air freight task in Australia.

International air freight movements into and out of Sydney Airport represent a very low percentage of goods by weight, accounting for less than one per cent of total NSW imports and export volumes. Air freight also accounts for a very small proportion of distinct aircraft slots as most freight is moved in passenger aircraft belly holds rather than dedicated freight planes. However, these air freight movements have a very high value in monetary terms. In 2006 approximately $33 billion worth of products were transported between NSW and other countries via Sydney Airport.[24]

International airfreight movements are dominated by imports of high value consumer goods from many different parts of the world, and exports of food products to Asia. Although air

[23] Sydney Airport Corporation Limited (2009), *Sydney Airport Master Plan 2009*, p. 73.

[24] Sydney Airport Corporation Limited, 2009.

freight represents a very small proportion of Australia's trade by volume, it makes up over 20 per cent of trade by value, as air services are utilised to carry high value and time sensitive goods.

In the short term, the air freight sector is expected to take a number of years to recover from the 2008 financial downturn.[25] Over the long term, it has been estimated that international air freight volumes through Sydney airport will grow by 85 per cent, or an additional 480,000 tonnes from 2009 to 2029.[26]

SACL is currently developing a Freight Precinct (the Northern Lands). The new facilities will provide a total space of 209,000 square metres-more than three times the current capacity.

3.4.2. Port Botany and the Sydney freight network

Port Botany is Australia's second largest container port handling over 2.0 million containers in 2010-11 or one third of Australia's national container traffic.[27] Over the next 25 years, increases in population and consumption, and reduced local manufacturing, will continue to generate significant growth in freight, particularly in Sydney. Freight activity has been growing by 7 per cent per annum. Projections indicate that container volumes will increase to meet the 3.2 million tonne equivalent cap (set by the NSW Government) by 2018.

Port Botany operates 24 hours a day 7 days a week. Although truck trips occur over the 24 hour period, relatively more trips are made between 7 am and 9 am coinciding with the commuter peaks in the road network although the peak for freight trips is less pronounced than peaks for other types of trips.

Although assumptions about growth in truck trips to Port Botany have been included in the modelling (refer Table 5), analysis has focused on land transport serving the airport rather than broader needs including rail and road transport to the Port.

[25] OAG 2020 Air Cargo Forecasts.

[26] Sydney Airport Corporation Limited (2009), *Sydney Airport Master Plan 2009*, p. 73.

[27] NSW Government (2011), *Port Botany and Sydney Airport Transport Improvement Program – Submission to Infrastructure Australia*, November 2011.

PART 2

4. *Solution identification and assessment*

Part 1 of this report presents analysis that identifies the impacts of growth at Sydney Airport on the land transport network and canvasses the capacity for existing networks to absorb some growth as well as constraints to accommodating it. Despite availability of some capacity on roads in the short term and the potential for greater utilisation of rail, the analysis demonstrates that action is necessary to adequately meet future demand at Sydney Airport.

The purpose of Part 2 is to identify and assess possible options. The analysis is preliminary and in summary form. It draws on options and suggestions that have been made by a variety of stakeholders in the past and is not based on Government policy. It primarily provides direction for further detailed analysis rather than an integrated solution to accommodate the forecast growth in land transport demand.

4.1. *Overview of process*

Figure 21 is a high-level outline of the solution identification and assessment process.

Figure 21 Process for identifying and assessing land transport options

Option identification and assessment process		
1	IDENTIFY Apply ATC guidelines to consider range of options.	1. Do nothing. 2. Use existing transport systems more efficiently. 3. Modify or add to existing transport options. 4. Alter proposed transport task. 5. Other measures (technology, organistation, education).
2	ASSESS Apply 15 assessment criteria to all options.	Apply multi criteria analysis of all possible options. Consider aspects such as: different airport user requirements, applicability in short/medium/long term and broader transport network implications.
3	ASSESS Conduct cost benefit analysis.	Cost benefit analysis undertaken for options shortlisted in step 2.
4	ASSESS Include against other options.	Determine policy and funding implications of all options for recommended actions

4.1.1. *Steps 1 and 2*

Step 1 involved applying the Australian Transport Council (ATC) guidelines to generate a range of options including options in the following categories:

1. Do nothing/base case.

2. Use existing transport systems more efficiently (eg. reduce the price of rail to encourage mode shift).

3. Modify or add to existing transport options (eg. develop park and ride facilities).

4. Alter the proposed transport task (eg. reduce the number of meeter and greeter trips).

5. Other measures, such as technology, improve management of processes and systems, education (eg. marketing of public transport).

Step 2 involved applying 15 different assessment criteria to all options in a matrix style assessment. The criteria used for assessing each of the options were divided into the following six categories:

- airport user requirements ie. how an option would assist airport users access Sydney Airport
- impact on the broader transport network
- broader government objectives, eg. effect on public transport mode share and land use outcomes
- development implications
- impacts on local residents
- environment and heritage impacts.

A rapid, qualitative assessment was applied to the options identified in step 1 as a filter to refine the range of possible options to a list of 24. The 24 options are listed in Table 13.

Table 13 Options identified in step 1 of the Options Identification and Assessment Process

STEP 1 OPTIONS	
1	Removal of Station Access Fee (SAF) at international and domestic terminal stations
2	Removal of SAF from Sydney Airport staff monthly rail ticket
3	Check in points off airport for rail users
4	Airport precinct access charge
5	Installation of RTA live traffic cameras at international and domestic terminals
6	Increased Transport Management Centre Traffic Light Involvement in airport precinct
7	Parking Space Levy on parking within the airport precinct
8	Staff ride share information campaign
9	Transit Mall to facilitate better access to and greater use of minibuses and buses
10	Introduction of high occupancy vehicle lanes in the airport area
11	Bicycles provided to Sydney staff
12	Faster taxi loading and taxi multi-hiring in airport precinct
13	Increased rail services in the network
14	Pedestrian link from Martin Place to St James stations to facilitate improved access to airport rail services
15	Ecotransit light rail from CBD extending south past Sydney Airport

STEP 1 OPTIONS	
16	High Speed Rail from Sydney to Melbourne via Canberra
17	Sydney Airport Arterial Road Upgrades
18	M5 East Expansion
19	M4 Extension
20	Build/upgrade of the F6
21	Public Buses to Sydney Airport from St George/Sutherland area and from the North Shore
22	Park and Ride situated at railway stations close to Sydney Airport
23	Reduction of meeter and greeter trips by restricting curb side and air side access
24	Public Transport Customer Information Campaign

These were then assessed against 16 criteria related to the five categories which are listed in Table 14.

Table 14 Criteria applied in step 2 of the Options Identification and Assessment Process

STEP 2 CRITERIA	
	Airport user requirements
1	Reduction in travel time to/from Sydney Airport
2	Increase in reliability to/from Sydney Airport
3	Volume of airport user beneficiaries
	Impact on the broader network
4	Reduction of travel time in the network
5	Increase in reliability in the network
	Alignment with Government objectives
6	Effect on public transport mode share in Sydney
7	Transport efficiency in Sydney
8	Cleaner air and progress on greenhouse gas reductions
9	Land use outcomes
	Development implications
10	Development costs
11	Potential timing of options
12	Compatibility with airport business plans/other stakeholders
	Impact on local residents
13	Potential impact on existing residents and other land users as a result of land acquisition
14	Noise impacts
	Environment and heritage impacts
15	Environment and/or heritage impacts identified

Options were allocated a score of -5 to +5 compared to a base case which was assumed to have a score of 0 for each criterion. Some modelling and supporting information was developed to support the scores allocated to each option. Given the strategic nature of the assessment, most factors, in particular costs, were high level estimates and were only indicative.

Given the diversity of options considered in this process, each option was categorised based on the potential timing for implementation: immediate (0-1 year); short term (2-5 years); medium term (5-15 years) and long term (15+ years).

Scores were generated by summing each of the individual scores against each criterion. Options were then ranked in order (within each timeframe group) from the highest score to lowest score.

Table 15 Results of the multi-criteria analysis

Results – Ranking of Options					
Option timing	**Rank**	**Option no.**	**Option title**	**Total option score (unweighted excluding cost)**	**Estimated indicative cost**
Immediate (0-1 year)	1	2	Removal of Station Access Fee	14.5	$40 M pa
	2	25	Public Transport Customer Information Campaign	9.0	$1-3 M pa
	3	3	Removal of SAF from Sydney Airport staff monthly rail ticket	8.8	$2-3 M pa
	4	24	Reduce Meeters and Greeters trips	7.5	$1M capex, $0.5 M pa
	5	6	RTA live traffic cameras at international and domestic terminals	6.8	$0.5 M capex, $4-5 M pa
	6	9	Staff ride share information campaign	6.8	$0.5 M pa
	7	7	Increased Transport Management Centre traffic light involvement	6.0	$0.4 - $1 M pa
	8	12	Bicycles provided to Sydney Airport staff	3.8	$20 M capex, $0.5 M pa
Short term (2-5 years)	1	10	Transit Mall to facilitate better access to and greater use of minibuses/buses	8.5	$5-10 M capex, $5 M pa
	2	15	Pedestrian link from Martin Place to St James stations	8.5	$300-600 M capex, $10-15 M pa
	3	13	Faster Taxi Loading and taxi-multi-hiring	6.8	$5 M capex, $1 M pa
	4	22	Public buses to Sydney Airport	6.5	$8-10 M pa (less revenue)
	5	5	Airport precinct access charge	4.5	$5-10 M capex, $0.5-1 M pa
	6	18	Sydney Airport Arterial Road Upgrades	4.5	$700 M - $1 B capex
	7	23	Park and Ride	4.3	$100 M, $1M pa
	8	8	Parking Space Levy	4.0	$0.5 M pa
	9	4	Check in points off airport for rail users	2.3	$1.5 M capex, $1-5 M pa
Medium Term (5-15 years)	1	14	Increased rail services (network)	14.0	Funding to be determined

	2	20	M4 Extension	8.5	$9.9 B capex
	3	19	M5 East Expansion	6.0	$4.5 B capex
	4	11	Introduction of high occupancy vehicle lanes in the airport area	0.3	$5-10 M capex
Long term (15 + years)	1	17	High Speed Rail	5.0	$40-100 B capex
	2	16	Ecotransit light rail	3.0	$500 M capex
	3	21	Build/upgrade of F6	-1.5	$4 B capex

The higher ranked options in each of the timeframe groups were then selected for preliminary economic appraisal if data was available to support the analysis or in some cases for qualitative analysis.

The table below describes the decision process for determining if an option was to be taken to the preliminary cost benefit analysis stage.

Table 16 Decision process for determining whether an option was taken to the CBA Stage

Rank	Option Title	MCA Score (un-weighted excluding cost)*	To be evaluated at this stage of the process?	Preliminary CBA option reference in this report
Timing: Immediate (0-1 year)				
1	Removal of Station Access Fee (SAF) at international and domestic terminal stations	14.5	Yes - preliminary CBA results included in this report	A
2	Public Transport Customer Information Campaign	9.0	Yes - preliminary CBA results included in this report	B
3	Removal of SAF from airport workers monthly rail ticket	8.8	Yes - Note: not examined separately as included in preliminary CBA of option A	-
4	Reduction of "Meeter and Greeter" trips by restricting curb side and air side access	7.5	No - increased use of parking facilities currently being considered / implemented by SACL	-
5	Installation of "RTA live" traffic cameras at international and domestic terminals	6.8	Yes - option likely to provide benefits for precinct but not significantly improve capacity. Qualitative evaluation only provided as part of this report	-
6	Staff Ride Share Information Campaign	6.8	No - not considered further because of low ranking amongst immediate options	-
7	Increased Transport Management Centre Traffic Light Involvement at airport precinct	6.0	No - consultation with SACL revealed that this is being undertaken already	-
8	Bicycles provided to Sydney Airport Staff	3.8	No - not considered further because of low MCA score	-
Timing: Short Term (2-5 years)				
1	Transit Mall to facilitate better access to and greater use of minibuses/buses	8.5	Yes - preliminary CBA results included in this report	C
2	Pedestrian Link from Martin Place to St James Station to facilitate CBD access to airport line services	8.5	Yes - preliminary CBA results included in this report	E

Rank	Option Title	MCA Score (un-weighted excluding cost)*	To be evaluated at this stage of the process?	Preliminary CBA option reference in this report
3	Faster Taxi Loading and taxi multi-hiring in airport precinct	6.8	No - unable to be considered in the short term due to the split deck between arrivals and departures. SACL is considering a new carpark structure for taxis in the long term.	-
4	Public Buses to Sydney Airport from St George/Sutherland area and from the North Shore	6.5	Yes - preliminary CBA results included in this report	D
5	Airport precinct access charge	4.5	No - Could be considered as a funding method but not considered further as part of this study	-
6	Sydney Airport Arterial Road Upgrades	4.5	Yes – qualitative evaluation only as part of this report. Further traffic analysis of these options are currently being undertaken. Initial indications are these works provide short-term capacity enhancements but are not sufficient to accommodate future traffic growth.	-
7	Park and Ride to be situated at railway station close to KSA	4.3	No - not considered further because of low MCA score	-
8	Parking Space Levy on parking within the airport	4.0	No - Could be considered as a funding method but not considered further as part of this study	-
9	Check in points off airport for rail users - Central Station	2.3	No - not considered further because of low MCA score	-
Timing: Medium Term (5-15 years)				
1	Increased Rail Services in the network	14.0	Yes - Being evaluated separately by Transport for NSW as part of the Long Term Transport Master Plan.	-
2	M4 Extension	8.5	Yes - Roads and Traffic Authority (RTA/RMS) have undertaken CBA of both of these projects separate to this study. This report includes qualitative evaluation of RTA/RMS modelling results as they apply to airport users	-
3	M5 East Expansion	6.0		-
4	Introduction of high occupancy vehicle lanes in the airport precinct	0.3	No - Not to be evaluated separately as part of this study, although may be considered as part of KSA Arterial Road Upgrades	-
Timing: Long Term (15+ years)				
1	High Speed Rail from Sydney to Melbourne via Canberra	5.0	Long term options are likely to be considered beyond KSA transport option analysis and will not be assessed further as part of this study	-
2	Ecotransit light rail from CBD extending south past KSA	3.0		-
3	Build/upgrade of the F6	-1.5		-

* Multi-criteria analysis involves assessing the options using criteria to score and rank them.The criteria used in the multi-criteria analysis are listed in Table 14

Figure 22 sets out the options that were identified for further analysis in each timeframe.

Figure 22 Groups of options

Options

Immediate	Short term	Medium term	Long term
A. Removal of SAF	C. Transit mall	M4 extension*	Increased rail services in the network
Staff rail tickets	D. Public buses to KSA	M5 east upgrade*	
B. PT info campaign	E. CBD pedestrian link to St James		Options below the line were assessed qualitatively at this stage of the process as costs and benefits could not be accurately estimated
"PTA Live" cameras at terminals		KSA arterial road upgrades	
Removal of M5 Cashback**			

Other options which did not proceed to the preliminary CBA stage

6- 12 month implementation list	2 - 5 year implementation list	5- 15 year implementation list	15+ year implementation list
Reduce meet and greet trips Increased TMC involvement. Bicycles for KSA staff. Staff ride share.	Cityrail Park and Ride Parking Space Levy. Off site luggage check in. Faster taxi loading and muitihiring. Airport precinct cordon charge.	Airport transit lanes.	Construction of F6 Motorway. *Subject of independent studies:* High speed rail. Ecotransit light rail.

*For expediency and consistency with other studies the network wide BCRs have been reported for major works
**Identified for consideration after MCA stage

SACL was consulted at this stage to ensure all available data and advice was captured, and recent developments at the airport (for example number plate recognition for public passenger vehicles) could be taken into consideration.

4.1.2. Step 3

Step 3 was a preliminary cost benefit analysis of shortlisted options including assessment of the groups of options by their timeframe. This analysis was the basis of the results presented as part of step 4.

Each of the options assessed are described in the following sections.

Limited qualitative analysis of Sydney Airport arterial road upgrades was also undertaken and additional analysis is currently being undertaken by RMS separately to this study which will rely on airport precinct specific modelling.

5. Results of analysis

5.1. Improved public transport pricing and information (immediate term options)

The immediate term options subject to preliminary cost benefit analysis were:

- Option A - Removal of the Airport Rail Link Station access fee
- Option B - Public transport information campaign

5.1.1. Option A - Removal of the airport Rail Link Station Access Fee

The assumptions for this option are that the Station Access Fee (SAF) is removed from the domestic and international terminal railway stations for all commuters, and the price paid by consumers for all tickets is aligned to CityRail system wide fares. This could be achieved in a number of ways that need to be further explored. In particular, identification of a funding source to meet the large cost of the option is necessary. One alternative is highlighted below.

It is expected that this option would encourage a mode shift to rail among all market segments due to the demand response caused by the relative price reduction of rail as a mode of travel to and from Sydney Airport. The response is anticipated to be greater for the single and day return trip market segments given these segments would benefit from a proportionately much greater reduction in fare compared to those who use weekly tickets and because these segments account for a much greater proportion of total trips to the airport.

One of the possible mechanisms for funding this measure is the development of a "product" for airport customers, similar to Showlink and other special event travel passes. Based on estimates of the cost of removing the SAF, a levy of approximately $1 on all air tickets to fund "free" public transport for air passengers could be considered. The benefits for air passengers would be two fold depending on their mode preference:

1. “Free” public transport to and from the airport on the day their boarding pass is valid and
2. Reduced road congestion for those who continue to drive or catch a taxi.

As growth in patronage would be related to growth in airport activity there is less risk of costs escalating as patronage grows. Airport employees already benefit from a significantly reduced surcharge on their weekly tickets (they pay an $18 surcharge on a weekly ticket compared to the $11.80 charge on a single ticket which is $1.80 per trip if they make 5 return journeys to the airport each week).

The mechanism, if successfully implemented could provide an opportunity to remove the surcharge altogether at no substantive cost to government and provide greater choice for airport customers.

The source of funding for removal of the SAF is not relevant to the results of the economic appraisal presented in this report although it would be important to identify sources of funds before deciding to support this option.

5.1.2. Option B - Public transport information campaign

The development and roll-out of a customer information campaign for public transport services to and from the airport would be a complementary and inexpensive way of encouraging a shift to bus and rail. The main focus of the campaign would be customer information about Airport Link services to the airport following the introduction of Option A

(SAF removal), with the possibility to extend it to information about public bus services and private minibus services in later years.

It is assumed that this option will increase awareness among all market segments of the availability and operation of public transport services to and from the airport, and act primarily to create a mode shift towards rail.

5.2. Improved customer experience for bus users and pedestrians (short term options)

The short term options are three distinct products.

- Option C – provision of Transit Malls for at the international and domestic terminals to improve accessibility and attractiveness of use of higher occupancy vehicles - bus, minibus and taxis
- Option D - Additional public bus routes servicing the airport from St George Sutherland and the Lower North Shore
- Option E - Pedestrian Link from Martin Place to St James to facilitate easier access to airport link train services from across the CBD.

In addition, a number of arterial road projects have been identified in and around the precinct that could increase capacity at some pinch points.

5.2.1. Option C - Transit mall

A transit mall at both the domestic and international terminals would provide space for bus, mini-bus and taxi passengers to depart from the airport using higher occupancy vehicles. This option involves converting a level of car parking between the two Domestic Terminals above the existing Airport Rail Link pedestrian link.

Analysis has shown that domestic terminal roads will reach capacity within a decade. Greater use of high occupancy vehicles would reduce terminal congestion.

Features could include:

- Safe efficient centralised spaces for vehicles to assemble to collect passengers.
- Real time information boards for customers on departure time, destinations served and price
- Applications and products (such as smart phone or info booths) to facilitate on demand shuttle bus services to popular destinations
- An sms or text service to inform passengers when mini buses are departing
- Customer service booths to assist passengers access the optimum mode for their trip

Taxis would continue to have a significant role at the airport. The transit malls provide greater recognition to and support the mini bus market. Amendments to the NSW Passenger Transport Act may be necessary for this option to be successfully implemented.

5.2.2. Option D - Additional public buses

Two areas were identified as sources of demand for additional bus services:

- St George/Sutherland.
- Lower North Shore.

St George/Sutherland and other southern suburbs have the highest proportion of airport employees.[28] The latent demand for bus services directly to the airport was modelled based on extending the existing 477 service by 8.5 kilometres from Rockdale station to the airport terminals, within a route that complements the existing rail line. Costs of stabling were assumed to be carried within the existing depots.

Of the two metro bus style services that connect the north shore line to the southern suburbs, the M20 from Gore Hill to Botany Public School was chosen over the M30 Spit Junction to Sydenham as the test route as it was considered more likely to be attractive to potential passengers. The extension of this service involves rerouting the bus away from Botany and into the Domestic then International Terminal.

5.2.3. Option E – Underground pedestrian Link from Martin Place to the Airport Rail Link (St James)

This option involves constructing an underground pedestrian link of up to 300 metres to improve access between St James and Martin Place Stations in the CBD (refer Figure 23).

This would enable easier access for passengers from more central parts of the CBD to connect to direct services to the airport line at St James.

Direct trains to the Airport operate around the City Circle line in a clockwise direction. Access to services is available at Town Hall, Wynyard, Circular Quay, St James and Museum Stations as well as Central.

Town Hall and Wynyard Stations are likely places for many people to access the Airport Line stations because they are the busiest CBD station, and because there is a significant network of underground pedestrian links to their entrances. Catching a train from Town Hall to the Airport involves travelling away from the Airport around the link and adds over 10 minutes to the trip. An alternative is to travel to Central and change services which may be quicker but less convenient. For these reasons, taxis may be favoured by some passengers.

It is not feasible to route Airport line trains to operate counter-clockwise, as this would have major impacts across the CityRail network.

St James is a better place to access Airport Line services without the need to travel around the City Circle. It is close to the retail core around Pitt St but also close to the Government quarter on Macquarie St and the southern end of the finance cluster. However, St James is a less used station, being only on the City Circle (Town Hall is on the Main West-North Shore and Eastern Suburbs-Illawarra Lines as well as the City Circle.) It is also comparably harder to access, having limited direct pedestrian links, limited at grade access, and fewer entrances to the station.

An underground pedestrian link between St James and Martin Place would eliminate many intersections. An entrance at Martin Place could provide a collection point for Airport passengers in this area of higher density CBD employment and central to many large hotels.

The tunnel would also enable easier access for passengers on the Eastern Suburbs Line to connect to direct services to the Airport Line at St James.

Other beneficiaries would be commuters travelling to and from the CBD on the Airport and East Hills and Bankstown Lines. They may be able to alight at St James and be able to walk more directly to their place of employment. The tunnel could also more generally contribute to improved pedestrian connectivity in the CBD.

[28] Sydney Airport Corporation Limited 2008, *Airport Ground Travel Plan*.

Figure 23 CBD Pedestrian Link

5.2.4. Short term options for arterial roads

The short term options for Sydney Airport's arterial roads are a combination of projects outlined in the Sydney Airport Masterplan and works identified by Roads and Maritime Services.

These projects do not provide sufficient capacity to accommodate the projected road traffic demand in the airport precinct in the medium to long term but provide additional capacity to relieve existing pinch points around the airport precinct. The benefits of these projects in the long term are limited by other network constraints. The majority of these projects while being defined as 'minor works' are relatively expensive to build and have an estimated cost of between $700 million to $1 billion dollars. In the event that the M5 East Expansion and/or the M4 Extension proceed, some of these projects will be vital to ensure the motorways connect smoothly with the airport precinct while others may be considered redundant.

This option has not been included in the preliminary CBA appraisal partly because the benefits are short to medium term and not suited to the 30 year appraisal period. However the Roads and Maritime Services are currently developing a network model for the Sydney Airport and Port Botany Precinct (and surrounding network) that will better allow for analysis of the effects of these projects in light of increased traffic generation from Sydney Airport and Port Botany and help to prioritise them. A first cut of the results of this analysis is expected in March/April 2012 with more detailed modelling work to follow. The projects are outlined below.

Projects described in the SACL Masterplan 2009:

Sydney Domestic Terminal access upgrade: This would involve partial grade separation of the right turn movement from Sir Reginald Ansett Drive to remove the constraint of short phasing at the intersection with Joyce Drive.

However, Roads and Maritime Service's view is that this intersection would benefit from full grade separation between Joyce Drive and O'Riordan Street. Domestic Terminal access is heavily capacity constrained and requires significant upgrade to ensure future demands to the Domestic Terminal Precinct can be accommodated. Full grade separation would have the potential to improve travel time from the Sydney CBD to the Domestic and International terminals.

Airport Drive / Qantas Drive widening: This would involve widening the section of Airport Drive and Qantas Drive east of Marsh Street through to O'Riordan Street to six lanes (three lanes each way).

This would increase the capacity between the domestic and international terminals. Earlier analysis has shown an increasing proportion of road users in this area will be making airport related trips. These changes mean the capacity of the existing road will be exceeded at critical locations without additional capacity.

Joyce Drive widening: This involves widening Joyce Drive between O'Riordan Street and Mill Pond Road to three lanes in each direction to continue the traffic flow from Qantas Drive and alleviate congestion. Similar to Airport Drive / Qantas Drive, Joyce Drive is forecast to carry an increasing proportion of airport related traffic and its capacity will be exceeded at critical locations.

Mill Pond Road widening: Mill Pond Road could be widened from two lanes to three lanes to increase the capacity of movements from General Holmes Drive to Botany Road via Mill Pond Road. This pinch point has also been identified as a possible site for an additional bus priority lane. Mill Pond Road provides a critical access route between the CBD and Sydney Airport. The interaction of airport related and other traffic in this area is forecast to cause significant congestion. Widening at this location provides some relief.

Projects proposed by Roads and Maritime Services

Wickham Street deviation: This involves realignment of Wickham Street to connect Forest Road to Marsh Street. The work should address the traffic queues extending through and beyond the intersections of Wickham, Marsh and West Botany Streets.

The current alignment involves a dog-leg arrangement that results in generally poor operation. Conversion to a regular four-way intersection is likely to improve the operation of this intersection. This improvement does however need to be considered in conjunction with any works involving the M5 East given its proximity to the M5 East's on/off ramps.

O'Riordan Street widening: As one of the major links connecting directly into the domestic terminal, O'Riordan Street is near capacity. It has been proposed to widen O'Riordan Street to six lanes (three lanes in each direction) from Botany rail bridge to north of Bourke Road. A minimum of one north bound lane is required to relieve the traffic out of the airport's domestic terminal for the interim solution. The existing rail bridge over O'Riordan Street would also require widening to accommodate the additional lanes.

O'Riordan Street is a critical pinch point in the Domestic Terminal precinct. Queuing on O'Riordon Street can impact both ingress and egress from the Domestic Terminal and additional lanes would provide some relief. O'Riordan Street also provides an important route for port vehicles travelling north-west.

Marsh Street widening from M5 East to International Terminal: This would involve widening Marsh Street to three lanes each direction to provide continuity for traffic flow from Airport Drive.

The widening of Marsh Street is primarily driven by the potential development at Cooks Cove, however improvements on Marsh Street in combination with the intersection improvement proposed at Wickham Street and widening of Airport Drive / Qantas Drive provides an improved access route to the airport from the west.

5.3. Improved road connections to the airport (medium term options)

Two medium term major road projects would provide improved road connections to the Airport and the additional motorway lanes needed to meet increased demand.

The M4 Extension is a motorway connection from the eastern end of the M4 at North Strathfield to the western outskirts of the Sydney CBD and then to the Airport-Port precinct. Most of the route would be via twin tube tunnel.

The M5 East Expansion involves widening the M5 East Freeway between King Georges Road and Bexley Road and constructing new lanes beside the existing M5 East tunnel (four lanes each way) and improved access from the M5 East tunnel to the North.

Both Motorway projects are currently the subject of study by the RTA and full cost benefit analysis has already been carried out. This work was not duplicated and the results of the existing work are summarised in later sections. However, travel time savings for airport customers were modelled for the purpose of this report.

5.4. Improved rail connections to the airport (long term option)

Additional capacity on the airport line is expected in 2016 with an extra 4 trains in the 1 hour am peak when services commence on the South West Rail Link assuming additional rollingstock is allocated to the line. There is capacity on this line for additional services to be added although wider network considerations come into play and some additional works would be needed to achieve the maximum of 20 services per hour under current operating conditions.

As part of developing a Long Term Transport Master Plan for NSW, options for the CityRail Network will be developed and assessed – some draft options are under development.[29] A network wide approach is necessary because of the interdependencies of operations and to achieve the greatest network wide benefits. Analysis of long term options for rail is outside the scope of the high level analysis in this report. However, it does not preclude heavy rail from being a significant part of the long term solution for addressing land transport constraints on access to the airport.

5.5. Results of preliminary economic appraisal

The five options (excluding the motorway projects that have been separately assessed) were assessed and compared to a base case which comprised the road, rail and bus plans currently planned by the NSW government to 2016. These include:

- Widening of the M5 West
- Widening of the M2 (already commenced)
- Widening of the Great Western Highway
- Ongoing program of state road improvements (such as the pinch point program on the Princes Highway)
- Rail upgrades as part of the South West Rail Link, including the Kingsgrove to Revesby rail quadruplication
- Removal of the station access fee at the airport terminal stations at the end of 2030 when the concession held by the Airport Link Company is due to expire.

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[29] See Transport for NSW (2011) *Rail options for the Sydney Greater Metropolitan area – Draft options paper*, November 2011.

5.5.1. Immediate term options

The results of the preliminary analysis indicate that both immediate term options—removing the SAF and a Public Transport Information Campaign—have BCRs greater than 1.0 (refer Table 17). However, more detailed analysis is needed to confirm this. For example, this rapid appraisal does not include the possible costs associated with the need for additional rollingstock and train services in the am peak earlier than currently scheduled (2016). Further, it is difficult to predict the growth in patronage given the attributes of the airport market and the proportionately high reduction in fares.

Two additional scenarios were also tested to determine the impact of a partial rather than full reduction of the station access fee (SAF). Although these have a lower BCR (that is, they result in proportionately less benefits than full removal), it may be more affordable to implement partial reduction. Full removal has the greatest decongestion benefits.

Although removal of the SAF has a net economic benefit, there are considerable financial costs for some parties depending on how it is achieved. Over the 30 year period of the appraisal, the total cost is estimated to be just under $600 million in net present value terms in 2011 dollars (and without accounting for possible fare increases in prices over time). This is based on high level preliminary analysis and much more detailed analysis is needed to determine an accurate estimate. Most of the benefit (about two thirds) is estimated to accrue to existing passengers who will enjoy a substantially reduced fare despite no change in behaviour. A smaller proportion of the benefit, just over 10 per cent, is from the effects of decongestion and just under 10 per cent would accrue to new users of the train services.

Figure 24 illustrates the impact of the immediate term options of removing the SAF and implementing the public transport information campaign on vehicle trip demand into the Domestic Terminal loop road. In year one, 3,500 trips are estimated to shift from road to rail on an average weekday and could push back the point at which the loop road reaches capacity by about one year under a medium growth scenario. However, this shift in the pinch point on the road network may result in bringing forward the point at which capacity on peak rail services is exceeded with associated additional costs of additional rollingstock and operating additional services which have not been incorporated in this analysis.

Figure 24 Capacity of the domestic terminal in-bound road with implementation of immediate term options

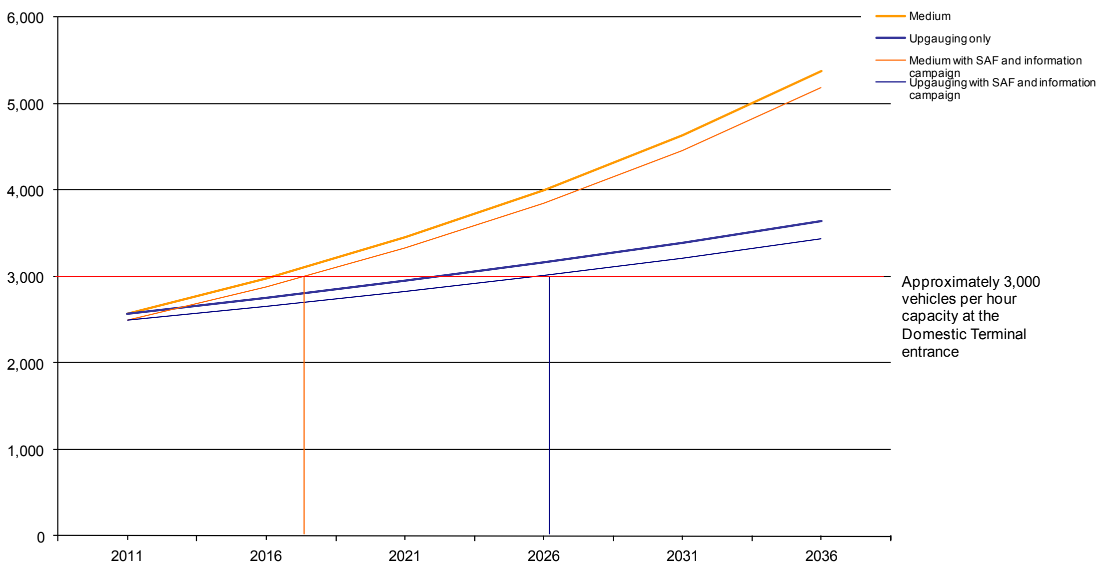


Table 17 Preliminary economic appraisal results for immediate term options, $m

	Option A (i) 100% Removal of SAF	*Option A (ii) 75% Removal of SAF*	*Option A (iii) 50% Removal of SAF*	*Option B: Public Transport Information Campaign*	*Option A (100% SAF Removal) + Option B*
Costs					
Upfront costs	538	403	269	0	538
Recurrent costs	44	44	44	8	54
Total Costs	582	447	313	8	591
Benefits					
GTC savings (existing users)	538	403	269	0	538
GTC savings (new users)	78	39	15	5	88
Fare revenue	59	39	21	29	75
Decongestion	89	60	37	5	100
VOCs	28	19	12	2	32
Externalities	23	16	10	1	26
Residual value	0	0	0	0	0
Total Benefits	815	575	363	42	859
NPV	**233**	**128**	**50**	**34**	**268**
BCR	**1.4**	**1.3**	**1.2**	**5.2**	**1.5**

Note: Positive values indicate incremental benefits. Present values are determined using a 7.0% discount rate with all costs and benefits discounted to 2010/11 (FY11) and with all values expressed in March 2011 prices. Totals may not sum due to rounding within the model.

5.5.2. *Short term options*

The results for the short term options are based on the assumption that neither of the immediate options (A and B) is implemented.

Apart from the CBD pedestrian link, all of the options that were subject to economic appraisal have a BCR greater than 1.0. The pedestrian link has a high upfront capital cost and only the benefits for airport users of the link were captured in this analysis. However, the capital cost estimates are uncertain and it does have the potential to generate benefits for a wider group of users, not just airport users. For example, through relieving congestion at Town Hall and Central stations and improving the interchange experience for all users. There is insufficient data available to reliably assess the wider benefits. However, the option may merit further analysis in a broader context, for example, CBD access analysis.

Other less expensive options could be to improve way finding and signage for Martin Place and installing covered, pedestrian friendly connectors on the surface streets within the St James to Martin Place precinct.

Table 18 Preliminary economic appraisal results – short term options, $m

	Option C: Transit Mall	Option D(i): Public Bus Airport - St George / Sutherland	Option D(ii): Public Bus Airport - Lower North Shore	Option E: CBD Pedestrian Link	Option C + Option Di + Option Dii
Costs					
Upfront costs	7	1	2	281	10
Recurrent costs	60	9	12	30	80
Total Costs	67	10	13	311	90
Benefits					
GTC savings (existing users)	56	0	0	12	56
GTC savings (new users)	1	3	3	0.1	7
Fare revenue	4	6	6	10	17
Decongestion	5	7	5	2	17
VOCs	2	3	3	1	7
Externalities	1	1	0	1	3
Residual value	0	0	0	22	0
Total Benefits	69	20	18	48	107
NPV	**2**	**10**	**5**	**-263**	**17**
BCR	**1.0**	**2.0**	**1.3**	**0.2**	**1.2**

Note: Positive values indicate incremental benefits. Present values are determined using a 7.0% discount rate with all costs and benefits discounted to 2010/11 (FY11) and with all values expressed in March 2011 prices. Totals may not sum due to rounding within the model.

5.5.3. Mode shift results of options A to E

The following tables summarise the estimated mode shift benefits (shifting from car and tax to rail or bus) of the immediate and short term options on an average weekday.

These show that the greatest shifts are achieved by the removal or reduction of the SAF – a reduction of 8,399 cars and taxis per day by 2036 relative to the base case. This reduction is for an average day rather than a peak period reduction and needs to be considered in the context of the 13,200 additional vehicle trips forecast per hour in the am peak. It is estimated removal of the SAF would result in an increase of approximately 35-70 people per train in the peak am hour (280 to 560 people per hour).

Despite the mode shifts generated by these options, overall they are a relatively small contribution to accommodating increased demand and if implemented need to be part of a larger, integrated package of road and rail solutions (as proposed in the 2011 NSW submission to Infrastructure Australia on the *Port Botany and Sydney Airport Transport Improvement Program*).

Table 19 Option A (100% SAF removal) –vehicle trips (car and taxi) to rail

Option	2011	2016	2021	2026	2031	2036
Base Case	12,890	15,441	18,192	21,127	23,912	24,694
Option A	16,243	19,723	23,512	27,816	31,766	33,093
Difference	3,353	4,282	5,320	6,690	7,854	8,399
% change	**26%**	**28%**	**29%**	**32%**	**33%**	**34%**

Table 20 Option A (75% SAF removal) – vehicle trips (car and taxi) to rail

Option	2011	2016	2021	2026	2031	2036
Base Case	12,890	15,441	18,192	21,127	23,912	24,694
Option A	15,066	18,249	21,722	25,522	29,072	30,200
Difference	2,176	2,808	3,529	4,396	5,160	5,506
% change	**17%**	**18%**	**19%**	**21%**	**22%**	**22%**

Table 21 Option A (50% SAF removal) – vehicle trips (car and taxi) to rail

Option	2011	2016	2021	2026	2031	2036
Base Case	12,890	15,441	18,192	21,127	23,912	24,694
Option A	14,209	17,134	20,313	23,754	26,993	27,977
Difference	1,319	1,693	2,121	2,627	3,082	3,283
% change	**10%**	**11%**	**12%**	**12%**	**13%**	**13%**

Table 22 Option B (Public information campaign) – vehicle trips (car and taxi) to rail

Option	2011	2016	2021	2026	2031	2036
Base Case	12,890	15,441	18,192	21,127	23,912	24,694
Option B	13,157	15,777	18,611	21,643	24,518	25,340
Difference	267	336	419	516	606	646
% change	**2%**	**2%**	**2%**	**2%**	**3%**	**3%**

Table 23 Option C (Transit Mall) – vehicle Trips (car and taxi) to bus

Option	2011	2016	2021	2026	2031	2036
Base Case	1,259	1,301	1,361	1,419	1,478	1,539
Option C	1,283	1,325	1,387	1,447	1,508	1,572
Difference	23	25	26	28	30	32
% change	**2%**	**2%**	**2%**	**2%**	**2%**	**2%**

Table 24 Option D (Public bus extension (south)) – vehicle trips (car and taxi) to bus

Option	2011	2016	2021	2026	2031	2036
Base Case	0	0	0	0	0	0
Option D(i)	411	523	588	643	700	768

Table 25 Option D (Public bus extension (north)) – vehicle trips (car and taxi) to bus

Option	2011	2016	2021	2026	2031	2036
Base Case	0	0	0	0	0	0
Option D(ii)	618	633	688	723	775	850

Table 26 Option E (St James to Martin Place underground pedestrian link) - vehicle trips taxi to rail

Option	2011	2016	2021	2026	2031	2036
Base Case	12,890	15,441	18,192	21,127	23,912	24,694
Option A	13,034	15,617	18,410	21,393	24,223	25,027
Difference	144	176	218	266	312	333
% change	**1%**	**1%**	**1%**	**1%**	**1%**	**1%**

5.5.4. Preliminary economic appraisal results: medium term options

Separate analysis provided by the RTA (see Table 27) shows that both the M5 East Expansion and M4 Extension have BCRs of 1.5 and 3.3 respectively. In both cases, this is primarily driven by travel time savings that result from the increased capacity on these motorways.

Table 27 CBA Results – medium term options, $m

	M5 East Expansion (un-tolled)	M4 Extension
Total Costs	**3,600**	**7,600**
Benefits		
Travel Time Savings	5,800	24,500
Vehicle Operating Cost Savings	-140	370
Accident Cost Savings	80	220
Environmental Externalities	-80	150
Total Benefits	**5,600**	**25,300**
NPV	**2,000**	**17,700**
BCR	**1.5**	**3.3**

Source: RTA (2008) M4 Extension – Preliminary Economic Evaluation, RTA (2009) M5 Expansion – Preliminary Economic Evaluation.

Table 28 shows trips along the M5 would have improved travel times of up to five minutes from suburbs such as Bankstown, Cabramatta and Liverpool. The M5 West widening project is forecast to be completed by 2016 and will also result in travel time improvements on this corridor. However, these were not included in the analysis as budget has been committed to this project and hence it forms part of the base case.

Trips along the M4 would have improved travel times of up to 30 minutes from the inner west and west from suburbs such as Burwood, Parramatta and Westmead.

Trips from the North Shore, while not directly impacted by the new road infrastructure, could decrease by up to 2 minutes because of network wide easing of traffic to the Airport, and a reduction of traffic on Southern Cross Drive. Many smaller, local streets of Sydney's Inner West will experience general benefits due to the removal of through traffic.

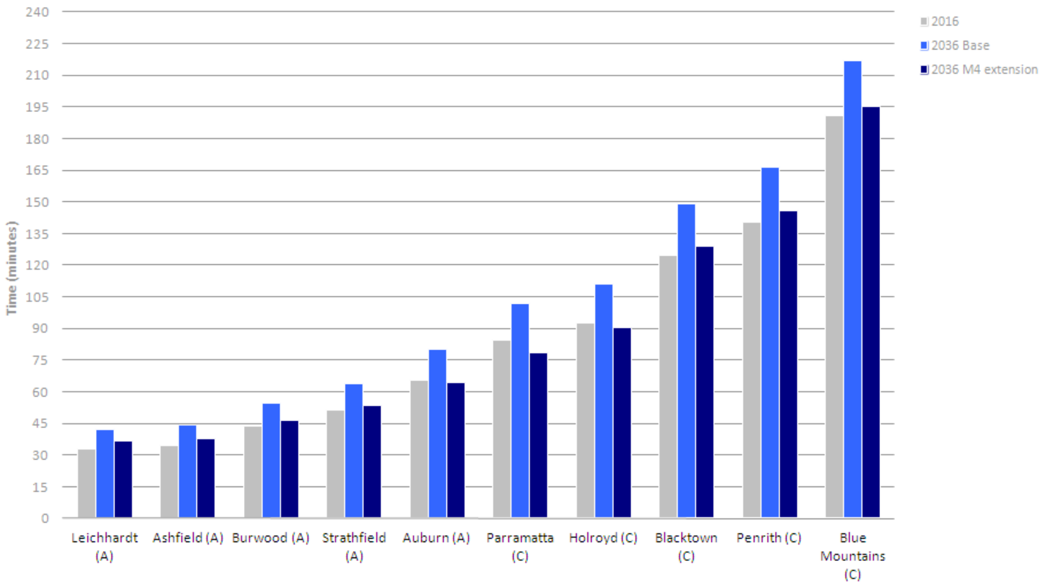
Table 28 Summary of travel time savings from the M4, M5 and future connection to the F6*

Travel time savings with new infrastructure			
From suburbs to KSA	**2036 travel time savings (AM peak)**		
	Minimum	Maximum	Average
South West Bankstown, Bankstown Airport, Cabramatta, Prairiewood, Liverpool, Campbelltown, Leppington	3.4%	7.2%	4.7% (up to 5 minutes)
Inner West and West Burwood, Olympic Park, Parramatta, Westmead, Penrith, Blacktown, Mt Druitt	4.4%	38.0%	22.2% (up to 30 minutes)
North Shore St Leonard's, Chatswood, Macquarie Park, Hornsby, Castle Hill, Norwest, Rouse Hill, Brookvale	0.8%	7.3%	1.5% (up to 2 minutes)

* Refer to the Modelling Report CTP September 2011, BTS Reference 11119, May 2011

Figure 25 illustrates the travel time savings achieved by the M4 extension for trips to Sydney Airport during the AM peak. The effect in 2036 is that the M4 Extension restores travel times to 2016 levels and reduces trip times to below 2016 levels for some local Government areas. The M4 Extension is assumed to be delivered between 2016 and 2021 under this option.

Figure 25 Travel time savings for trip to airport by Local Government Area of Origin (2016 to 2036)



Appendix A Additional options considered

In addition to the options considered for the rapid appraisal, other general and specific options were discussed but not taken to the rapid cost benefit analysis phases. These are outlined below.

Re-directing train paths at Central Station: Various suggestions were made about providing more direct rail services to the airport (from the North Shore Line and Illawarra Line for example). The cost of these changes were seen as prohibitive from the perspective of serving the airport only (users on these lines can now interchange at Wolli Creek and on the City Circle). Options for the rail network will be considered as part of the NSW Long Term Transport Master Plan development process.

Light rail: Two main corridors were originally considered for inclusion in the assessment.

- North south corridor (Airport to City centre)
- East West corridor (similar to 400 bus, but connecting to Dulwich Hill extension and Sydenham Station)

Since the commencement of the Aviation Capacity Study the NSW Government has initiated a major study of light rail corridors for Sydney and Light Rail options for the South-Eastern Suburbs of Sydney and these options will be assessed as part of that work.

Additional long distance bus services, including buses that utilise the motorway network: An effective bus network is currently being provided by several smaller, private sector shuttle bus companies. The marketing, promotion and efficient back-loading of these services could be improved from a customer experience point of view by the transit mall option.

Doody St Station/Kingsgrove Station/Additional City Circle station: Although it is acknowledged that additional stations add value to the local areas they serve, these options, from an airport perspective, do not improve capacity and increase travel time for other users of the corridor. Options like these may provide additional interchange opportunities and therefore relieve other congested stations. Interchange congestion relief from new stations comes at a high capital cost and creates an ongoing time penalty to other users.

***Various park and ride options*:** Park and ride options are difficult to assess in terms of the cost (including upfront capital and local traffic and amenity impacts) and congestion relief benefits on the road and rail network.

High speed rail: The high proportion of domestic travel for aviation trips in the Sydney region provides opportunities to meet the aviation growth market with High Speed Rail services between Melbourne, Canberra, Sydney and Brisbane. High Speed rail has the potential to free up existing airspace capacity for the growing international market between Asia and the East coast of Australia.

Airspace requirements to support regular passenger transport operations at Bankstown Airport

C3

JOINT STUDY ON AVIATION CAPACITY FOR THE SYDNEY REGION

AIRSERVICES AUSTRALIA

AIRSPACE REQUIREMENTS TO SUPPORT REGULAR PASSENGER TRANSPORT OPERATIONS AT BANKSTOWN AIRPORT

Executive Summary

As part of a joint Commonwealth and NSW State Government initiative to develop an Aviation Strategic Plan for the Sydney region, Airservices Australia has been requested to undertake analysis in relation to aviation capacity in the Sydney region. Specifically, the tasks undertaken in this report include:

- An analysis of airspace and air traffic management feasibility and requirements regarding the development of Bankstown airport to accommodate Regular Public Transport operations; and

- An analysis of the effect of the development of Bankstown airport on Sydney airport operations.

This report is not intended for circulation beyond the Department of Infrastructure and Transport and the Joint Study Steering Committee.

Airservices provides no warranty or guarantee as to the accuracy or completeness of this report. Readers should rely on their own enquiries and seek independent advice.

Airservices makes no representation, warranty or guarantee concerning any findings in this report. Any findings are to be treated as indicative only, and based on Airservices limited role in the overall study.

This report represents the view of Airservices and not the view of any individual person.

Assumptions

A number of assumptions have been applied in developing the analysis. Specifically, it should be noted that, for Sydney airport, the currently legislated cap of 80 aircraft movements per hour and the aerodrome curfew between the hours of 2300 and 0600 local time remain and that, for Bankstown airport, the current alignment of runways remains and the runways and taxiways are suitable for the proposed traffic.

This report should be considered in conjunction with the demand/capacity findings contained in the Airservices Report on Capacity at Sydney (Kingsford Smith) Airport. In particular, the analysis in this report assumes available capacity at Sydney airport is maintained at 80 movements per hour. This capacity is reliant on weather conditions supporting current procedures to 80 per hour or future all-weather capability at Sydney.

It should be noted that any development of Bankstown to accommodate Regular Public Transport operations is assumed to require the relocation of General Aviation operations. The commercial implications of moving General Aviation operations from Bankstown to another location are unclear to Airservices.

Similarly, the costs of associated infrastructure such as aircraft parking and maintenance, terminals, fuel facilities and transport links are unclear to Airservices.

The key assumptions applied in this report are:

1) That the currently legislated cap of 80 aircraft movements per hour is maintained at Sydney (Kingsford-Smith) Airport.
2) The Long Term Operating Plan continues to be applied at Sydney (Kingsford-Smith) Airport.
3) The current runway alignment is maintained at Bankstown aerodrome.
4) Airline operator utilisation would be regional service airlines[1] and other high performance turbo-prop RPT services, including such services to, and from Canberra, which currently utilise Sydney airport.
5) The traffic volume, aircraft type mix and schedules are applied from current Sydney schedules.
6) Jet aircraft operations are not relocated from Sydney to Bankstown.
7) High performance turbo-prop RPT operations are relocated from Sydney to Bankstown.
8) Emergency and State aircraft are excluded from the analysis.
9) Bankstown aerodrome would not operate as a general aviation facility.
10) The current aerodrome infrastructure and airspace design is altered to accommodate high performance turbo-prop RPT operations.

Exclusions

This analysis is limited to considerations of airspace and air traffic management and the airside facilities supporting those considerations. Matters such as airport terminal and apron development and consumer market research have not been analysed within this report.

Key Findings

The key findings of the analysis to date include:

1. Any significant variation in aviation activity at Bankstown will necessitate a review of LTOP.

[1] ***regional service*** means an air service operating wholly within New South Wales *(Slot Management Scheme 1998)*.

2. The proximity of Bankstown airport to Sydney (Kingsford-Smith) Airport precludes the segregated operation of RPT jet traffic from both airports.
3. The analysis concludes that RPT jet aircraft operations are not viable at Bankstown and unlikely to be made suitable.
4. The most viable option for Bankstown is the establishment of the aerodrome as a regional hub servicing Sydney (Kingsford-Smith) Airport with appropriate connections between the two airports.
5. Current airline schedules indicate approximately 220 Regular Public Transport (RPT) turbo-prop movements occur at Sydney (Kingsford-Smith) Airport daily.
6. Current daily traffic levels at Bankstown average 900 movements in winter and 1100 movements in summer with movements in excess of 1400 on peak days.
7. The current airspace classification and control zone dimensions do not support a combination of high density general aviation traffic and significant RPT turbo-prop movements.
8. The feasibility of Bankstown airport as a secondary RPT hub in the Sydney basin will require the relocation of general aviation traffic to another airport.
9. Any development of Bankstown airport to support high performance RPT turbo-prop aircraft operations must also support the maintenance of capacity and efficiency of Sydney (Kingsford-Smith) Airport.
10. Current Bankstown control zone dimensions will not contain high performance turbo-prop aircraft.
11. Any development of Bankstown aerodrome as an additional RPT airport would have an effect on Sydney (Kingsford-Smith) Airport operations, requiring airspace redesign:
    a. The Bankstown Control Zone reclassified airspace Class C and controlled by the Sydney Terminal Control Unit as an integrated airspace operating plan.
    b. The Class G airspace in the immediate vicinity of Bankstown reclassified as airspace Class E also controlled by the Sydney Terminal Control Unit.
12. Runway dimensions and associated lighting require assessment against aircraft operational requirements.
13. An upgrade of approach navigation facilities will be required to facilitate as close to all-weather operations as possible.

14. The proximity of military restricted airspace requires assessment against aircraft operational requirements for airborne manoeuvring to the southeast of Bankstown.
15. Any significant increase in traffic on the northern airways servicing Bankstown will require a redesign of military airspace northwest of Sydney.
16. The transfer of approximately 220 aircraft from Sydney to Bankstown will have the following immediate effects:

    a. The realisation of up to 10 extra movement slots at Sydney airport in peak traffic hours.
    b. The expansion of the available hours for the operation of LTOP noise sharing modes of operation.
    c. The increased availability of noise sharing departure tracks in all hours, excluding curfew.

17. The transfer of high performance turbo-prop aircraft from Sydney to Bankstown will establish a homogeneous aircraft fleet mix at both airports, thereby facilitating flightpath flexibility for enhanced noise sharing.
18. A variation to LTOP Modes 12 and 14A arrival tracks will be required to integrate operations at both airports.
19. A variation to LTOP Modes 7, 8 and 13 departure tracks will be required to integrate operations at both airports.
20. The transfer of high performance turbo-prop aircraft from Sydney to Bankstown will facilitate the selection of LTOP noise sharing modes of operation up 2025, based on projected growth at 2% forecast per annum average for scheduled movements[2].

[2] Sydney Airport Master Plan 2009

CAGR supplied by Booz&Co indicates a more conservative figure of 1.8% to 2020, reducing to 1.3% between 2020 and 2030.

Airspace and air traffic management feasibility and requirements

Aircraft

Current:

Bankstown Airport accommodates between 800 and 1200 aircraft movements per day on the majority of days, with aircraft movements on a few peak days exceeding 1,400 movements. Approximately 260 aircraft are permanently located on the airport.

The majority of aircraft, 68 per cent, operating at Bankstown Airport are single-engine piston aircraft. These aircraft are typically engaged in flying training, private flying and related activities.

Twin-engine piston aircraft are the second largest category at 21.9 per cent.

A further 8.2 per cent of aircraft are turbo-prop aircraft, typically involved in flying training, as well as charter, business/corporate and other aerial work activities.

Rotary aircraft account for 1.4 per cent, typically involved in charter or freight activity.

The remainder, at 0.4 per cent, typically includes regional jet, military and overseas registered aircraft.[3]

Future:

The study assumes that Bankstown would become a regional service aerodrome for the Sydney region.

The Sydney airport movement schedule for a typical weekday[4] contains approximately 110 regional service departures and a similar number of arrivals. These movements are predominantly operated by Qantaslink, Regional Express, Brindabella and Aeropelican, servicing NSW destinations.

Airspace and Facilities

1. Runway Dimensions and Facilities

Runway dimensions and associated navigation and lighting facilities will require assessment against aircraft and air traffic management requirements.

[3] Data sourced from Bankstown Airport Master Plan

[4] Sample day, 12th of November 2010

The main runway, 29C/11C, is 1416 metres in length, 30 metres in width and equipped with a Visual Approach Slope Indicator System (PAPI), Low Intensity Runway Lights (LIRL) and Runway Threshold Identification Lights (LTIL).

Runway 29R/11L is 1100 metres in length, 30 metres in width and equipped with Low Intensity Runway Lights (LIRL).

Runway 29L/11R is 1038 metres in length, 23 metres in width and is not equipped with permanent lighting.

2. Runway and Airspace Separation Standards

At Class D aerodromes, simultaneous, independent, same direction operations on parallel runways are permitted if the runway centrelines are at least 150m apart.

The runway centreline spacing between the runways at Bankstown is 106m. This spacing requires ATC to broadcast traffic information to all affected aircraft conducting parallel runway operations.

The Class D airspace model also requires full separation of IFR aircraft. It is assumed that RPT traffic will retain IFR status for the entire flight. In a constrained control zone such as Bankstown, this will require the airspace to be clear of traffic for each IFR movement – a one in, one out concept.

This model, assessed against the projected increase in IFR movements indicates that general aviation activities would be problematic from an air traffic management perspective and, most probably, unviable from a general aviation business perspective.

3. Navigation Aids

A Non-Directional Beacon (NDB) is the only navigation aid located at Bankstown. The Sydney Distance Measuring Equipment (DME) beacon is utilised to support some instrument approaches.

4. Instrument Approaches

Bankstown is serviced by 4 instrument approaches:

- RWY 11C NDB (using Sydney DME), cloud base minimum 680’, runway aligned approach.
- NDB-A, cloud base minimum 940’, not runway aligned, for visual circling to the runway.
- NDB-C, cloud base minimum 940’, not runway aligned, for visual circling to the runway.
- RNAV (GNSS) 11C cloud base minimum 680’, satellite based, runway aligned approach.

To limit the incidence of aircraft diversions to Sydney or other alternate aerodromes, an upgrade of approach navigation facilities will be required to facilitate as close to all-weather operations as is possible. This would involve the installation of Instrument Landing Systems (ILS) or precision satellite based procedures such as RNP or GLS and an associated upgrade to runway and taxiway lighting facilities (e.g. HIAL and HIRL).

5. Radar Coverage

Airservices is planning to install a permanent Mode S radar site at Cecil Park, approximately 15 kilometres northwest of Bankstown. It is expected that this will provide radar coverage to the ground at Bankstown. Should there be any coverage gaps, they will be evaluated and possibly “filled in” with Wide Area Multilateration installations.

The ATC requirement for surveillance at Bankstown is assurance of the radar identification of departing aircraft within 1 nautical mile of the upwind end of the runway.

Noise Abatement

Currently, Bankstown airport does not have a curfew.

The noise preferred operating circuit is to the southwest of the runways – left circuit to runway(s) 29 and right circuit to runway(s) 11.

Sydney terminal area noise abatement requirements limit the holding of jet aircraft over built-up areas to altitudes not below 5000’. This requirement would affect terminal airspace management if jet aircraft movements were significantly increased at Bankstown (see below).

Terminal Airspace Management

Noise abatement requirements (limiting the holding of jet aircraft over built-up areas to altitudes not below 5000’) will place jet traffic from Bankstown and Sydney airports in conflicting flight paths at the same altitude, precluding the segregated operation of RPT jet traffic from both airports.

In order to maintain an efficient rate of aircraft movements, the airspace over Bankstown airport (the current Class D control zone) would be managed by the Sydney Terminal Control Unit using Airspace Class C separation procedures.

Class G airspace to the immediate west and south of Bankstown airport would be managed by the Sydney Terminal Control Unit using Airspace Class E separation and traffic alerting procedures. Airspace Class E allows access to VFR aircraft to transit west of Bankstown without the requirement for an ATC clearance.

Bankstown and Sydney airports would operate as integrated airspace, controlled by the Sydney Terminal Control Unit.

In this model, only the runways and taxiways would be controlled by the Bankstown control tower, similar to current primary airport control zone procedures.

Satellite based instrument flight procedures would be utilised for vertical and lateral flightpath containment.

Airspace and Route Structure

Aircraft performance category dictates the area required for circling and obstacle clearance. The aircraft considered in this study are generally performance category B (e.g. SAAB 340 is Category B, but operated by Regional Express to category C criteria, Dash 8 is also category B). Furthermore, the above aircraft types are regarded as Category C for single engine (engine out) performance.

The circling area for airspace containment of Performance category B is 2.66 nautical miles radius from the landing runway threshold (4.9 kilometres). Performance Category C requires 4.2 nautical miles radius from the landing runway threshold (7.8 kilometres).

The Bankstown control zone dimensions (2 nautical miles radius in the southeast segment) will not contain high performance turbo-prop aircraft, thereby causing aircraft infringement of the Sydney control zone and R555A (Holsworthy Army airspace).

The current route structure associated with Bankstown generally supports RPT turbo-prop operations. The establishment of additional air routes (in the Hunter Valley area) to connect northern NSW coastal destinations will be required.

The route structure to support a significant increase in jet aircraft operations at Bankstown will necessitate a complete redesign of Sydney basin airspace architecture and a significant review of the LTOP flight-paths at Sydney airport.

Military Restricted Areas

R555 series:

R555 is a military airspace series abutting the southern edge of the Bankstown Control Zone, primarily used for flying and artillery range activities associated with the Holsworthy Army Barracks.

- R555A and R555C are permanently active surface to 1,500’ in the northern portion (A) and surface to 2,500’ in the southern portion (C).
- Airspace overlying R555A and R555C is occasionally activated to higher levels, normally up to 10,000’ for artillery range firing.

The proximity of the R555 series will require assessment against aircraft operational requirements for airborne manoeuvring to the southeast of Bankstown. (Departures from runway 11 and arrivals to runway 29)

Activation of airspace overlying R555A and R555C limits the availability of flight-paths to, and from, Bankstown.

R559 series:

R559 is a large military airspace series extending northwest of Richmond, primarily used by RAAF Williamtown for military flying training.

- R559A is predominantly active between 7,500’ and 26,000’.
- R559F, overlying R559A, is normally active from 26,000’ to 60,000’.

Activation of these areas restricts access to a range of airways, in particular for Bankstown northern arrivals and departures, the tracks from Gunnedah, Quirindi and Scone, via Richmond to Bankstown. During activation periods, traffic on those routes is diverted into the northern arrival airspace servicing Sydney airport.

A significant increase in traffic on the above tracks will require a redesign of R559A and R559F.

Major Findings

1. Any development of Bankstown airport to support high performance turbo-prop Regular Public Transport (RPT) aircraft operations must also support the maintenance of capacity and efficiency of Sydney (Kingsford-Sith) Airport.
2. The Sydney sample day schedule indicates that approximately 220 regional service aircraft movements per day would operate at Bankstown.
3. Any significant variation in aviation activity at Bankstown will necessitate a review of LTOP.
4. The proximity of Bankstown airport to Sydney airport precludes the segregated operation of RPT jet traffic from both airports.
5. The analysis concludes that RPT jet aircraft operations are not viable at Bankstown and unlikely to be made suitable.
6. If Bankstown was to support a significant amount of RPT jet traffic, the inability to conduct segregated jet operations from both airports would necessitate a complete redesign of Sydney basin airspace architecture and a significant review of the Long Term Operating Plan.
7. Current Bankstown control zone dimensions will not contain high performance turbo-prop aircraft.

8. The current airspace classification and control zone dimensions do not support a combination of high density general aviation traffic and significant RPT turbo-prop movements.

9. The development of Bankstown aerodrome as an additional RPT airport would have an effect on Sydney (Kingsford-Smith) Airport operations, requiring airspace reclassification:

    a. The Bankstown Control Zone reclassified as airspace Class C and controlled by the Sydney Terminal Control Unit as an integrated airspace operating plan.

    b. The Class G airspace in the immediate vicinity of Bankstown reclassified as airspace Class E also controlled by the Sydney Terminal Control Unit.

10. The establishment of additional air routes to connect northern NSW coastal destinations will be required.

11. Runway dimensions and associated lighting require assessment against aircraft operational requirements.

12. An upgrade of approach navigation facilities will be required to facilitate as close to all-weather operations as possible.

13. Current daily traffic levels at Bankstown average 900 movements in winter and 1100 movements in summer with movements in excess of 1400 on some peak days.

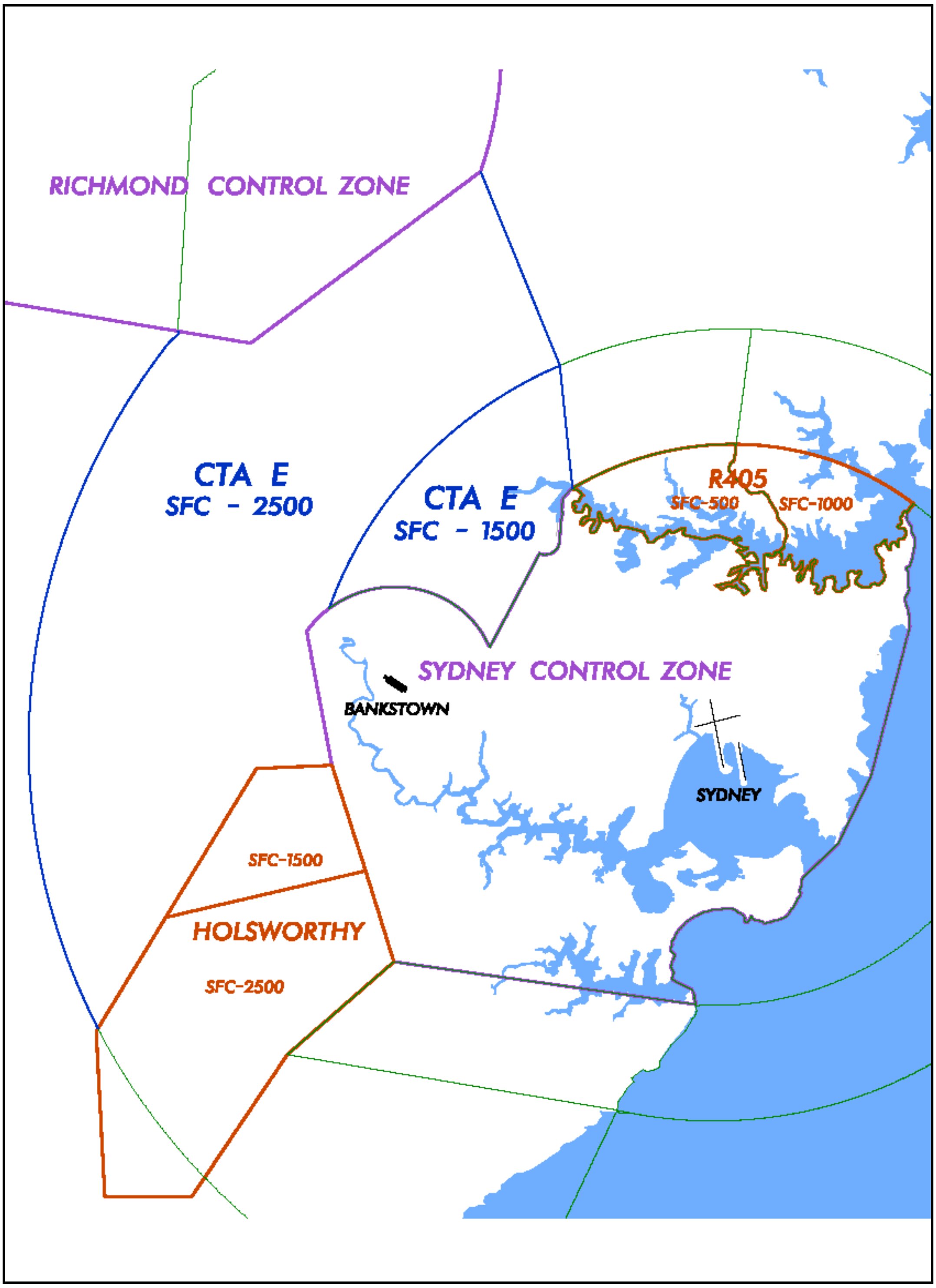
14. The distance between the parallel runways at Bankstown, assessed against the projected level of twin engine aircraft movements indicates that a reduction in the availability of simultaneous parallel runway operations would be significant enough to make general aviation operations unviable.

15. The feasibility of Bankstown airport as a secondary RPT hub in the Sydney basin will require the relocation of general aviation traffic to another airport, possibly Camden.

16. The proximity of military restricted airspace, R555 series, will require assessment against aircraft operational requirements for airborne manoeuvring to the southeast of Bankstown.

17. Any significant increase in traffic on the northern airways servicing Bankstown will require a redesign of military restricted airspace R559A and R559F.

AIRSPACE CONCEPT



AIRSERVICES AUSTRALIA

INDICATIVE DEPARTURE FLIGHT PATHS

RUNWAY 11 TRACKS

RUNWAY 29 TRACKS

INDICATIVE ARRIVAL FLIGHT PATHS

RUNWAY 29 TRACKS

RUNWAY 11 TRACKS

EFFECT ON SYDNEY AIRPORT OPERATIONS

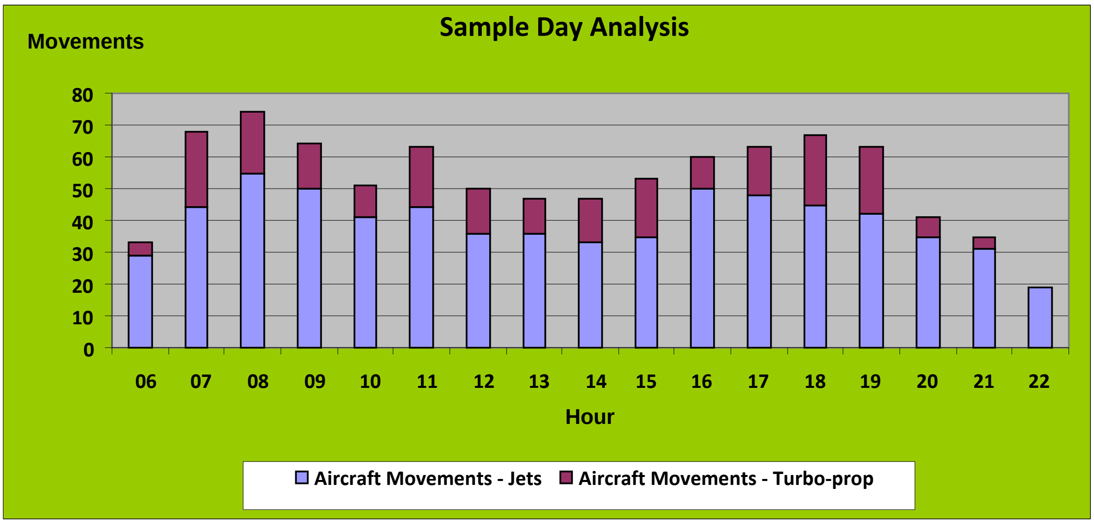
Sample regional service traffic by hour

Data sourced from the Sydney sample day schedule.[5] Movements are shown as a regional service amount against the total traffic amount for the hour. Example: between 0700 and 0800, scheduled regional service arrivals numbered 15 out of a total scheduled arrival amount of 41.

Hour	Arrivals	Departures
0600 to 0700	1 of 14	3 of 19
0700 to 0800	15 of 41	9 of 27
0800 to 0900	7 of 38	12 of 36
0900 to 1000	7 of 29	7 of 35
1000 to 1100	6 of 25	4 of 26
1100 to 1200	13 of 37	6 of 26
1200 to 1300	3 of 36	11 of 14
1300 to 1400	6 of 24	5 of 23
1400 to 1500	10 of 27	4 of 20
1500 to 1600	7 of 20	11 of 33
1600 to 1700	5 of 33	5 of 27
1700 to 1800	7 of 32	8 of 31
1800 to 1900	16 of 32	6 of 35
1900 to 2000	6 of 30	15 of 33
2000 to 2100	3 of 24	3 of 17
2100 to 2200	3 of 19	1 of 16
2200 to 2300	0 of 9	0 of 10
	Totals	
Regional	115	110
All movements[6]	470	428

[5] 12th of November 2010

[6] Regional + all jets + itinerant and medical aircraft



This data is analysed for two aspects of Sydney operations – the effect on morning and evening peak hours and the effect on the availability of LTOP noise sharing modes of operation.

Effect on peak hours

Peak period analysis concentrates on the 0700 to 0900 and 1800 to 1900 hours. Between 0700 and 0900, 142 movements[7] occurred, of which 43 were regional service operations. Slot allocation over these hours is currently at maximum levels (80 per hour) with latent demand for slots at 92 per hour.

Relocating 43 regional aircraft (logically) frees 43 slot allocations for other operators. 24 slots will be reallocated from latent slot demand, leaving 19 slots vacant and bringing the hourly movement rates back to 44 in the 0700 to 0800 hour and 55 in the 0800 to 0900 hour.

Similarly, between 1800 and 1900, 67 movements[8] occurred, of which 22 were regional service operations. Slot allocation over this hour is also currently at maximum levels (80 per hour) with latent demand for slots at 88 per hour.

By relocating those 22 regional aircraft slots, 8 slots will be reallocated from latent slot demand, leaving 14 slots vacant and bringing the hourly movement rate back to 53 in that hour.

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[7] Note: scheduled by CTMS, not by ACA slot allocation.

[8] Note: scheduled by CTMS, not by ACA slot allocation.

Effect on LTOP

This analysis concentrates on the hours of 1100 to 1500L. Demand in the early morning and late evening shoulder periods is not significant enough to warrant detailed analysis.

The major constraint on the nomination of LTOP noise sharing runway modes of operation is the schedule of arriving aircraft to a single arrival runway mode (modes 5, 14A and SODPROPS). The acceptance rate for a single arrival runway is 24 arrivals per hour. The current criteria for abandonment of those modes of operation is currently set at 20 minutes of airborne holding for an individual aircraft, triggering the establishment of an arrival runway mode utilising parallel runway landings.

For analysis of the data presented in this report, it is reasonable to assume that a noise sharing runway mode of operation is questionable when scheduled movements exceed 55 in a given hour.

The sample schedule shows that the hours of 1100 to 1200 (37 arrivals) and 1400 to 1500 (36 arrivals) require airborne holding for a single runway arrival sequence.

The demand vs capacity difference for the 1100 hour is 13 aircraft. The time interval between arrivals is flowed at 2 minute gaps between each aircraft. The cumulative delay for 13 aircraft (2 minutes + 4 minutes + 6 minutes + etc, for each aircraft holding) is 156 minutes. The 20 minute trigger is reached when 4 aircraft are in consecutive holding (2 + 4 + 6 + 8 minutes).

By relocating the 13 regional aircraft arrivals, the arrival demand is reduced to 24 movements, making the option of an LTOP noise sharing runway mode viable at 1100.

Similarly, in the 1000 to 1100 hour, by relocating the 6 regional aircraft arrivals, the arrival demand is reduced to 19 movements, making the option of an LTOP noise sharing runway mode viable at 1000.

These assumptions must be considered against any future slot demand for this hour.

The demand vs capacity difference for the 1400 to 1500 hour is 3 arriving aircraft.

By relocating the 10 regional aircraft arrivals, the arrival demand is reduced to 17 movements in that hour, with a flow-on reduction in arrival demand making the option of an LTOP noise sharing runway mode viable up to 1700.

This assumption must be considered against any future slot demand for those hours.

Effect on LTOP flight-paths

The relocation of regional aircraft to Bankstown will make available departure tracks from Sydney airport currently utilised by turbo-prop aircraft. As jet departure tracks from runways 16R and 16L are constrained by aircraft corridor legislation, the benefit will be for Runway 34L and 34 R departures, Runway 25 and Runway 07 departures.

The jet departure tracks available for Runway 34L and 34 R departures, subject to environmental assessment, increase from 2 tracks to at least 3 tracks per runway.

The jet departure tracks available for Runway 25 departures, subject to environmental assessment, increase from 2 tracks to at least 3 tracks per runway.

A variation to LTOP Modes 7, 8 and 13 departure tracks will be required to integrate operations at both airports.

The jet departure tracks available for Runway 07 departures, subject to environmental assessment, increase from 1 track to at least 2 tracks.

Arrival paths to Runways 34L and 34 R and departure paths from Runways 16R and 16L are constrained by Air Navigation (Aerodrome Flight Corridors) Regulations 1994, and will not change.

The arrival path to Runway 07, currently a straight-in approach from 10 nautical miles will be infringed by high performance turbo-prop operations at Bankstown.

A variation to LTOP Modes 12 and 14A arrival tracks will be required to integrate operations at both airports.

Forecast effect on LTOP

In this analysis, the sample day traffic[9] is extrapolated to provide an indication of the longer term effect on Sydney airport demand. The base hourly data is increased by the percentage assumed in the Sydney Airport Master Plan 2009, being 2% forecast per annum average for scheduled movements.

This rate is considered conservative compared with BITRE data[10] at 2.3% forecast per annum average for scheduled movements. More recent analysis, commissioned by the Department of Infrastructure and Transport and conducted by Booz&Co indicates a CAGR in aircraft movements of 1.8% to 2020, reducing to 1.6% between 2020 and 2030.

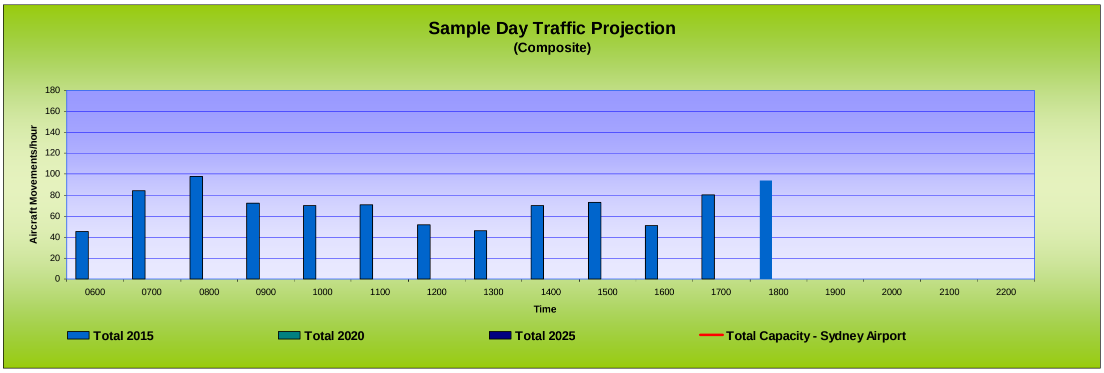
The following table shows the annualised result of 2% per annum growth from a 2009 baseline. It should be noted that the figures are averaged scheduled traffic over the entire year, taking into account the reduced traffic levels typical of weekends.

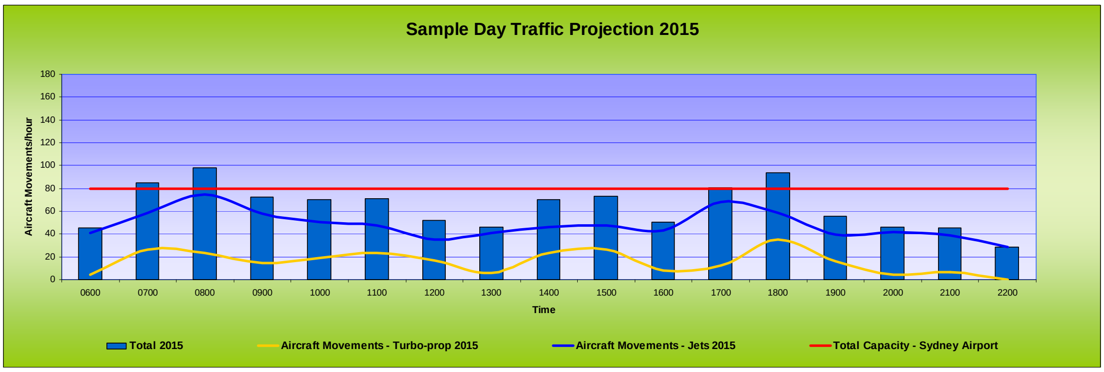
Sydney Forecast 2% growth*	**2009**	**2015**	**2020**	**2025**
	285,000 ≈780/day	**322,000** ≈880/day +13%	**355,000** ≈970/day +24%	**396,000** ≈1100/day +41%

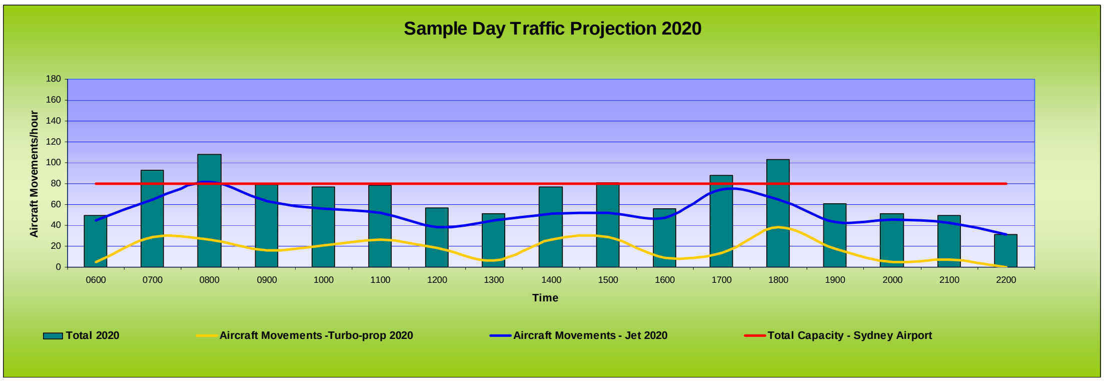
[9] Monday, 1st of August 2010

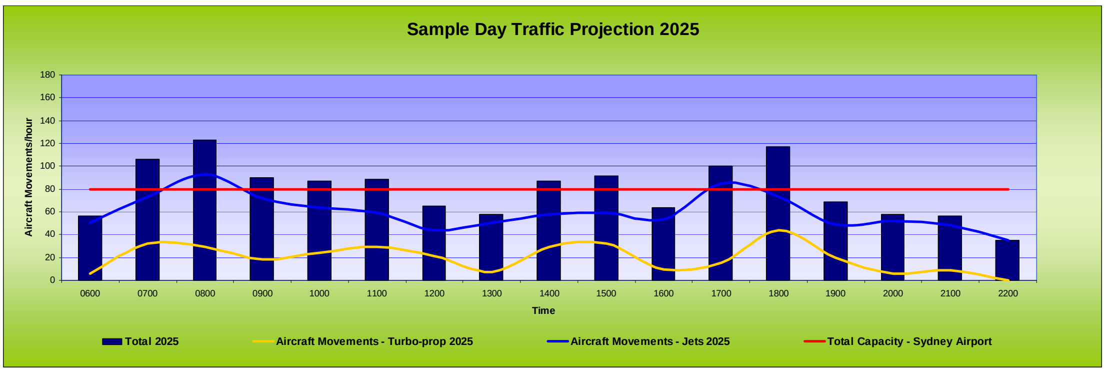
[10] BITRE Research Report 117

The following tables apply the above percentages to the sample traffic day.









Major Findings

1. The transfer of approximately 220 aircraft from Sydney to Bankstown will have the following immediate effects:

    d. The realisation of up to 10 extra movement slots at Sydney airport in peak traffic hours.

    e. The expansion of the available hours for the operation of LTOP noise sharing modes of operation.

    f. The increased availability of noise sharing departure tracks in all hours, excluding curfew.

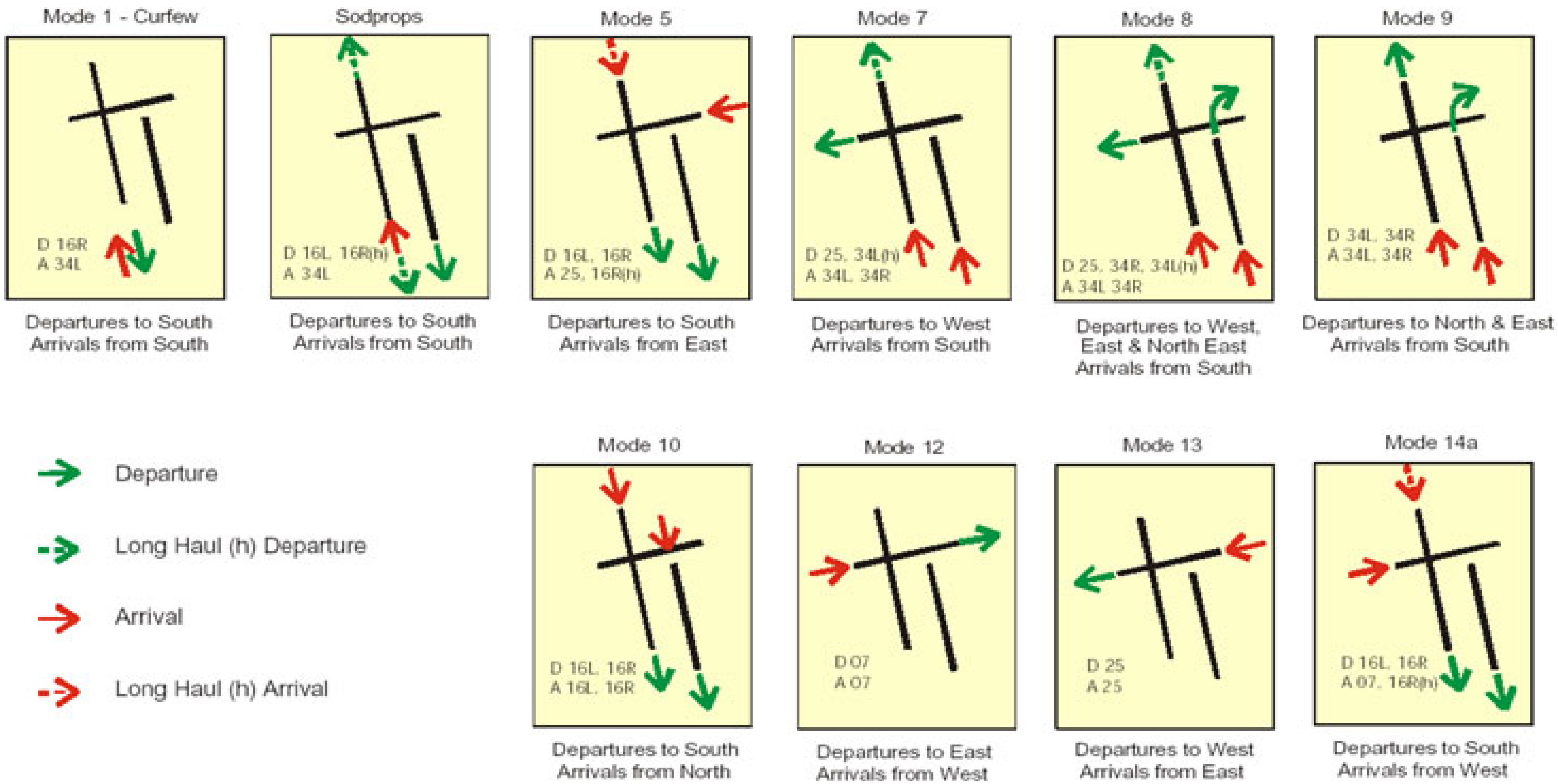
2. The transfer of high performance turbo-prop aircraft from Sydney to Bankstown will establish a homogeneous aircraft fleet mix at both airports, thereby facilitating flightpath flexibility for enhanced noise sharing.
3. A variation to LTOP Modes 12 and 14A arrival tracks will be required to integrate operations at both airports.
4. A variation to LTOP Modes 7, 8 and 13 departure tracks will be required to integrate operations at both airports.
5. The transfer of high performance turbo-prop aircraft from Sydney to Bankstown will facilitate the selection of LTOP noise sharing modes of operation up 2025, based on projected growth at 2% forecast per annum average for scheduled movements.

Glossary of Terms

Term	Definition
ATC	Air Traffic Control
AWIS	Automated Weather Information System – broadcast actual local weather conditions to aircraft
CTMS	Central Traffic Management System – strategic demand and capacity management system
CTA	Controlled Airspace
DVA	Dependant Visual Approach – parallel runway separation standard
GLS	GPS Landing System – a satellite based precision approach navigation system
HIAL	High Intensity Approach Lighting – runway lighting providing visual guidance to a runway threshold
ILS	Instrument landing System
IVA	Independent Visual Approach – parallel runway separation standard
IMC	Instrument Meteorological Conditions – a defined set of meteorological conditions requiring flight using aircraft instrumentation
LIRL	Low Intensity Runway Lighting (single stage lighting system)
LTOP	Long Term Operating Plan for Sydney Kingsford-Smith airport and surrounding airspace
MOS	Manual Of Standards – an expansion of CASA regulations
PAPI	Visual Approach Slope Indicator System – a lighting system which provides a visual indication of the glideslope to the runway threshold for landing
PBN	Performance Based Navigation – navigation to a level of accuracy defined for the operation being conducted
PRM	Precision Runway Monitor – high fidelity radar system which

	permits independent parallel approaches in IMC
RNAV	Area Navigation – navigation based upon satellite or internal aircraft navigation systems
RNP	Required Navigation Performance - a precise form of RNAV requiring on-board conformance monitoring systems
RTIL	Runway Threshold Indicator Lighting (flashing white lights) providing a visual aid to identify the landing threshold.
RWY	Runway
SID	Standard Instrument Departure - a predefined flight path utilised by aircraft navigation systems
STAR	Standard Arrival Route – a predefined flight path utilised by aircraft navigation systems
TMA	Terminal Area – airspace associated with arrivals and departures at major aerodromes
VMC	Visual Meteorological Conditions – a defined set of meteorological conditions permuting flight using visual reference

Long Term Operating Plan (LTOP) Modes



Bankstown Airport and RAAF Base Richmond regular passenger transport scenarios

C4

JOINT STUDY ON AVIATION CAPACITY FOR THE SYDNEY REGION: BANKSTOWN AND RICHMOND RPT SCENARIOS

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Airservices analysis to support the joint Commonwealth and NSW State Government initiative to develop an Aviation Strategic Plan for the Sydney Region has identified three critical ATM issues requiring further consideration:

1. In the near to medium term (5 to 20 years) airport capacity will not accommodate forecast demand;
2. As demand increases, the existing noise management processes will become less effective and in the near term will no longer deliver the benefits of the original principles forming the Long Term Operating Plan, and;
3. Pending the provision of additional aviation infrastructure for the region, interim arrangements to accommodate forecast demand will be required.

Our analysis of brown-field sites, namely Bankstown and Richmond, has led to a conclusion that an alternative use of those facilities is a viable interim solution from an ATM perspective to the three issues.

BACKGROUND

As part of our support for the Joint Study, Airservices has been tasked by the Department of Infrastructure and Transport to undertake analysis in relation to aviation capacity and forecast demand and the consequent implications of those factors to air traffic management in the Sydney region.

SYDNEY AIRPORT ATM ISSUES – CAPACITY AND NOISE MANAGEMENT

Airservices' analysis has identified two critical ATM issues at Sydney Airport:

1. In the near to medium term (5 to 20 years) airport capacity will not accommodate forecast demand, in particular demand on the main runway and the provision of suitable parking gates due to forecast aircraft up-gauging to accommodate passenger growth and;
2. As demand increases over time, the existing noise management processes will become less effective and will no longer deliver the benefits of the original principles forming the Long Term Operating Plan. Our analysis indicates that demand growth is already impacting on the preferred operating hours of LTOP noise sharing modes, particularly the middle of the day hours and the opportunity to deliver noise respite will continue to degrade over time.

Capacity

Analysis to determine the capacity of Sydney Airport identified the theoretical maximum annual capacity to be 496,000 movements; calculated as 80 movements per hour x 17 hours (curfew excluded) x 365 days.

The use of the high capacity parallel runway modes is dictated by traffic demand; therefore the current application of the Long Term Operating Plan is not considered in an analysis of practical capacity. The effect of weather is a primary influence on the practical capacity of Sydney Airport. Based on historical analysis of weather on traffic acceptance rates, it is estimated to reduce capacity from the theoretical level by around 10% to a practical capacity of 446,000 movements per annum.

According to Booz & Company forecasting[1], scheduling at the practical capacity level will occur in the 2038 - 2039 financial year. This estimate assumes scheduling up to the movement cap in any given hour and does not include an estimate for any residual or unaccommodated demand for slots during peak periods;

Airservices engaged Landrum and Brown Worldwide to conduct analysis on the current capacity of Sydney airport ground infrastructure and the capacity of planned infrastructure. The analysis applied airside development information obtained from the Sydney Airport Master Plan 2009. Applying Booz & Company aircraft growth and fleet forecasts, indications are that there will not be sufficient aircraft gates and stands to accommodate peak demand. The analysis indicates that 25 aircraft in the sample day[2] are unaccommodated in 2015; reducing, as planned airside infrastructure is developed, to 18 unaccommodated aircraft in 2020 and 16 by 2029.

In addition, Landrum & Brown conducted sensitivity analysis on theoretical movement cap settings, applying 85, 90 and 95 movements per hour. The analysis has determined that the maximum daily capacity of aircraft gate infrastructure is approximately 1,200 movements per day, or 438,000 movements per annum, assuming the provision of all gates proposed in the Master Plan by 2029.

Further, whilst the analysis indicates that the runways and taxiway system can accommodate forecast demand out to 2029, the up-gauging of aircraft to accommodate passenger growth is increasing demand on the main runway (16R/34L). The analysis suggests that the main runway will be at full capacity during peak hours as early as 2015. This imbalance can be addressed by moving suitable aircraft to the short parallel runway (16L/34R), however, the increased requirement for airborne cross-over's to place aircraft in the appropriate runway circuit will necessitate a redesign of the Terminal Area airspace structures, procedures and flight-paths.

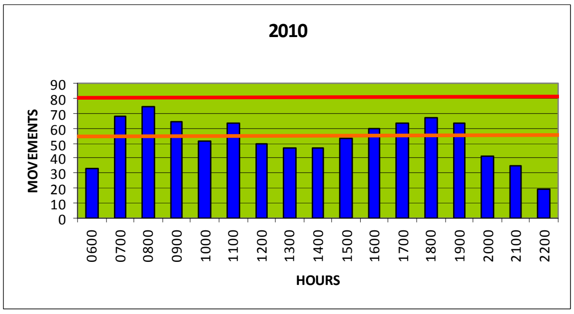
A primary driver of these outcomes is the aircraft up-gauging forecasts which indicate growth in the number of Code E aircraft and a decline in Code C and D aircraft. Considering that the growth rate applied in this analysis is less than that applied in the development of the Sydney Airport Master Plan 2009[3], the number of unaccommodated aircraft is a concern. Furthermore, given recent fleet purchasing events by major carriers, we believe that some of the fleet assumptions in the schedule forecasts are open to challenge, for example, the absence of Code C aircraft operating on the Tasman routes and the growth in Code E aircraft types replacing Code C and D aircraft. Gate usage sensitivity testing indicated that the number of unaccommodated aircraft would be significantly reduced if the level of up-gauging is to be moderated. Notably, however the demand levels would continue to exceed gate capacity.

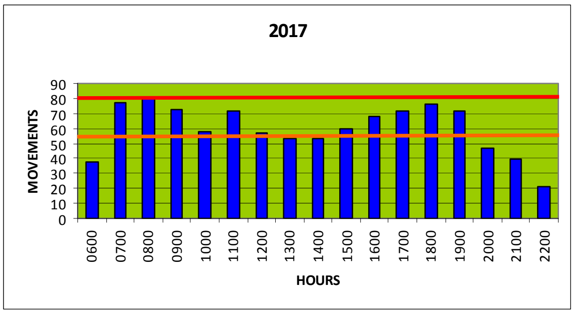
This analysis identifies a near term need for additional capacity in the Sydney region. Options to address the capacity shortfall will be discussed later in this report.

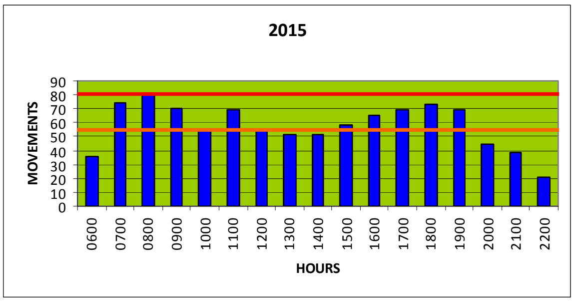
[1] Booz - CAGR 1.8% to 2020, reducing to 1.3%
[2] 12 November 2010 – Booz&Co
[3] SACL - CAGR 2.0%

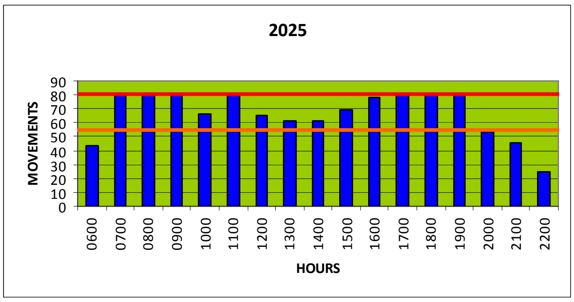
Noise Management

The following graphs present the effect of Booz & Company supplied schedule forecasts on hourly demand. The red line represents the 80 per hour movement cap.









The orange line on the above graphs represents a reasonable traffic acceptance rate determining the selection of LTOP noise respite modes (55 movements, based on actual performance for a single arrival runway mode of operation). Currently, the ability to utilise noise sharing runway modes during the 11am to 3 pm period is compressed, particularly due to demand in the 1100 to 1200 hour. By 2017, this ability is forecast to be significantly reduced to not more than two of the middle of the day hours.

The demand forecasts indicate that noise management performance will continue to decline over time. An alternative operating plan which delivers the LTOP principles will be required and, as depicted in the graphs, may be required as early as the 2015 – 2017 timeframe.

SYDNEY AIRPORT ATM ENHANCEMENTS – NEAR TERM

Airservices, in consultation with industry, are exploring options to enhance capacity and manage demand in the near term. Items under consideration include runway and taxiway infrastructure improvements, enhanced weather capabilities such as GBAS, HIAL and Category 2 ILS and demand management initiatives including ATFM, A-CDM and ADMAN.

Airservices is also working with industry on better management of aircraft under tow. Currently, the slot loss due to tows across the main runway is around 20 per day. Given proposed developments for additional layover parking on the aerodrome, this figure will increase over time.

Airservices is also exploring emerging technologies in the Demand and Capacity Management area as well as enhanced utilisation of current technology such as PRM, Metron Traffic Flow and MAESTRO.

Further, initial analysis supports the need for a review of demand management practices, whereby the allocation of slots is matched to gate availability and runway capacity. We believe that more granular slot management and improved terminal management would deliver better on ground and airborne efficiency through delay reduction and assist movement cap management.

Additionally, in order to better balance traffic demand on the parallel runways, the approvals for the use of 16L/34R should accommodate the growth of Code E aircraft. Runway balancing will be a significant issue in the near future, particularly as aircraft such as the B787 commence operating towards the end of 2012.

Whilst these activities will optimise the available capacity at Sydney Airport, our analysis of forecast traffic growth, fleet mix and planned infrastructure concludes that, despite these initiatives, demand will not be accommodated in the medium (10 to 20 year) term and noise management outcomes will be compromised in the near (5-10 year) term. Consequently, other options must be sought to accommodate demand growth and maintain effective noise management.

SYDNEY REGION ATM SCENARIOS – MEDIUM TERM

Acknowledging that an interim solution to capacity and noise management issues will be required prior to the development of additional infrastructure servicing the Sydney region; Airservices has considered alternative utilisation of current aviation assets, particularly Bankstown and Richmond, to relieve demand pressure on Sydney.

General

Bankstown aerodrome was analysed as a potential option to provide additional capacity. The analysis determined that jet aircraft operations would require major infrastructure upgrading and airspace re-design. Analysis therefore focussed on options relating to turbo-prop services. The findings concluded that turbo-prop operations would be viable but some infrastructure upgrading and airspace changes would be required. Notwithstanding, the 1,400m main runway is able to accommodate DHC8-400 and ATR72 type aircraft at Maximum Take-off Weight.

Richmond was analysed as a potential Low Cost Carrier aerodrome model, similar to Avalon and Newcastle. The number, and scheduled times of potential users did not have a significant effect on peak period demand at Sydney, considering the existing latent demand for slots at peak times. The findings concluded that the model would not deliver significant outcomes for capacity and noise management at Sydney Airport and is therefore not considered a viable solution.

Drawing together the findings of previous analyses, Airservices has formed a view on various scenarios regarding the use of current aviation assets in the region.

Scenario 1: A combination of additional Regular Public Transport and General Aviation operations at Bankstown.

This scenario examines start-up RPT operations and assumes the maintenance of the permanent regional service slots establishment at Sydney. As there are no existing schedules to draw on for analysis and, given the variance in General Aviation activity at Bankstown, the findings were largely qualitative. The analysis was however, able to input growth projections, supplied by Booz & Company, which were used in the development of the draft Bankstown Airport Master Plan.

This scenario assumes, in the first instance, no change to the current use of Bankstown as a General Aviation facility and no change to airspace structure, airspace classifications and applicable airspace rules.

Currently, Bankstown IFR GA traffic which accesses Sydney Terminal Area Class C airspace number around 50 movements per day. Applying projected growth of 1.5% per annum and assumed movement projections for a niche start-up RPT operation, this figure will increase to total IFR movements of approximately 80 in 2015 and 90 by 2020.

The main issues with this model are tactically applied restrictions on access to the Bankstown Control Zone in order to maintain safe operations (managing a mix of VFR and IFR in a high capacity environment) and the ability of IFR aircraft to hold in high traffic density Class G airspace pending clearance to enter the control zone. It should also be noted that the ongoing suitability of airspace classifications would be a matter for the Office of Airspace Regulation. A determination of the upper limit of IFR movements per hour is qualitative and dependent on traffic at the time, but is considered unlikely to be more than 10 to 12 movements per hour in the peak period.

This option may be a consideration to address a near term (5 to 10 year) capacity shortfall at Sydney, but is not considered to be a medium term solution.

Scenario 2: The relocation of all turbo-prop services from Sydney to Bankstown and the consequent relocation of General Aviation from Bankstown to an alternative site.

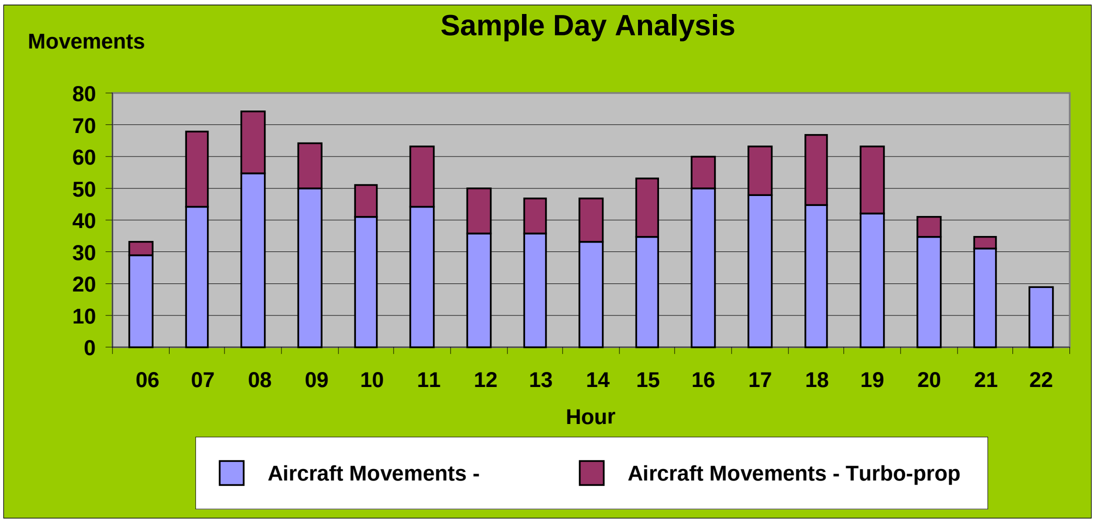
This scenario examines the transfer of all turbo-prop operations currently at Sydney, including permanent regional service slot operations, to Bankstown. The establishment of significant numbers of RPT aircraft at Bankstown would require the relocation of General Aviation to an alternative site.

Based on current schedules, this scenario would transfer approximately 220 aircraft per day from Sydney to Bankstown. The model would deliver up to 10 extra (vacant) movement slots per hour at Sydney airport in peak traffic hours, after including the backfill of existing latent demand for peak period slots.

It would also increase the number of hours where demand is below the 55 aircraft movement rate. This would expand the available hours for the operation of LTOP noise sharing modes of operation, to as early as 10am and as late as 4pm at current scheduling levels.

Additionally, a more homogeneous fleet mix operating at Sydney would increase options for noise sharing flight-paths as access to the current turbo-prop tracks would be available for jet traffic.

The analysis indicates that operating Bankstown airport as a dedicated turbo-prop service aerodrome would provide relief to Sydney demand pressure; significantly improving LTOP performance and extending the effective life of LTOP beyond 2020. This option represents a near- medium term (5 to 20 year) solution to address the Sydney capacity shortfall. The model is considered to deliver superior capacity and noise outcomes in comparison to scenario 1.



The above graph provides an indication of potential hourly movements at Sydney, using the Booz & Company supplied sample day schedule for November 2010. Whilst the data does not account for latent demand backfill (12 slots in each of the 0700 and 0800 hours and 8 slots in the 1700 hour), the residual demand is significantly less.

Scenario 3: The relocation of all turbo-prop services from Sydney to Bankstown and the use of Richmond as an alternative General Aviation facility.

This scenario is an extension of scenario two and proposes that Richmond is considered to be a viable alternative site for General Aviation operations from an ATM perspective.

In this scenario, the existing airspace structures in the Richmond area would not require significant amendment; the displacement from Sydney operations will not impact capacity and noise management at Sydney, circuit operations are not constrained by the Sydney Terminal Control Zone, the location provides ready access to Class G training areas and IFR training facilities (ILS and NDB) are on-site.

Furthermore, we believe that a joint user arrangement with Defence may be compatible with General Aviation operations if some infrastructure upgrades are undertaken to meet civil aerodrome compliance standards. The arrangement would be dependent on Defence security and safety requirements.

Airservices considers this scenario to be the best near to medium term (5 to 20 year) solution to address the Sydney capacity shortfall, facilitate noise management and stage development of additional infrastructure. Analysis of the likely airspace structures and the interplay of traffic indicate that this model is highly viable from an ATM perspective.

Scenario 4: Bankstown turbo-prop, Richmond General Aviation, Badgerys Creek development.

This option assumes the Commonwealth owned land at Badgerys Creek comprises a current aviation asset and that a single runway airport capable of accommodating aircraft up to Code C (B737, A320) is developed. Airservices Greenfield site analysis concluded that a north/south runway orientation would be compatible with Sydney Airport operations however, the CTA steps required to accommodate jet traffic at this location would impose significant constraints on IFR operations at Bankstown and the VFR training areas.

Airservices does not consider that the proposed usage of the three airports, operating in combination with Sydney Airport, to be a preferred option.

RPT Aviation Operations RAAF Base Richmond East West Runway Scenario

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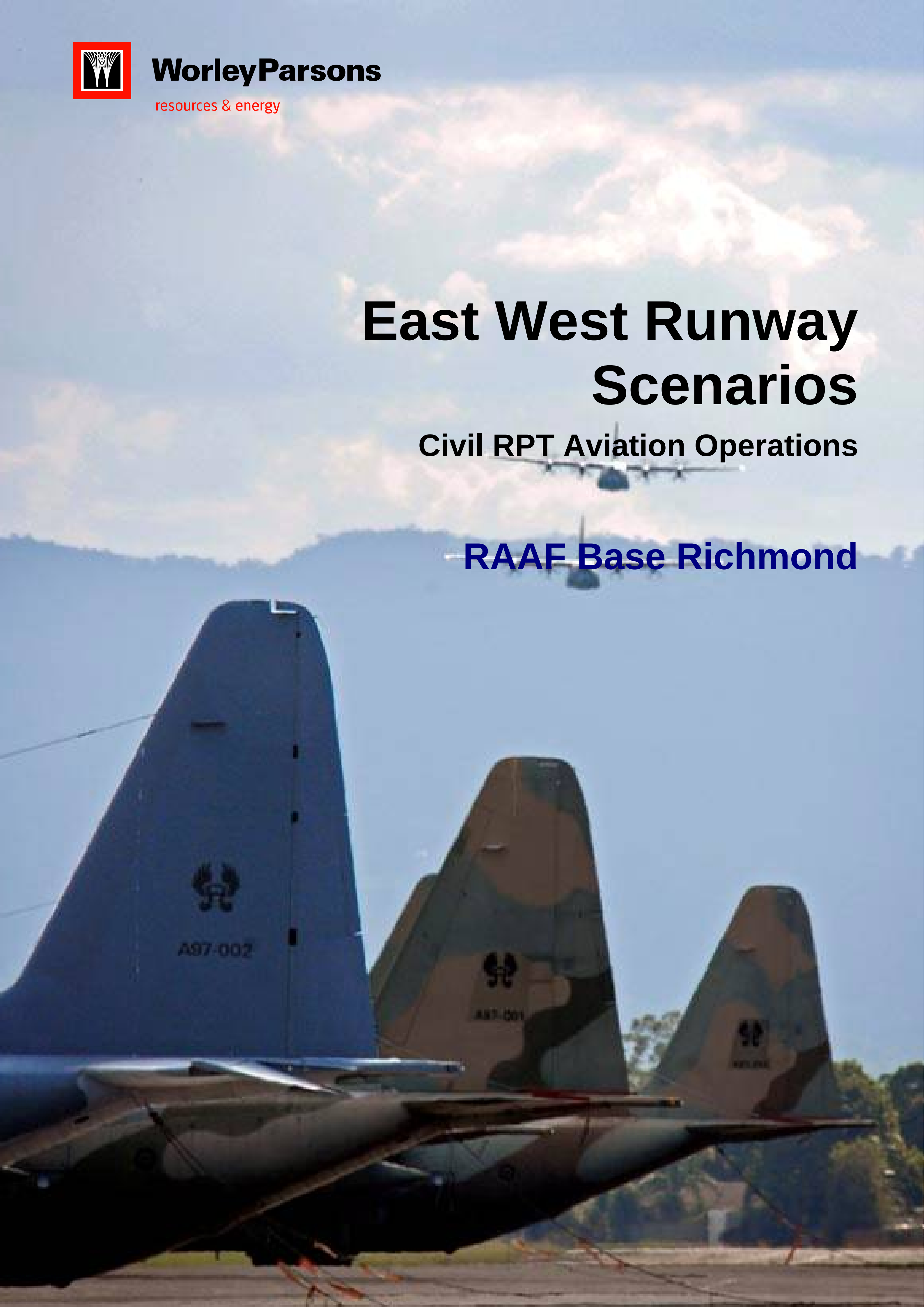
WorleyParsons
resources & energy

East West Runway Scenarios

Civil RPT Aviation Operations

RAAF Base Richmond



Disclaimer

This Report was prepared for the exclusive use by the Department of Infrastructure and Transport ("Department"), in advising the Steering Committee on the Joint Study on Aviation Capacity in the Sydney Region and in their advice to Government. The Report may only be relied upon by the Department, Worley Parsons disclaims all liability to any party or persons other than the Department for any costs, loss and damage and liability that any other party may suffer or incur arising from or relating to or in any way connected with the Report, including any reliance without Worley Parsons prior written consent. The Department has agreed that it will not amend the Report without prior written approval from Worley Parsons. If any other party chooses to rely on the Report in any way, they do so entirely at their own risk.

CONTENTS

1 INTRODUCTION

1.1 Scope of this Study

As an input to the Sydney Region Aviation Capacity Study, the Department of Infrastructure, Transport Regional Development and Local Government (the Department) requires an assessment of the likely costs that would be incurred in order to provide the necessary infrastructure for operating Regular Passenger Transport (RPT) aviation service from RAAF Base Richmond. The work follows on from the assessment made of airport infrastructure in the Sydney Region[1] which collected data on 12 aerodromes including Richmond.

In particular, the Department wishes to understand:

- The costs to aviation assets and supporting infrastructure;
- Costs to land transport to support air traffic;
- Other factors which arise in establishing a civil aviation operation at RAAF Base Richmond; and
- The scale of investment which would be required to permit RPT operations.

The study has been divided into two stages:

- Stage 1 – aviation and airport planning assessments; and
- Stage 2 – landside access and transportation links, noise abatement works and other landside issues.

This report addresses Stage 1 and includes consideration of:

- Estimated future traffic projections adopting Avalon in Victoria and Newcastle / Willamtown in NSW as benchmark operations for RPT and General Aviation (GA);
- Operable development scenarios based on meeting similar levels of demand involving consideration of adjustments to buildings; runway requirements, taxiways, services such as fuel and the like;
- Obstacle limitation surfaces (OLS) for civil operations and the effect of aircraft noise and other off airport issues that would require management; and
- The effect of continued Defence operations at the airport or otherwise.

Stage 2, if commissioned, would consider in more detail:

- Landside transportation links;

[1] *"Airport Infrastructure in the Sydney Region" WorleyParsons / AMPC for the Department of Infrastructure, Transport Regional Development and Local Government August 2010*

- Other airside issues need to support growth of the civil operation; and
- Any further landside issues such as noise amelioration.

1.2 Role of RAAF Base Richmond

RAAF Base Richmond is located approximately 48 km north-west of the Sydney CBD and is accessed from Percival Street off Richmond Road. The towns of Windsor and Richmond lie to the immediate east and west of the airport respectively. It is the RAAF's only operational air base in the Sydney Basin.

Currently, the only flying squadron is 37SQN operating the C-130H/J Hercules. These aircraft provide a vital air mobility capability for the Australian Defence Force (ADF). RAAF Base Richmond is also home to Headquarters Air Lift Group, which is responsible for the ADF air mobility aircraft. The base also accommodates a further number of support units including the Air Mobility Control Centre which is the central tasking agency for airlift operations across the ADF. Other transport assets of the RAAF such as the C-17, BBJ, Challenger and forthcoming KC-30A multi role tanker transport (MRTT) use the base as required as do other ADF elements including fast jets. The base also supports air drop and parachute training as well as itinerant foreign military aircraft operations and the USAF.

Statistics provided by the Department of Defence show there were 5,318 military aircraft movements in 2009 and 7,513 civil transits of Richmond airspace. The base is used during the bushfire season for firefighting helicopter operations. Helicopter transits between Holsworthy and Richmond are also undertaken.

The base is commonly used for:

- Transit of explosive ordnance from Defence Establishment Orchard Hills;
- A point of exit for air medical evacuation (AME), disaster relief and combat forces;
- A point of delivery for repatriation for wounded or deceased personnel; and

- A divert for fighter aircraft from Williamtown.

Partners at the base are Australian Aerospace and Qantas Defence Services, which both provide aircraft maintenance services for Defence, as well as contracted partners Serco, Sodexo, Defence Maintenance Management, Childcare Centre, Frontline (Australian Commercial Catering), Lockheed Martin, Standard Aero and Jacobs Australia.

Civil operations are not undertaken on a regular basis although the following activities occur:

- RAAF Richmond Gliding Club which operates on weekends and public holidays;
- Aeroclub flying on weekends; and
- Use of the Instrument Landing System (ILS) for flying training purposes.

Figure 1.1 depicts the main elements and layout of the airport.

Figure 1.1 – RAAF Base Richmond Airport Layout

Source: Base Image Google Earth Pro 2010 (Image Date January 2007)

1.3 Context

The context of RAAF base Richmond has been documented in "***Sydney Region Aviation Capacity Study – Airport Infrastructure in the Sydney Region"*** prepared for the Department of Infrastructure and Planning" by WorleyParsons in association with Airport Master Planning Consultants (AMPC) August 2010.

1.4 Terminology

A glossary of general aviation and airport planning terms is included in Appendix 3.

Other terms are defined in the text or as noted below:

- RPT Regular Passenger Transport
- GA General Aviation
- CBD Central Business District
- m metres
- feet (ft) – an imperial measure equal to 0.305 m
- km kilometers
- kg kilograms
- PMF Probable maximum flood

1.5 Important Notice

This study is an input to the Sydney Region Aviation Capacity Study being undertaken by the Department of Infrastructure and Transport (the Department).

The matters discussed herein are **concepts only** for consideration as a part of the above mentioned study. WorleyParsons and AMPC are not aware of any commitment by Government to implement all or any of these concepts.

1.6 General Qualifications

This following should be noted when this report is reviewed.

Forecasts or Demand thresholds – prepared only to provide a framework for development of one possible conceptual layout and are not intended as a formal forecast for the future use of RAAF Base Richmond;

Review of the OLS – is based on a desktop study of 1:25,000 topographic maps, and does not address obstacles other than terrain such as trees, powerlines, towers, masts etc. A detailed survey would be required should the concept be developed to the next stage;

PANS-OPS - have not been addressed and a detailed survey would be required should the concept be developed to the next stage;

Explosives – the specific safety templates applicable to the type and quantity of explosives stored or being handled require separate assessment by Defence. The clearances shown in the report are indicative only and to show that the overall issue has been recognized;

RAAF requirements – initially assumed one for one replacement of affected facilities. RAAF will need to determine its requirements in greater detail; RAAF feedback is summarized in the report;

Airspace interaction – potential airspace conflicts near Hornsby have been identified. It is assumed that the conflicts with the existing airspace arrangements are manageable, but this requires separate review and assessment by Defence, CASA OAR and Airservices Australia;

Publically available data from ERSA has been relied upon;

Specific site issues such as any environmental, heritage or contaminated sites and the like have not been specifically addressed in detail the report although, to the extent possible, concepts have responded to those constraints that were known;

Flood management **-** it is assumed that the proposed earthworks at Rickaby's Creek can be demonstrated to be manageable in regard to flood management. More detailed work would be required to further consider this issue if the decision is made to advance the concept to a next stage;

Cost estimates are high level budget figures intended only to indicate the overall order of costs and should not be used for any other purpose. The costs have been prepared without site survey, geotechnical data and detailed planning such as airport master grading or design of pavements or services for the quantification of volumes. The quantities and rates are indicative and are based on available information at the time of writing the report, and will be subject to change over time;

Publically available unit rate sources such as Rawlinson were used were applicable or as part of developing rates;

Industry rates were also used (note some information is based on commercial in confidence information).

2 DEVELOPMENT SCENARIOS

Three basic development scenarios have been considered to enable RPT civil aviation operations to commence operations. Two scenarios are based on RAAF operations being retained but with some base modifications. There are three key planning considerations:

- RAAF continued presence at Richmond either to the full extent as currently or in some other form which may include no explosives ordnance (EO) operations.
- As RAAF Base Richmond is a closed secure defence facility, strong physical separation of any civil precinct from the defence precinct is required – in a similar manner to that which exists at RAAF Williamtown.
- As Explosive Ordnance (EO) is handled at RAAF Base Richmond, specific rules exist as to the proximity of any civilian or civilian activity form defined points such as Ordnance Loading (OLA) areas.

A decision to relocate the RAAF operational facilities or even just EO operations, would enable a different approach to be taken for the location of civil functions, depending on how much of the existing base infrastructure might be retained or adapted for other uses.

Accordingly, the scenarios differ in their assumption as to the means of handling the issue of ordnance loading areas (OLA). Current OLA procedures are spatially intrusive over the most suitable areas for developing the civil facilities necessary for passenger operations, as well as having an impact on runway availability.

- **Scenario A** assumes it will be possible to relocate the OLA to the land zoned "Special Uses 1 Aerodrome – Defence Services" north of Percival St and within the flood plain area of Rickaby's Creek and develop the area in the north west quadrant of the base for civil facilities.
- **Scenario B** assumes the existing OLA is only shifted to the north as a means of achieving adequate distances from airport infrastructure liable to be used for civil operations and thereby minimising ordnance loading implications on runway operations. Civil facilities would be developed in the southwest quadrant and off-airport to the south of the runway, Richmond Road and the rail line west of the existing Clarendon Station. This would require:
    - Acquisition of land zoned "Special Purposes 1 – Education" and thought to be owned by the University of Western Sydney;
    - Deviation of the existing railway and road to the south to accommodate a Civil RPT terminal;[2]
- **Scenario C** this would only be possible if there was no continued Defence presence on the airport as it would involve adaptive reuse of the existing RAAF precinct. It is assumed that

[2] For the purposes of this study it was assumed that retention of transport infrastructure on the surface would be less expensive than lowering it into a trench and requiring an enable an air bridge to be built. However this option could still be considered

this would not occur within the timescale in which a civil operation may need to be implemented.

The following figures illustrate these basic planning options.

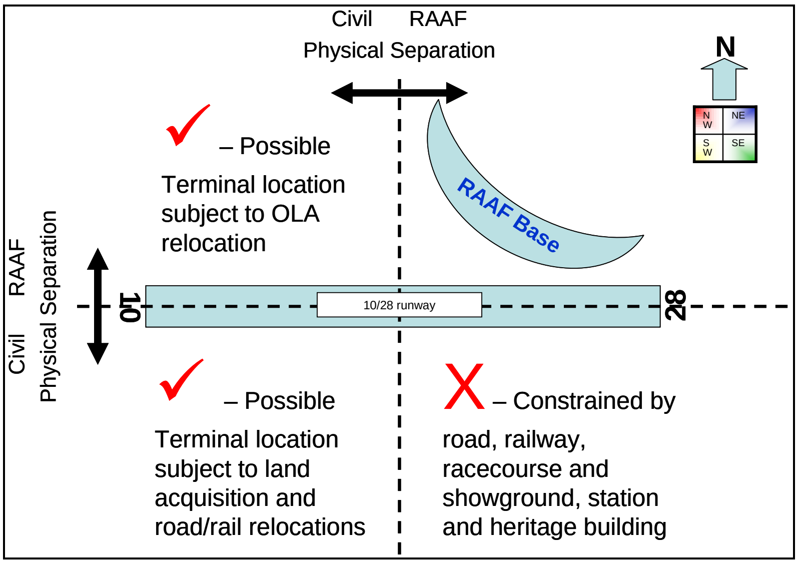


Figure 2.1 Basic Planning Principles - RAAF remaining on site

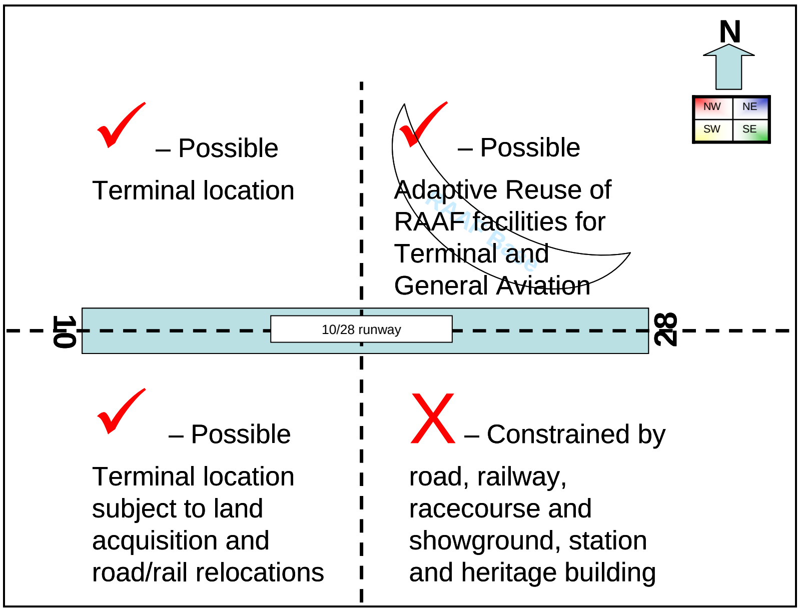


Figure 2.2 Basic Planning Principles - RAAF having departed the site

In both these cases it has been assumed that the south east quadrant is too heavily constrained by existing land uses. This assumption should be thoroughly tested as most of those uses are relocatable in a purely physical sense though there may be significant objection by users of these facilities as they are so well established and some elements have heritage designations.

The development concepts presented in this report indicate the level of infrastructure required to support civil operations catering for approximately 5 million passengers per annum. Chapter 5 details the air traffic forecasts underpinning this passenger throughput assumption.

3 GENERAL CONSIDERATIONS

3.1 Possible Civil Role for RAAF Base Richmond

3.1.1 Strategic Context of Richmond

In order to consider what infrastructure might be required at Richmond to support RPT operations, it is necessary to consider what types of aircraft might operate from there. In order to do this it is necessary to postulate what the role of Richmond would be in the overall context of Sydney's aviation needs.

In terms of its physical location, Richmond is at the north western extremity of metropolitan Sydney and accordingly at the northwestern edge of one of the fastest growing regions in the metro area.

Figure 3.1 shows its location in the context of the current metropolitan planning strategy for Sydney.

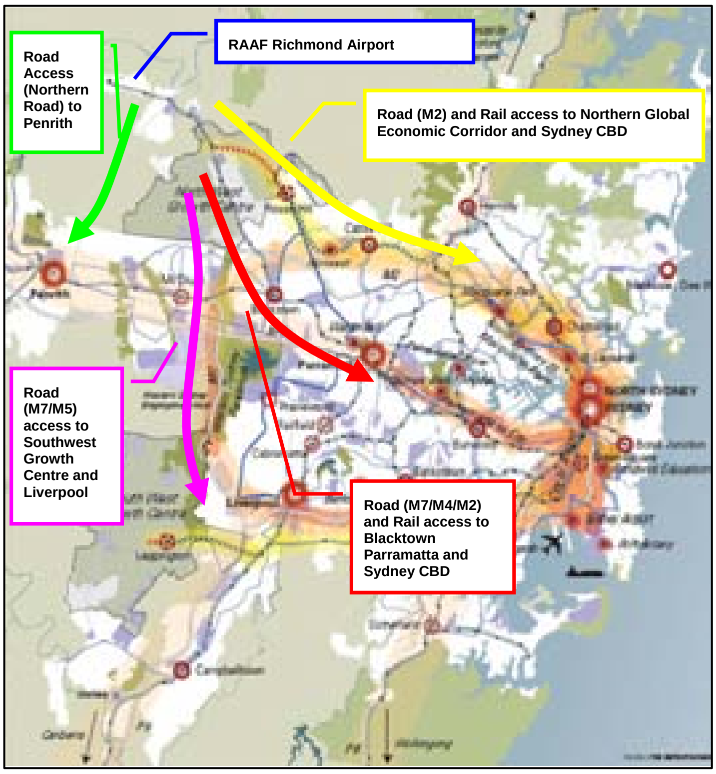


Figure 3.1 Strategic Context of Richmond Airport

Base Map Source: Metropolitan Strategy

This figure shows that Richmond is accessible to many of the major centres of growth in population and economic activity in the western parts of Sydney, in most instances, at least in part, on Freeway standard roads.

Additionally, Richmond is directly accessible by road for urban centres such as the Blue Mountains townships, Penrith, as well as Lithgow, Bathurst and Orange beyond the Blue Mountains. Bathurst and Orange are currently served by Regional Express (REX) services direct to Sydney (KSA) Airport.

A further key context issue for RAAF Base Richmond is its close proximity to the Richmond rail line. This line is currently undergoing considerable capacity upgrading and, according to The NSW Metropolitan Transport Plan February 2010 will form a part of the proposed Western Express operational sector. This would allow direct rail services from Richmond to the major growth centres of Blacktown, Parramatta, Burwood and the major CBD stations of Central, Town Hall, and Wynyard. Connecting rail services can be made to Penrith, Liverpool, and Campbelltown.

Additionally, should the North West rail link project be completed and connected to the Richmond line as has been proposed, direct rail service to the designated growth centres of Rouse Hill, Castle Hill and the major employment centres of Norwest, Macquarie Park, Chatswood, and North Sydney will be provided.

A rail connection with Sydney (KSA) airport could be made at Central, by interchanging from the Richmond Line service to the Airport Line service and vice versa.

3.1.2 RPT passenger

Given the existing level and extent of existing movement area infrastructure as well as possible enhancements, possible civil roles would be:

- To develop new induced patronage markets based on Richmond's proximity to centres of urban and employment growth;
- To develop new internal tourism products based on low cost carriers (LCC); and
- To provide a domestic reliever capability for Sydney Airport.

The types of services which might be operated from Richmond and which would be most likely to be commercially successful would be those offered by the current LCCs such as Jetstar and Tiger and probably to a lesser extent Virgin. It is noteworthy that Jetstar expressed interest in establishing a route to Richmond, when they commenced operations in 2004. Richmond may also be attractive to regional operators such Rex for some regional routes that are not feeders to services only operated from Sydney (KSA) such as long haul international or for services which the regional airlines have arrangement in place to facilitate transfers. It is less likely to be attractive to Qantas and its regional operator QantasLink because of Qantas's network model and range of domestic and international services.

An example of possible viable routes would be:

- Richmond-Canberra route, noting that Canberra is technically not a regional destination but is nevertheless serviced primarily by regional type aircraft from Sydney.

- Richmond–Gold Coast or Sunshine Coast, as a low cost tourist route.

Based on this the most likely types of aircraft which would be adopted by operators interested in developing service from Richmond would be those types in their current fleets[3] and therefore the appropriate aircraft for which a Richmond civil operation would potentially need to provide at start up would be:

- Regional NSW routes – Bombardier Q400 or Saab 340;
- Domestic Australian routes – Embraer 170, Boeing B737 series or Airbus A320 series (Code C aircraft types)

While these aircraft are currently in use, it is prudent to consider the next generation of aircraft, such as Code E types, when developing concepts for a civil aviation capability at Richmond, as is outlined later herein.

3.1.3 Freight

The potential for Richmond to handle air freight traffic has been raised in the past in the context of enhanced civil operations. LCC passenger operations as outlined above would probably involve relatively low belly freight volumes of time critical items. The potential for dedicated freight operations is considered less likely, other than niche-type services capable of operating from Richmond's 2,134m runway. Runway length would be a limiting factor in being able to facilitate dedicated international freight aircraft. These aircraft are generally heavy wide bodied Code 4D/E aircraft such as B747 and MD11, requiring significant runway lengths. In any event, the numbers of these aircraft operating through Sydney Airport is relatively small in comparison to passenger aircraft. As noted in Sydney Airport's current Master Plan, over 80% of freight is carried in holds of passenger aircraft. For the purpose of the development concepts presented below, provision has been made for a small dedicated freight operation.

3.1.4 General aviation and other related activities

Additionally, the Brief requests that consideration be given in the development of concepts for general aviation. This could be considered to include small scale civil aircraft maintenance activities. It is relevant to note, however, that no civil general aviation takes place at RAAF Williamtown. Discussion of this issue with RAAF indicated that they would not accept usage of the airport by private owners, flying schools and the like but might consider larger executive jet charters and heavy maintenance on larger aircraft that for example that cannot be undertaken at Bankstown.

[3] As LCC operators tend to prefer a single aircraft type or series in their fleets.

3.1.5 General Planning Objectives for Secondary Scale Airports

Commercial success and sustainability of LCCs is generally predicates on their use of secondary airports at which they incur low operating costs as a result of:

- Secondary airports being less busy, leading to fewer delays;
- Taxiing times and surface movement delays are generally shorter;
- Aircraft can use free moving (power in/power out) operations if apron size permits;[4]
- There are generally lower airport user costs and charges as a result of lower investment in infrastructure;
- There is reduced direct competition with established traditional airlines;
- Ground access may be less congested; and
- Reduced car parking costs possible.

In developing scenarios for Richmond, these considerations have been taken into account to the extent possible.

Avalon and Newcastle have demonstrated that LCC passenger services at secondary airports in relative close proximity their major capitals are sustainable. Avalon with its distance to the Melbourne CBD of 55 km and road travel time of 47 minutes is not significantly different to Richmond's distance of 65 km and 1 hour and 5 minute road travel time to the Sydney CBD. Newcastle on the other hand is developing specific regional market.

3.2 Design Aircraft

3.2.1 Primary Design Aircraft

The primary design aircraft adopted for this study is Code C, which encapsulates the full range of medium narrow body jet aircraft such as the B737 and A320 series, as well as the smaller EMB-190. The B737 and A320 series can have passenger capacities of up to about 210 whereas the EMB - 190 has seating up to 104. The major critical dimensional characteristics are:

- Wing span 36m (based on B737 series with winglets);
- Length 44.5m (based on A321); and
- Fin height 12.6m (based on B737 series).

[4] However, as noted later, constraints at Richmond mean power in - push out have been adopted to maximise space available on the apron.

Figure 3.2 - B737 and A320 Aircraft

Figure 3.3- Embraer 190 Aircraft

3.2.2 Ultimate Design Aircraft

For overall geometric planning, it is considered prudent to take account of Code E aircraft which may under some circumstances be able to operate from Richmond, particularly the new generation B787 and current A330 aircraft. These are generically referred to as large wide body jet aircraft with passenger capacities of up to around 300. Code D aircraft such as the B767 have not been specifically considered as they are being phased-out of Australian service but would be able to be accommodated under the larger Code E design parameters in any event.

Figure 3.4 – Boeing B787 Aircraft

Source: http://787flighttest.com/

The major critical dimensional characteristics are:

- Wing span 65m (noting the A330 and B787 series are both slightly smaller at just over 60m);
- Length 63.6 (based on A330-300); and
- Fin height 17.4m (based on A330-200).

3.3 Airport Planning Standards and Requirements

The Civil Aviation Safety Authority's (CASA) *Manual of Standards Part 139 – Aerodromes* (MOS) prescribes the physical geometric standards applicable to civil aerodrome operations. Relevant standards applicable to the design aircraft are shown in Table 3.1.

Table 3.1 – Geometric Standards

Element	Code E	Code C
Runway centreline to taxiway centreline (precision approach)	182.5m (Note 1)	168m (Note 1)
Runway centreline to taxiway centreline (non-precision approach)	107.5m (Note 2)	93m (Note 2)
Taxiway centreline to taxiway centreline	80m	44m
Taxiway centreline to object	47.5m	26m
Parking position taxi lane to object	42.5m	24.5m
Apron wingtip clearance	7.5m	4.5m

Source: CASA 2004.
Note 1: based on a 300m wide runway strip.
Note 2: based on a 150m wide runway strip.

3.4 Apron Geometric Setout

For the purpose of the development concepts presented below, a power-in/push-out configuration has been assumed which minimises the length of apron required. This does add to an airline's operating costs but is used at airports such as Gold Coast which is largely serviced by LCC's.

4 OPPORTUNITIES/CONSTRAINTS

4.1 Runway Capability

At a length of 2134m and width of 45m, the existing Richmond Runway 10/28 satisfies civil Code 4C requirements. The runway strip width of 154m satisfies the requirements for civil Instrument Non-Precision operations. Runway 28 is, however, equipped for Instrument Precision approaches through the provision of a CAT 1 ILS, supported by a high intensity approach lighting (HIAL) system. In order to fully utilise the capability of an ILS, a 300m runway strip width is required consisting of a 150m wide graded area and 75m wide flyover areas on either side. In a situation where the full 300m wide runway strip is provided and subject to other factors, a CAT 1 ILS can provide instrument approaches with a decision height not lower than 200 feet and either a visibility not less than 800m, or a runway visual range (RVR) not less than 500m. In the case of Runway 28, the published civil instrument approach has a decision height of 307 feet and a visibility requirement of 1,200m (reducing to 800m with actual QNH[5]). This suggests the lack of a 300m wide strip, and possibly other issues, would result in a penalty to the decision height of some 107 feet, combined with higher visibility requirements. The practical implication of this means there would be occasions when additional landing diversions would be required due to actual weather falling between the two decision height and visibility criteria. The situation of a 150m wide runway strip associated with a CAT 1 ILS is not unprecedented and Tamworth airport's runway 30R is an example. In this case, the decision height is 414 feet and visibility criterion is 1,700m (reducing to 1,500m with actual QNH).

Provision of the 300m wide runway strip would enhance the overall civil usability of the airport and is a worthwhile objective. Figure 4.1 indicates it may be possible to achieve the strip widening required, albeit with trade-offs in terms of impacts on the existing RAAF eastern aprons and the need for a small off-airport land acquisition on the southern side of the runway.

[5] QNH is a pressure setting used by pilots, air traffic control (ATC), and low frequency weather beacons to refer to the barometric altimeter setting which will cause the altimeter to read altitude above mean sea level within a certain defined region. This region may be fairly widespread, or apply only to the airfield for which the QNH was given. An airfield QNH will cause the altimeter to read field elevation on landing irrespective of the temperature. Source: http://en.wikipedia.org/wiki/QNH

Figure 4.1 – Possible Widening of Runway Strip to 300m

Source: Base Image Google Earth Pro 2010 (Image Date January 2007)

There are a number of airports in Australia where these types of operations are taking place from circa 2,000m runway lengths, as shown in Table 4.1.

Table 4.1 - Current East Coast Code C Jet Operations from circa 2,000m Runways

Origin	Runway Length (m)	Destination	Air Distance (km)	Carrier	Aircraft
Ballina/Byron Gateway	1,900	Sydney	612	Jetstar/Virgin Blue	A320/B737
Coffs Harbour	2,080	Sydney Melbourne	443 1,118	Virgin Blue Virgin Blue	B737/EMB190 B737
Hamilton Island	1,764	Brisbane Melbourne Sydney	888 1,965 1,526	Jetstar Jetstar Jetstar/Virgin Blue	A320 A320 A320/B737
Hervey Bay	2,000	Sydney	973	Virgin Blue	B737
Mackay	1,981	Avalon Brisbane Sydney	1,881 797 1,433	Tiger Jetstar/Virgin Blue Virgin Blue	A320 A320/B737 B737
Sunshine Coast	1,797	Melbourne Sydney	1,454 837	Jetstar/Tiger/Virgin Blue Jetstar/Virgin Blue	A320/B737 A320/B737
Norfolk Island	1,950	Brisbane Melbourne Newcastle Sydney	1,465 2,345 1,593 1,680	Norfolk Air Norfolk Air Norfolk Air Norfolk Air	B737 B737 B737 B737
Proserpine/ Whitsunday Coast	2,073	Brisbane	895	Jetstar/Virgin Blue	A320/B737

Sources: Airservices Australia 2010, Jetstar, Norfolk Air, Qantas, Tiger & Virgin Blue 2010, BITRE 2010.

The available runway length of 2,134 m at Richmond, therefore, would appear to provide the capability for Code 4C jet passenger transport operations to a range of international and domestic (primarily east coast) destinations as shown in Table 4.2.

Table 4.2 Destinations potentially achievable from Richmond with Code 4C aircraft

Origin	Destination	Approximate Air Distance (km)
Richmond	Wellington NZ	2282
Richmond	Auckland NZ	2210
Richmond	Christchurch NZ	2182
Richmond	Ayers Rock	2132
Richmond	Queenstown NZ	1994
Richmond	Noumea	1986
Richmond	Cairns	1919
Richmond	Norfolk Island	1707
Richmond	Townsville	1639
Richmond	Hamilton Island	1478
Richmond	Adelaide	1137
Richmond	Hobart	1064

For civil operations, Runway End Safety Areas (RESA) is required to be provided. For Runway 10/28, the mandatory RESA are 90m long x 90m wide commencing from the end of clearway i.e. 60m from the paved runway ends. Figure 4.1 shows that it will be possible to achieve the RESA requirements within the airport boundary. The existing grading and ground surface conditions would need to be checked but may already meet civil RESA requirements.

The runway pavement is rated as 70a PCN 47/F/C/1750 (245 PSI)/T (e.g. B737-800). It has a bitumen surface with concrete ends and is grooved. Permanent pavement concessions are in place for military KC10/C5/C17 aircraft.

As noted above, Runway 28 is equipped with a HIAL system. Other visual aids include:

- High intensity runway edge lighting;
- Taxiway centreline green lighting;
- Double sided Precision Approach Path Indicator (PAPI) system 10 and 28 approaches;
- Runway, taxiway and apron markings and markers;
- Two illuminated wind direction indicators (IWDI); and
- Runway distance to run markers.

Non-visual navigation aids are:

- Tactical Air Navigation System (TACAN);
- CAT 1 ILS with marker beacons Runway 28; and
- Non-Directional Beacon (NDB). Note the NDB is probably to be disposed of at the end of the year.

While the primary focus of this study is based on no changes to the existing runway length, a preliminary analysis suggests minor extensions at each end may be achievable within the existing airport boundary and mandatory RESA provisions. This is shown in Figure 4.2 which identifies it may be possible to achieve extensions of:

- 90m at the eastern end; and
- 270m at the western end (assumes 28 localiser relocated to the west of the RESA).

If both extensions were pursued, the overall runway length could be potentially increased from 2,134m to approximately 2,494m. Depending on obstacle considerations, it may be preferable to retain the current threshold locations i.e. using the runway extension potential, primarily for improving take-off payload performance. This may also be relevant for managing noise.

This analysis is based on lateral spatial considerations only and does not take into account issues such as longitudinal grading requirements, obstacle clearance issues and the like. These and possibly other factors such as operational factors would need to be assessed in detail to confirm the above conclusions.

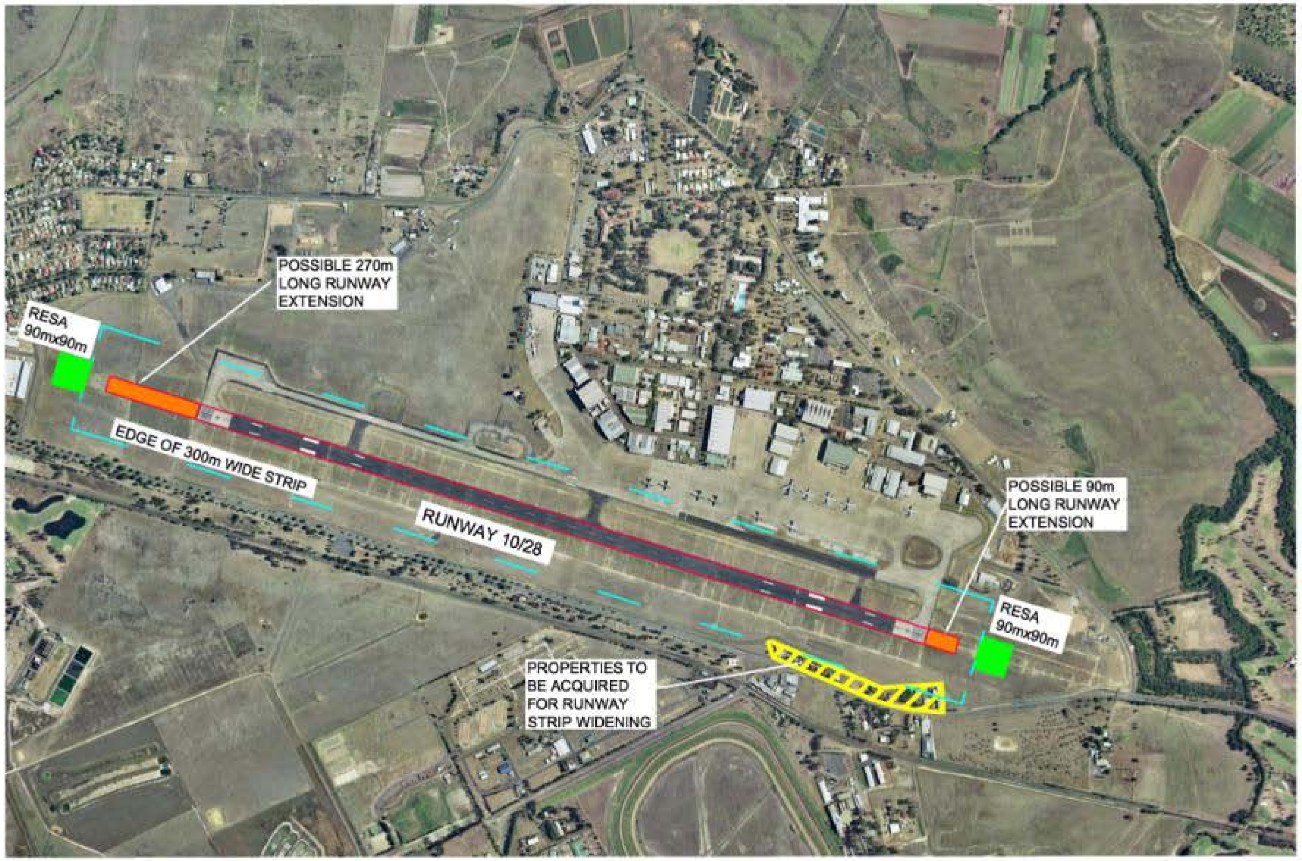


Figure 4.2 – Possible Runway Lengthening Options
Source: Base Image Google Earth Pro 2010 (Image Date January 2007)

4.2 Taxiway Capability

Runway 10/28 is currently served by a full length parallel taxiway on the northern side. It is 15 m wide generally and ignoring shoulder requirements would therefore meet Code C civil standards. The taxiway centreline to runway centreline distance is 122 m which meets Code E Instrument Non-Precision requirements (based on a 150m wide runway strip).

With the exception of Taxiway B which is limited to aircraft up to 20,000kg, taxiway pavements are rated as for the runway.

As indicated above, a worthwhile objective for ultimate design aircraft operations is to achieve the full 300m wide runway strip width requirement for instrument precision approaches. Figure 4.1 also depicts the object clearance implications of relocating the taxiway to provide this Code E capability.

As can be seen from Figure 4.1, compliance with Code E civil object clearance requirements impacts on part of the RAAF eastern apron, a situation which already partly exists in relation to the location of Taxiways Z1 and Z2. The development scenarios presented below seek to address this with replacement apron (if it is required) located elsewhere on the base.

4.3 Runway Capacity

The single runway configuration with full length parallel taxiway would be capable of supporting up to 40 movements per hour based on a relatively homogenous fleet mix of Code 4C jet aircraft in visual weather conditions. The maximum hourly demand rate arising from the air traffic forecasts presented below is around 16 movements per hour. While it has not been possible to compare this hourly rate against the current RAAF hourly rate, the most recent yearly traffic figures for RAAF operations of 5,318 (or an average of around 14 movements per day) would suggest runway capacity is not likely to be a major impediment for significant levels of civil operations, other than what might be short periods of high military activity.

4.4 Obstacle Limitation Surfaces Review

Obstacle limitation surfaces (OLS) protect the immediate airspace in the vicinity of the airport for visual operations and are based on specifications laid down in the MOS for the applicable runway classification. The OLS comprise a series of imaginary planar surfaces in the air surrounding an airport, which desirably should be kept free from penetration by obstacles. This is to ensure the safety of aircraft operations on approach to, departure from and generally around airports.

A preliminary check has been made of the most critical element of the OLS for runway 10/28. This concerns the Instrument Precision approach surface which is also used to determine the threshold location in relation to obstacle clearance requirements. The dimensions of the approach surface are:

- 300m wide inner edge located 60m beyond the threshold;
- divergence of 15% on each side;

- a first section length of 3000m at a slope of 2%;
- a second section length of 3,600m at a slope of 2.5%; and
- a horizontal section length of 8,400m.

This template has been applied over the standard 1:25,000 topographical mapping available for the area, as shown in Figures 4.3 and 4.4. It should be noted this assessment only looks at terrain clearance based on the vertical accuracy of +/- 5m applicable to the contours shown on the base mapping. It does not address any natural or man-made obstacles which may be present in the relevant airspace.

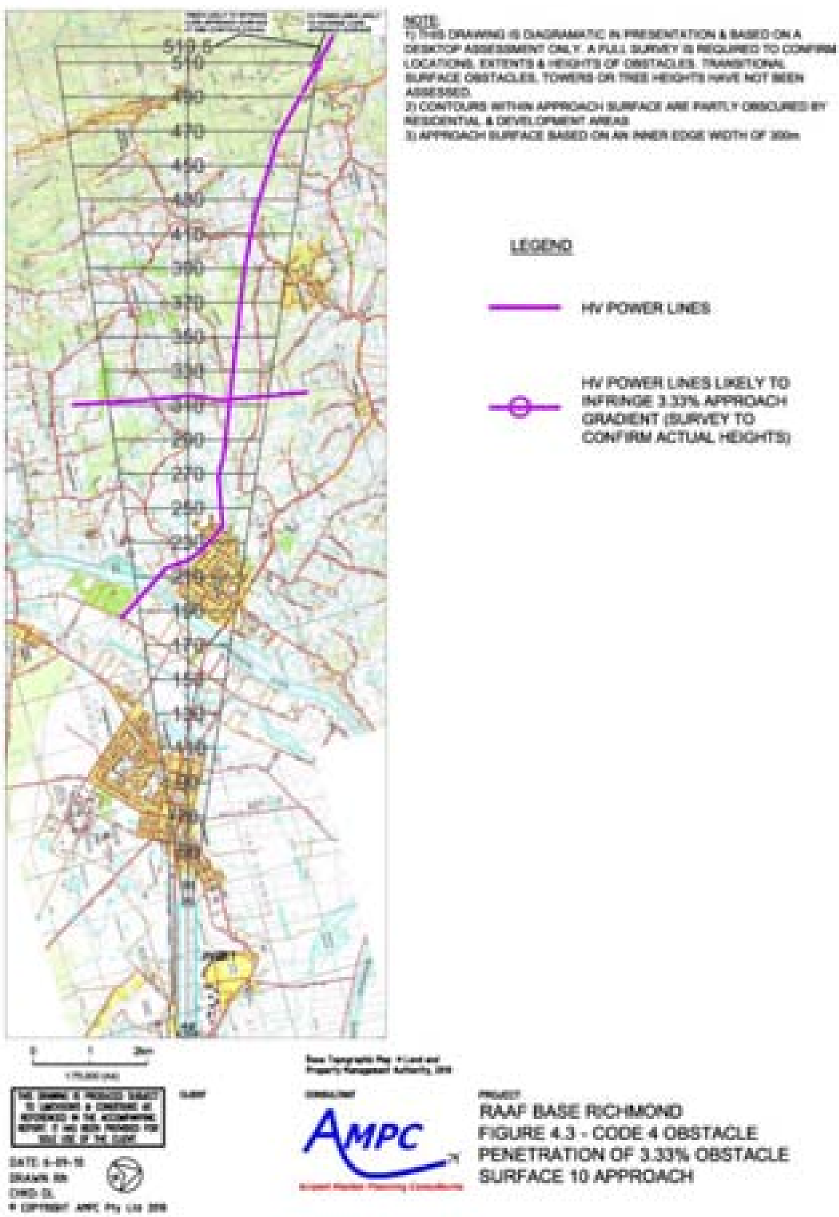


Figure 4.3 – Runway 10 Instrument Precision Approach Surface

Figure 4.3 depicts the 3.33% obstacle free approach surface for Runway 10 rather than the Instrument Precision approach surface as it appears terrain is likely to infringe the latter surface. The importance of the 3.3% obstacle free approach surface is that MOS allows this steeper gradient to be adopted for the purpose of threshold placement. It appears with the exception of a small area of terrain/trees at the extreme end of the approach area and possible power lines as shown in the figure, it may be possible to achieve this requirement. Therefore, subject to survey, field verification and discussions with CASA, the current threshold location may be able to be retained for Code 4 civil use.

Figure 4.4 – Runway 28 Instrument Precision Approach Surface

Figure 4.4 depicts the Instrument Precision approach surface for Runway 28. It would appear the surface is not penetrated by terrain but there are power lines in the locations shown. An obstacle survey would be required to confirm the conclusions reached.

This assessment has not considered all the other elements of the OLS such as the take-off climb surface, inner and outer horizontal surfaces, and conical surface. It also has not considered the transitional surfaces, which are part of the approach surfaces and relate to obstacles adjacent to the runway strip. It may well be for example, that structures in the RAAF area on the northern side of the runway will need to be considered. This indicates a comprehensive obstacle survey is required of all relevant OLS, to confirm or otherwise the conclusions of this preliminary assessment.

The obstacle assessment has not specifically considered any issues arising from the Procedures for Air Navigation Services and Operations (PANS-OPS) surfaces which protect the immediate airspace in the vicinity of the airport for instrument operations and are based on specifications laid down by CASA's *Manual of Standards Part 173 – Standards Applicable to Instrument Flight Procedure Design* (MOS 173).

The PANS-OPS surfaces differ to the OLS in that they protect aircraft conducting operations under Instrument Flight Rules IFR) and as such cannot be infringed under any circumstances, as aircraft relying on them may be flying in Instrument Meteorological Conditions (IMC). However, like the OLS, they comprise a series of airspace reference surfaces. PANS-OPS surfaces generally (although not always) sit at an equivalent or higher level in the airspace than the OLS and are therefore normally protected by virtue of the lower OLS.

4.5 Fog Events

4.5.1 Bureau of Meteorology Analysis

Issues in relation to fog events at Richmond have previously been mentioned in the public arena as a potential reason that enhanced civil operations could be operationally impractical and perhaps commercially unviable. The Bureau of Meteorology (BoM) through the Department of Defence provided some statistical information and further data was obtained by WorleyParsons/AMPC and analysed to assist in obtaining a better understanding of the issue. Fog is technically defined as visibility below 1000m so any fog is, strictly speaking, below the ILS criteria.

BoM has advised that observations at Richmond extend from 1928 to the present so there is a substantial record available. Two observation sites have been used. Visual observations of fog have been recorded from 1941 to 1994 at the first site and from 1995 to 1999 at a second site nearby. After 1999, automatic visibility and cloud height sensors replaced manual observations. Fog occurrence was not recorded but could be largely deduced from sustained visibility reductions. Using the long record of observations of fog at Richmond monthly records of fog occurrence were documented for both the 1941-1994 period and the 1995-1999 period as shown in Figures 4.5 and 4.6.

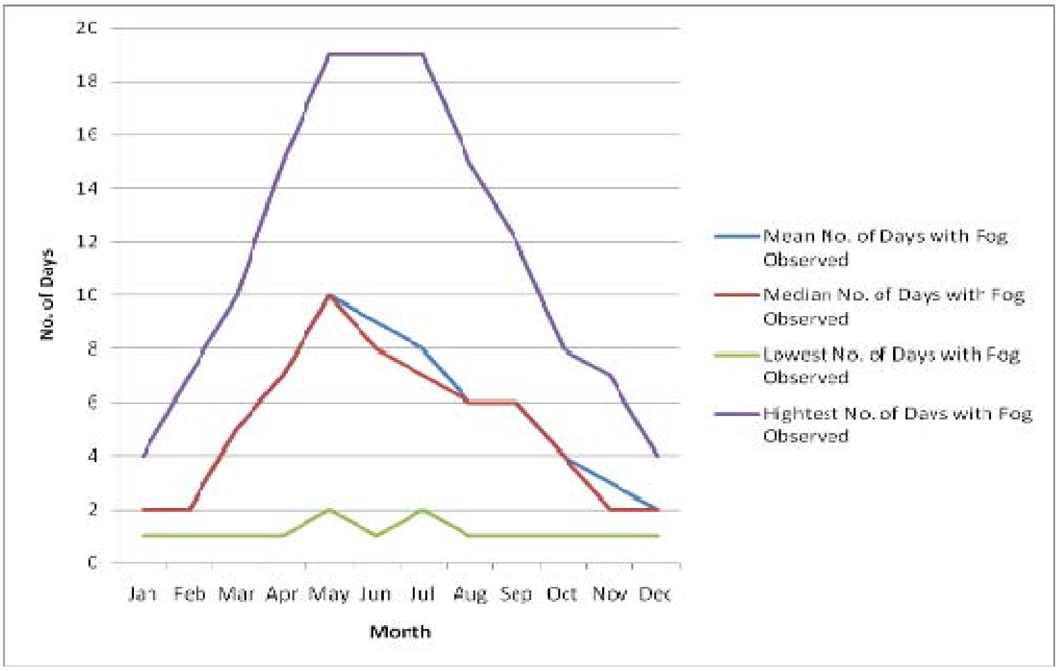


Figure 4.5 – Monthly Fog Occurrence (1941-1994)

Source: BoM 2010

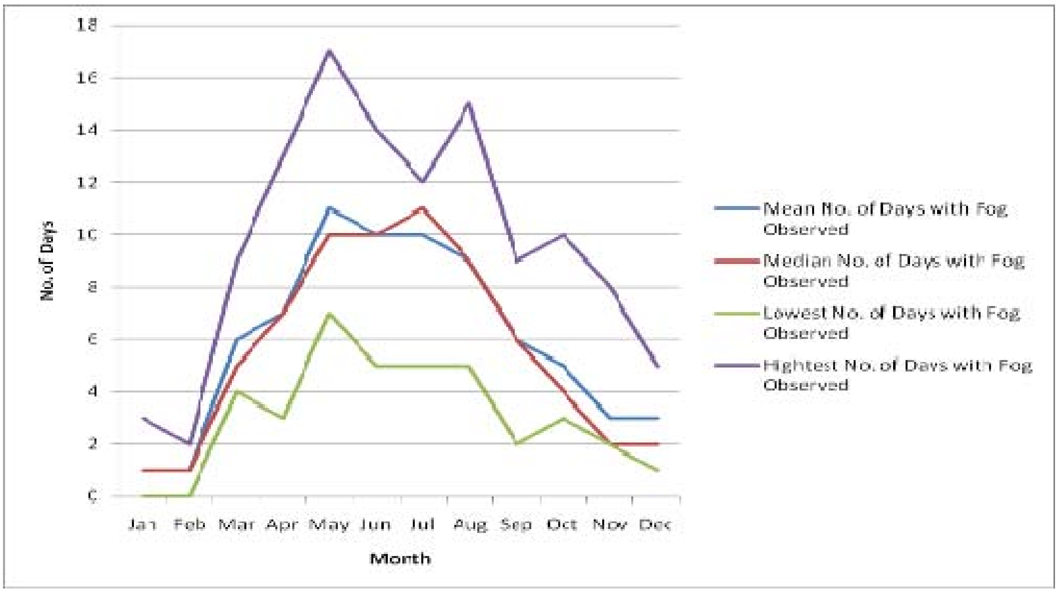


Figure 4.6 – Monthly Fog Occurrence (1995-1999)

Source: BoM 2010

From these records it can be seen that Richmond averages 70 fogs a year, varying from 40 to 100. The months of May to August are the worst with approximately one in three days affected. The 1941-1994 record is little different from the 1995-1999 record.

While these records do not say how extensive the fog was, it could be assumed that whether the fog was widespread or not, fog forecasts would have impacted severely on air movements and planning. Also, it could be argued that given some bias towards conservative forecasting, the frequency of disruptive fog forecasts would be higher than the actual fog frequency.

4.5.2 WorleyParsons/AMPC Analysis

Some additional analysis of Richmond and, for comparison purposes, other airport data was analysed, as discussed below.

The complete databases of observations were obtained from BoM for Richmond, Bankstown, Canberra, Camden and RAAF Base Williamtown. These records were mainly half hourly observations recorded by automatic weather stations (AWS) although the earliest records in the databases were often manual recordings at greater than half hourly intervals. Only the half hourly records dating from when all half hourly records were available were utilised to provide a common basis for this analysis. The record periods used were:

- Richmond – 1994 to present;
- Bankstown – 1993 to present;
- Canberra – 1988 to present;
- Camden – 1998 to present; and
- Williamtown – 1997 to present.

Two sets of airport usability criteria were employed:

- For each airport the main runway direction was compared with the half hourly wind velocity to determine its usability due crosswind limits; and
- The cloud base and visibility were compared with 'average' ILS minima to determine whether the airport would be closed due weather conditions or not.

Only the main runway at each airport was considered for usability against wind velocity. Those runways were:

- Richmond – 10/28;
- Bankstown – 11/29;
- Canberra – 17/35;
- Camden – 06/24; and
- Williamtown – 12/30.

Runway selection criteria of 15 knots crosswind and 5 knots downwind, were used for all airports in this assessment, for consistency of the results. The ILS minima used for all airports (whether or not they are equipped with an ILS) was a cloud base of 300 ft Above Ground Level (AGL) and a visibility of 800m. It was assumed that there would need to be more than scattered cloud below the ILS minima to render the airport unusable. For the purpose of analysis of both runway usability and occurrences of weather conditions below the ILS minima, the recordings between the hours of 6am to 7pm (day time) were used to represent the reasonable operating hours of the airports.

The following lists both the average percentage and time per year (assuming half hourly observation intervals for the day time period) that no runway would meet the specified wind criteria:

- Richmond – 0.65% or 32.0 hours;
- Bankstown – 0.69% or 34.0 hours;
- Canberra – 0.39% or 19.2 hours;
- Camden – 0.75% or 37.0 hours; and
- Williamtown – 2.18% or 107.4 hours.

The following lists both the average percentage and time per year (assuming half hourly observation intervals for the day time period) that airport weather would be below the specified cloud base and/or visibility criteria:

- Richmond – 0.96% or 47.3 hours;
- Bankstown – 0.17% or 8.4 hours;
- Canberra – 0.37% or 18.2 hours;
- Camden – 0.65% or 32.0 hours; and
- Williamtown – 0.51% or 25.1 hours.

These data are also shown graphically in Figure 4.7.

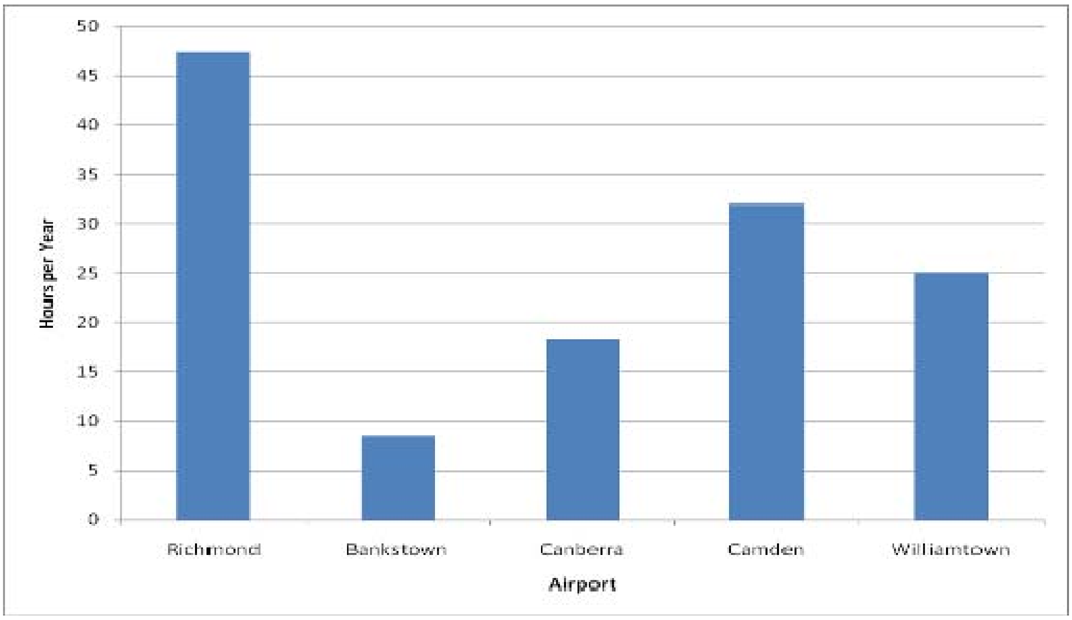


Figure 4.7 – Average Time per Year Less than Specified Cloud Base and/or Visibility Criteria

Source: Dataset BoM 2010

Figure 4.7 suggests that civil operations at Richmond would be more impacted by the occurrence of specified cloud base and/or visibility criteria compared to those at other airports assessed.

Table 4.2 presents for each half hourly observation (over 24 hours) the percentage of time that the airports would have weather conditions below the specified criteria.

Table 4.2 – Half Hourly Observation Comparison over 24 Hours

Observation Time	Richmond (Percentage of Time)	Bankstown (Percentage of Time)	Canberra (Percentage of Time)	Camden (Percentage of Time)	Williamtown (Percentage of Time)
00:00	2.11	0.70	0.21	2.06	1.31
00:30	2.37	0.74	0.31	4.29	1.54
01:00	3.09	0.71	0.39	3.41	1.84
01:30	3.87	0.90	0.57	6.01	1.99
02:00	4.84	1.03	0.63	4.84	2.03
02:30	5.43	0.98	0.87	8.31	2.32
03:00	6.15	1.13	0.77	5.44	2.42
03:30	6.50	1.29	1.07	9.65	2.87
04:00	7.01	1.43	1.25	5.97	3.15
04:30	7.86	1.37	1.43	10.26	3.19
05:00	8.11	1.54	1.58	7.06	3.44
05:30	9.06	1.55	1.88	10.58	3.69
06:00	9.19	1.55	1.96	6.71	3.41
06:30	8.66	1.35	2.16	9.80	3.32
07:00	7.61	1.35	2.06	4.82	2.94
07:30	6.15	1.10	2.14	4.63	2.94
08:00	4.64	0.81	1.90	1.79	2.47
08:30	3.48	0.57	1.87	1.69	2.04
09:00	2.55	0.46	1.36	0.54	1.57
09:30	1.84	0.34	1.20	0.42	1.33
10:00	1.13	0.20	0.96	0.09	1.05
10:30	0.47	0.13	0.62	0.10	0.57
11:00	0.24	0.05	0.38	0.11	0.43
11:30	0.07	0.06	0.22	0.07	0.31
12:00	0.04	0.02	0.10	0.04	0.17
12:30	0.02	0.02	0.00	0.14	0.11
13:00	0.02	0.02	0.04	0.02	0.08
13:30	0.02	0.00	0.01	0.04	0.00
14:00	0.04	0.03	0.01	0.00	0.04
14:30	0.03	0.02	0.03	0.04	0.02
15:00	0.05	0.07	0.01	0.04	0.06
15:30	0.09	0.02	0.00	0.07	0.02
16:00	0.02	0.03	0.01	0.07	0.04
16:30	0.00	0.03	0.03	0.04	0.16
17:00	0.00	0.00	0.00	0.00	0.08
17:30	0.00	0.00	0.00	0.10	0.09
18:00	0.03	0.03	0.00	0.04	0.10
18:30	0.02	0.02	0.00	0.24	0.12
19:00	0.03	0.03	0.00	0.18	0.15

Observation Time	Richmond (Percentage of Time)	Bankstown (Percentage of Time)	Canberra (Percentage of Time)	Camden (Percentage of Time)	Williamtown (Percentage of Time)
19:30	0.14	0.08	0.01	0.38	0.21
20:00	0.17	0.11	0.05	0.33	0.11
20:30	0.19	0.11	0.04	0.63	0.23
21:00	0.31	0.16	0.05	0.55	0.20
21:30	0.58	0.40	0.08	1.19	0.33
22:00	0.44	0.37	0.10	0.80	0.50
22:30	0.73	0.21	0.15	1.58	0.67
23:00	1.26	0.40	0.21	1.64	0.70
23:30	1.49	0.48	0.28	2.67	0.91

Source: Dataset BoM 2010

These data are also presented graphically in **Figure 4.8**.

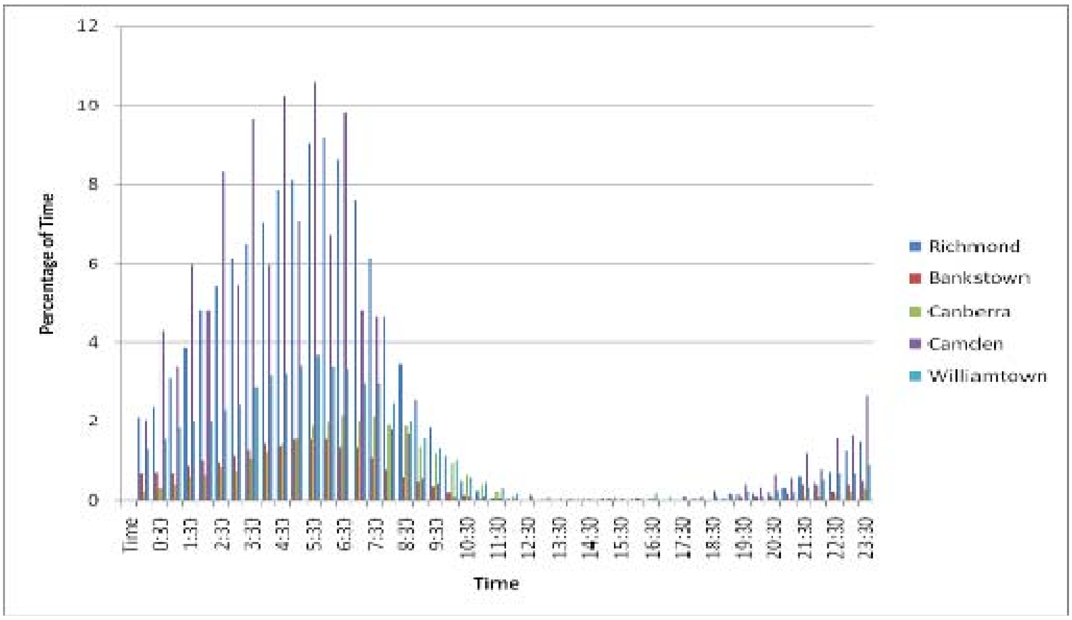


Figure 4.9 – Half Hourly Observation Comparison over 24 Hours

Source: Dataset BoM 2010

Figure 4.8 shows that the incidence of each airport having weather conditions below the assumed ILS minima are concentrated in the early to mid morning parts of the day as would be expected when fog was the limiting factor. The Richmond 7am records for conditions below the ILS minima were examined in detail and the great majority of those records had both reduced visibility and a 'broken' or 'overcast' cloud base below the 300' minima suggesting that the airport would be severely impacted by prevailing weather conditions on average 27 mornings of the year. This figure is less than the average of 70 events identified by BoM. This may be due to the different lengths and periods of data records assessed (1941-1995 – BoM) and (1994-present – WorleyParsons/AMPC).

It is important to note the limitations of this assessment. The AWS records cloud base directly above the station and that may not reflect the conditions on the approach to the runway. The AWS records visibility in a single direction and that may not reflect the conditions on the approach to the runway. The recordings are at half hourly intervals and are a snapshot of conditions at that time and may not reflect the overall trend of changes to the weather conditions. The cloud base is recorded in up to three layers with each layer being given an amount of either, scattered, broken or overcast. The assumption that there needs to be 'more than scattered cloud below the ILS minima to close the airport' is untested. Finally, these data do not provide an actual indication of fog if it is present.

4.6 Technological Opportunities

There are a number of technological opportunities which could be employed to mitigate some of the weather related operational impacts, such as the incidence and duration of fog events, and noise impacts.

4.6.1 CAT II ILS

Until recently, all ILS in Australia have been CAT 1 systems. However, Melbourne Airport has recently commissioned a CAT IIIb system serving Runway 16. This also has the capability to provide CAT II and CAT IIIa approaches for suitably equipped aircraft and appropriately rated pilots. Canberra and Sydney Airports are understood to be contemplating provision of CAT II systems. The primary benefit of these higher standard systems is to reduce the likelihood of diversions in poor weather (primarily fog). Compared to a CAT I system, CAT II provides for:

- a decision height lower than 200 feet but not lower than 100 feet and a Runway Visual Range (RVR) not less than 350m.

Therefore, provision of a CAT II system for Runway 28 at Richmond could be a worthwhile enhancement. Provision of a 300m wide runway strip as discussed above is assumed to be required to fully utilise the CAT II potential. In addition to the system itself, additional supporting infrastructure required would include:

- Enhanced HIAL system;
- Touchdown zone lights;
- Runway centreline lights;
- Taxiway centreline lights that provide continuance guidance between the runway centreline and the apron; and
- Stop bars at each runway holding position serving the runway.

Secondary power would also be required but may already be provided for RAAF operations. Transmission meters, which provide a more accurate means of assessing RVR than a human observer would be assumed to be required.

As aircraft making CAT II approaches would be utilising radar altimeters, an additional consideration is the terrain immediately preceding the threshold. The International Civil Aviation Organization (ICAO) notes it is desirable that slope changes be avoided or kept to a minimum, on a rectangular area at least 300m long before the threshold of a precision approach runway. The area should be symmetrical about the extended centre line, 120m wide. It is known that the terrain drops appreciably in the area to the east beyond the Runway 28 threshold, and therefore a survey would be required to determine if compliance with the ICAO guidance is met or would require earthworks.

4.6.2 Required Navigation Performance (RNP)

Required Navigation Performance (RNP) is a statement of the navigation performance necessary for operation within a defined airspace. It is part of a broader concept called "Performance-based Navigation." RNP is a method of implementing routes and flight paths that differs from previous methods in that not only does it have an associated performance specification that an aircraft must meet before the path can be flown, but it must also monitor the achieved performance and provide an alert in the event that this fails to meet the specification.

Airservices Australia has recently commissioned Naverus to develop RNP procedures for arrival and departure flight paths at up to 28 major airports around Australia over the next five years, as the initial stage in the wider use of this technology.

ICAO has recognised that approaches with some form of vertical guidance or approach vertical guidance should be the minimum approach design standard as this (vertical guidance) can add some eight times the safety to the straight-in approach. Australia is working towards this goal and one such advancement is the incorporating of vertical guidance on Global Navigation Satellite Systems (GNSS) approaches known as BARO-VNAV. The BARO-VNAV approach allows for suitably equipped and certified aircraft to conduct a GNSS approach with the addition of computer generated vertical guidance, similar to an ILS display. It is envisaged that a single approach plate will be produced depicting both the “standard” GNSS approach with its associated minima, and additional BARO-VNAV decision altitude (DA) information for the BARO-VNAV approach. PANS-OPS describe BARO-VNAV approaches as “… Instrument procedures in support of approach and landing operations with vertical guidance… They use obstacle assessment surfaces (OAS) similar to those for ILS but based on a specific lateral guidance system.” In this case the guidance system referred to is the GNSS receiver. In the Federal Government’s Aviation White Paper released in December 2009, the commitment to APV utilising BARO-VNAV was reinforced, with the objective of having APV procedures available for 100% of instrument runways used by APV-capable aircraft in the 2014-19 timeframe.

The use of RNP with BARO-VNAV at Richmond should provide additional instrument approach capability complimenting the existing ILS, as well as potential flexibility in the definition of approach and departure tracks, as a means of mitigating noise impacts.

An example of a RNP instrument approach procedure is shown in Figure 4.9 for Runway 14 at Gold Coast Airport. As can be seen, the aircraft carries out a curved approach to Waypoint CG641 before intercepting the runway extended centreline at a distance of only 1.9 nautical miles (3.5km) from the threshold.

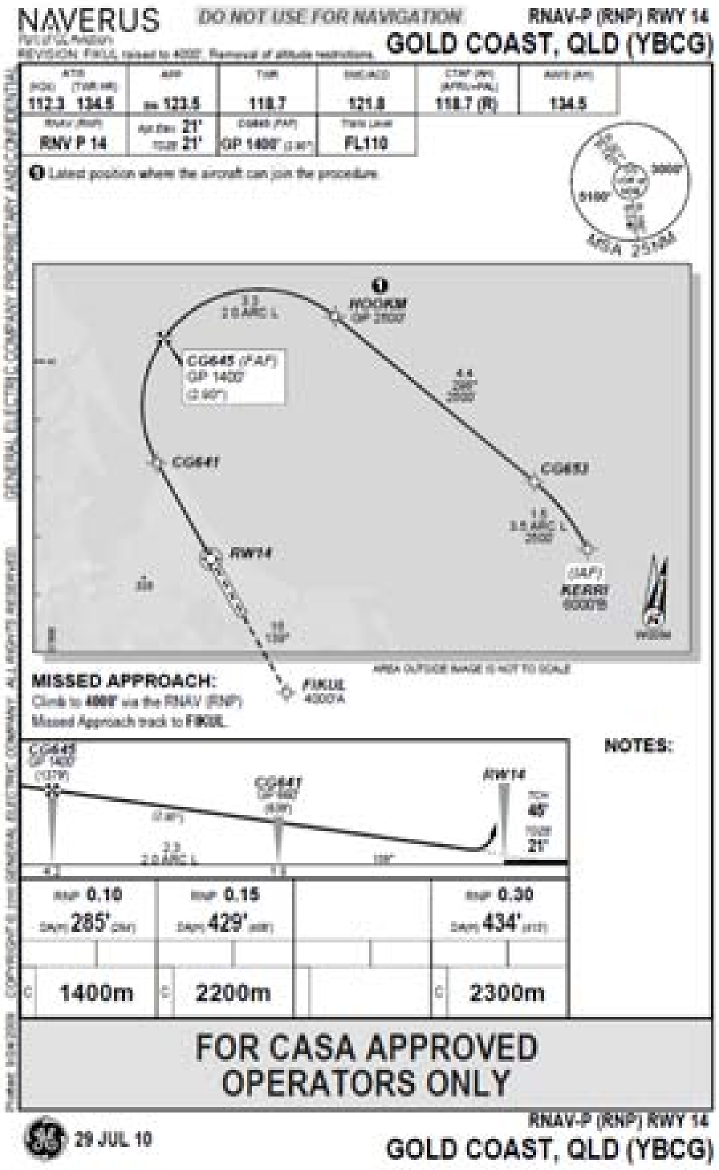


Figure 4.9 – RNP Instrument Approach Example

Source: Airservices Australia 2010

4.6.3 Very High Frequency Omni-Range and Distance Measuring Equipment (VOR/DME)

Depending on the timing of any future civil operations it may be prudent to allow for the installation of VOR/DME equipment to support instrument non-precision approaches, ahead of a more widespread removal of these and other ground-based navigation aids and their replacement by satellite based technology such as RNP and the like.

The development concepts presented below, therefore show a nominal site for a future VOR/DME if it is deemed to be required.

4.7 Airspace Interaction

It is noted there could be issues in relation to the airspace interaction between enhanced civil operations at Richmond and those at Sydney (Kingsford-Smith) Airport. For example, concurrent instrument approaches in the 28 direction at Richmond and the 16 direction at Sydney will intersect in the airspace to the north of Hornsby as shown in Figure 4.10. Assuming concurrent aircraft approaches with all aircraft established on the 3 degree glideslope, aircraft would be at the approximate altitudes as shown on Figure 4.10. This provides less than the standard 1,000 feet vertical separation applicable in controlled airspace.

The design and management of Richmond procedures would therefore need to address these types of issues, with the objective of minimising any dependency requirements which might impact on the capacity potential at either airport.

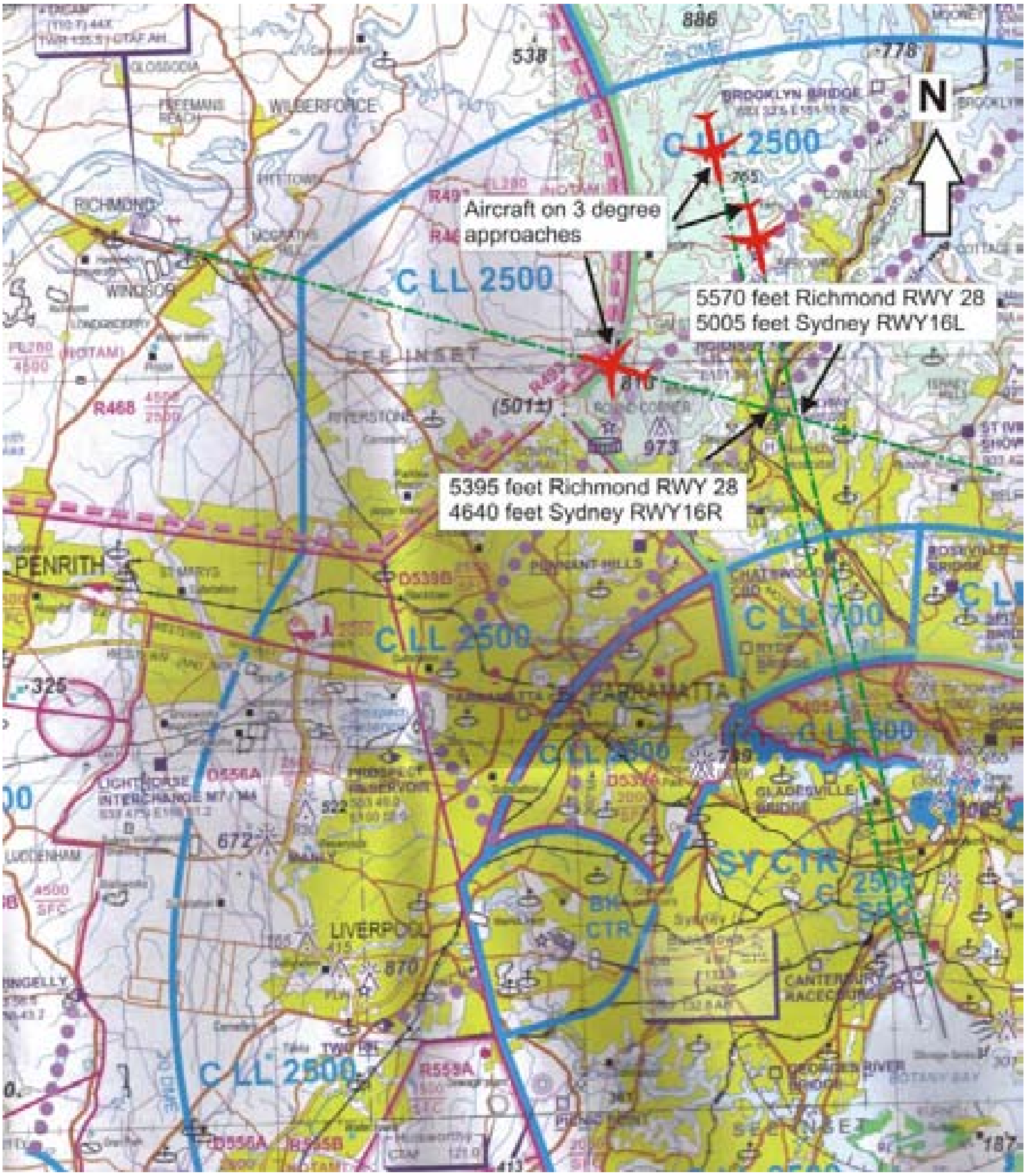


Figure 4.10 – Airspace Interaction (Not to Scale)

Source: Base Image Airservices Australia 2010

4.8 Public Safety

In the Aviation White Paper[6], the Federal Government indicated its intention to work with state, territory, local governments and industry stakeholders to undertake a detailed examination of the implications of public safety zones in the vicinity of airports. This policy initiative followed an earlier Discussion Paper associated with the Green Paper, entitled *Safeguards for airports and the communities around them 2009* which was released with the aim of increasing public safety and protecting aviation infrastructure from inappropriate development around airports and under flight paths. The Discussion Paper noted that with the exception of Queensland, there are no guidelines or standards currently operating in Australia.

Within its *State Planning Policy 1/02* and associated guidelines, the Queensland Government has requirements for public safety areas (PSA) which are applicable at a number of Queensland aerodromes. The PSA are based on UK research undertaken in the late 1990's by NATS and on which UK public safety zone policy is currently based.

Although these PSA requirements only apply in Queensland, some airports in other jurisdictions nevertheless apply the Queensland PSA in the absence of the national policy still to be determined. The Queensland policy seeks to avoid significant increases in people living, working or congregating in the PSA and the use or storage of hazardous materials. In the PSA, the risk of an accident is sufficient to justify restrictions on development within those areas. Increased risks to public safety can arise from development that involves the following:

- Residential uses;
- The manufacture or bulk storage of inflammable, explosive or noxious materials;
- Uses that attract large numbers of people eg sports stadium, shopping centre, industrial uses involving large numbers of workers or customers; or
- Institutional uses eg schools, hospitals.

Application of the Queensland PSA template in relation to Runway 10/28 would suggest some of the existing land uses fall within the categories identified above, at least for the Runway 10 end.

[6] Aviation White Paper - Flight Path to the Future - December 2009

5 AIR TRAFFIC FORECASTS

5.1 Passengers

For the purpose of this study it has been assumed that passenger aircraft types will comprise the range of Code 4C medium narrow body jet aircraft currently operating in Australia on domestic routes such as the B737 series, A320 series and EMB-190, as used by Qantas, Jetstar, Virgin Blue and Tiger. As discussed, Richmond may be particularly suitable to the LCC model in the same way that has seen Avalon Airport develop in part as a second RPT airport for the Melbourne region. Richmond is likely to be less attractive to regional operators or passengers and therefore operations by these smaller aircraft have been ignored for the purpose of the assessment.

It is common practice to develop air traffic forecasts based on actual historical passenger activity and then apply growth factors over subsequent years based on drivers such as economic activity. In this case, as there is no historical passenger activity, the forecasts are based on three passenger demand levels which are not specifically time related but nevertheless represent points along a logical growth path from start-up through to the medium/longer-term as follows:

- 1 million passengers per annum representing start-up and initial growth (1 million passengers is similar to Avalon Airport's current operating levels);
- 3 million passengers per annum representing medium-term growth (3 million passengers is similar to Canberra Airport's current operating levels); and
- 5 million passengers per annum representing longer-term growth (5 million passengers are similar to Gold Coast Airport's current operating levels).

An approximation of when post start-up traffic growth levels might be achieved can be made with reference to the Bureau of Infrastructure, Transport and Regional Economics 2010, *Aircraft movements through capital city airports to 2029–30*, Report 117. This study projects annual average domestic passenger growth rates at Sydney Airport of 3.8% between 2008/09 and 2029/30. Therefore, if these growth rates were reflected at Richmond it would theoretically take almost 30 years to reach 3 million passengers from the 1 million level. This should be treated with caution as factors such as lower operating costs at Richmond might drive much higher growth rates particularly in the earlier years. The experience of Newcastle Airport serves as an example which has seen passengers increase from about 150,000 in 1998/99 to about 1.2 million in 2008/09, or an annual average increase of almost 23% over this 10 year period. Applying a similar growth rate, would see 3 million passengers reached in as little as around five years from the 1 million level at Richmond.

5.2 Aircraft Movements

For the purpose of deriving aircraft movement numbers, a 180-seat aircraft configuration has been adopted and an 85% load factor assumed. Table 5.1 shows the annual and average daily aircraft movement numbers responding to each of the annual passenger demand levels.

Table 5.1 – Indicative Annual and Average Daily Aircraft Movements

Passenger Demand Level (Millions)	Seats (85% Load Factor)	Annual Aircraft Movements	Average Movements per Day
1	1,176,471	6,536	18
3	3,529,412	19,608	54
5	5,882,353	32,680	90

5.3 Gate and Busy Hour Projections

The annual and daily aircraft movements can be further broken down to develop gate and passenger busy hour requirements which can then be used for other functional planning aspects such as terminal and carparking requirements and the like. Assumptions relevant to deriving the busy hour requirements are:

- The traffic profile reflects that of Australia generally i.e. pronounced morning and late afternoon peaks;
- Nominal airfield operating hours between 0600-2300 hours daily;
- A conservative aircraft turnaround time of 40 minutes (noting the LCC preference for 30 minutes);
- A 10 minute buffer each side of a scheduled arrival or departure; and
- A further 15 minute allowance either side of the buffer for gate occupancy.

Figures 5.1 to 5.3 show indicative daily schedules based on these assumptions for each of the passenger demand levels.

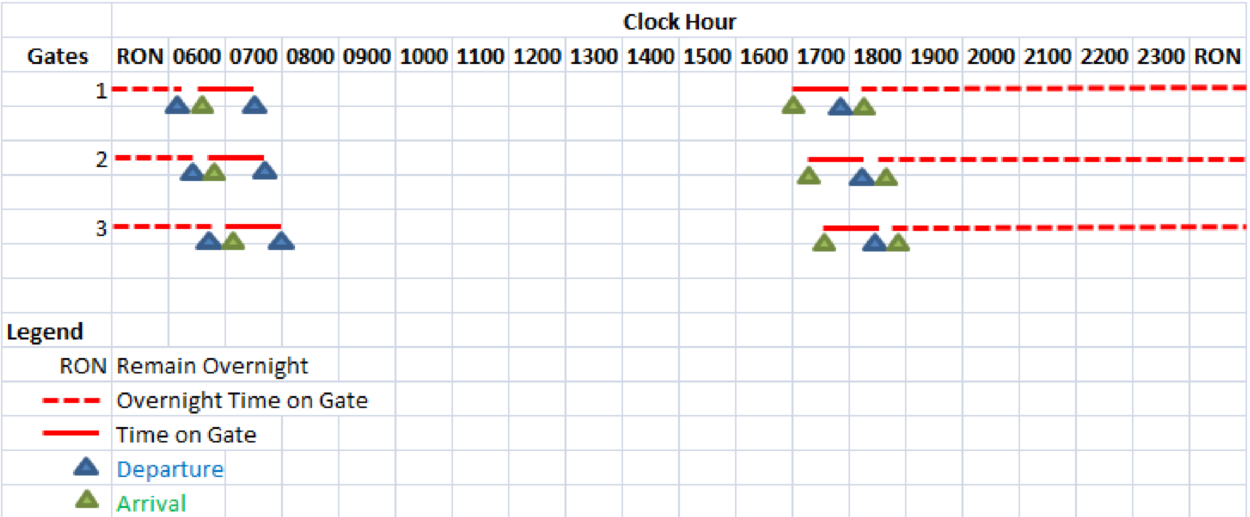


Figure 5.1 – Indicative Daily Schedule for 1 Million Passengers per Year

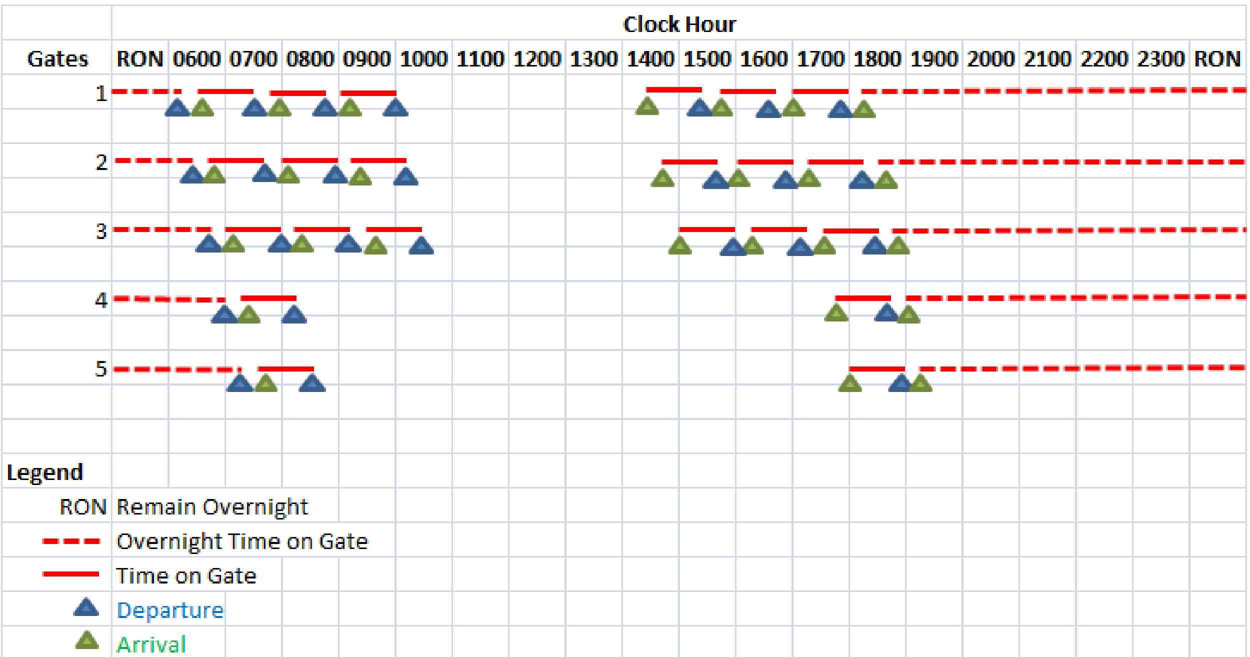


Figure 5.2 – Indicative Daily Schedule for 3 Million Passengers per Year

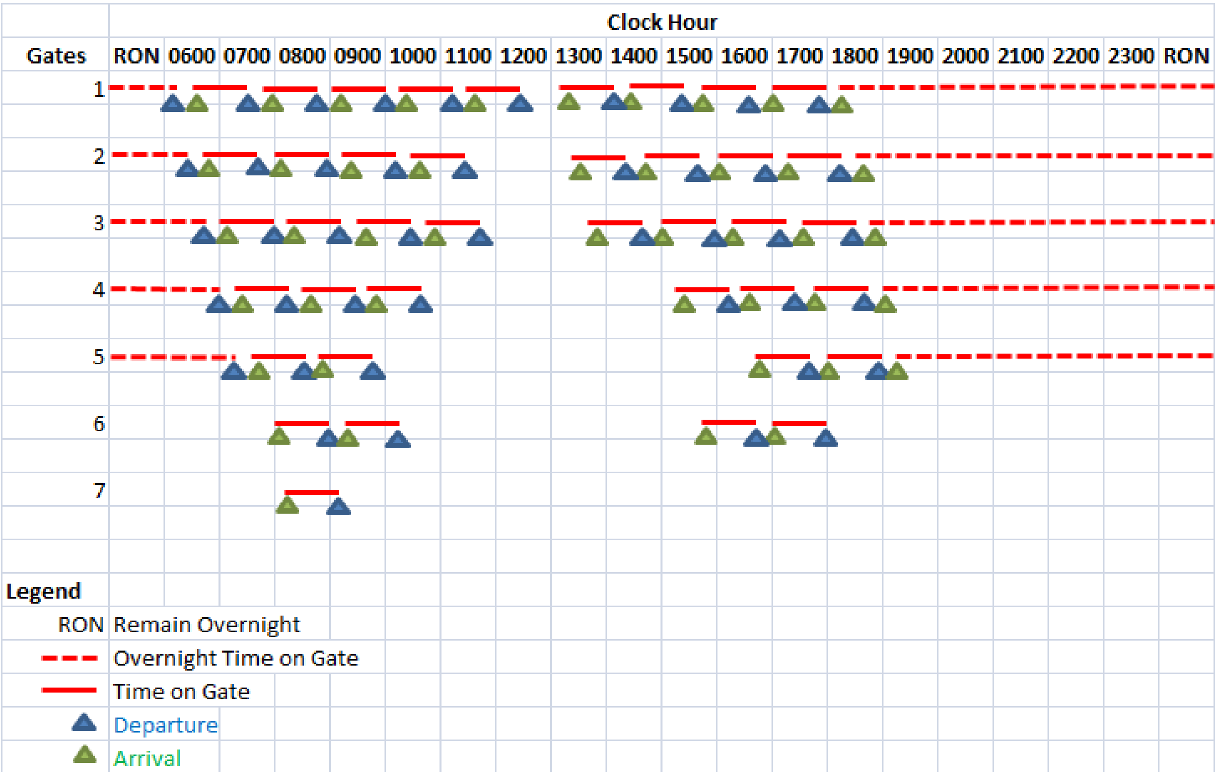


Figure 5.3 – Indicative Daily Schedule for 5 Million Passengers per Year

From Figures 5.1 to 5.3, the respective peak hour gate demands are summarised in Table 5.2.

Table 5.2 – Peak Hour Gate Demand

Passenger Demand Level (Millions)	Gate Requirements (Note 1)
1	4
3	6
5	8

Note 1: includes one additional gate for off-schedule, itinerant or unserviceability purposes.

Also from Figures 5.1 to 5.3, the passenger busy hour numbers are as shown in Table 5.2.

Table 5.2 – Busy Hour Passengers (Arrivals plus Departures)

Passenger Demand Level (Millions)	Passengers
1	918
3	1,530
5	2,448

6 AUSTRALIAN NOISE EXPOSURE CONCEPTS

6.1 Aircraft Noise

The traditional system of aircraft noise assessment has been based around the Australian Noise Exposure Contour (ANEF) metric, which was a modification of the US Noise Exposure Forecast system. The ANEF is a generic name for three types of equal energy aircraft noise contours:

- The Australian Noise Exposure Forecast (ANEF) is the only metric approved and promoted by the Federal Government for use in determining the suitability of land use in regards to aircraft noise. The ANEF is generally provided for a 20-year time frame, is updated regularly and there can be only one approved set of ANEF contours at a given time. The approving authority is Airservices Australia;
- The Australian Noise Exposure Index (ANEI) provides historical data on aircraft noise exposure. Normally one year's actual traffic at an airport is used to generate the ANEI and the approval process is the same as that for the ANEF; and
- The Australian Noise Exposure Concept (ANEC) is used as a planning tool to investigate likely changes to aircraft noise exposure resulting from proposed changes to conditions at an airport. Those changes include, among other things, changes to aircraft types or numbers.

The ANEF system is described in the Australian Standard AS2021 and is the only method of controlling land use planning at all but two minor Australian aerodromes. It is not used to regulate aircraft operations, but rather to report on the effects of those activities. This system takes into account the frequency, intensity, time and duration of aircraft activities and calculates the total sound energy generated at any location. While ANEF contour charts are often misunderstood by the public at large, various expert committees that have considered the regulation of aircraft noise around Australian aerodromes have concluded that they are the most appropriate measure available. In the last few years there have been supplementary indices developed to help better describe aircraft noise in terms that are more readily understood by the public. These indices include N70 and Flight Track Frequency charts.

The only method of calculating ANEF contours is by use of the Integrated Noise Model (INM) developed by the Federal Aviation Agency of the USA. It cannot be directly measured. The INM calculates the aircraft noise exposure for an average day (averaged over a year) activity at an airport and for an ANEF, this day is an average day of a complete year at the forecast date.

The Australian Standard AS2021 provides guidance to regional, local authorities and others associated with urban and regional planning and building construction on the acceptable location of new buildings in relation to aircraft noise. Zones that are described as 'conditionally acceptable' may be approved as building sites provided that any new construction incorporates sound proofing measures. Section 2 of the standard gives guidelines for determining the acoustic acceptability of a particular site. Conversely, the standard can be used to assess the noise impact of a new aerodrome or of altering an existing one, by the production of an ANEC.

The Australian Standard AS2021 provides recommended land use compatibility as reproduced at Table 6.1 below. For land designated "conditionally acceptable" it should be noted that land use authorities might consider that "the incorporation of noise control features in the construction of residences or schools is appropriate".

Table 6.1 - AS2021 table of Building Site Acceptability Based on ANEF Zones

Building Type	ANEF Zone of Site		
	Acceptable	Conditional	Unacceptable
House, home unit, flat, caravan park	Less than 20 ANEF (Note 1 of AS2021)	20 to 25 ANEF (Note 2 of AS2021)	Greater than 25 ANEF
Hotel, motel, hostel	Less than 25 ANEF	25 to 30 ANEF	Greater than 30 ANEF
School, university	Less than 20 ANEF (Note 1 of AS2021)	20 to 25 ANEF (Note 2 of AS2021)	Greater than 25 ANEF
Hospital, nursing home	Less than 20 ANEF (Note 1 of AS2021)	20 to 25 ANEF	Greater than 25 ANEF
Public building	Less than 20 ANEF (Note 1 of AS2021)	20 to 30 ANEF	Greater than 30 ANEF
Commercial building	Less than 25 ANEF	25 to 35 ANEF	Greater than 35 ANEF
Light industrial	Less than 30 ANEF	30 to 40 ANEF	Greater than 40 ANEF
Other industrial	Acceptable in all ANEF zones		

Source: AS2021-2000

For aerodromes that do not have ANEF charts published for them, AS2021 provides a land use compatibility table based on measured aircraft noise and frequency of flight. Table 6.2 reproduces that table:

Table 6.2 – AS2021 Table of Building Site Acceptability Based on Aircraft Noise Levels

Building Site	Aircraft Noise Level expected at building site, dB(A)					
	20 or less flights per day			Greater than 20 flights per day		
	Acceptable	Conditionally acceptable	Unacceptable	Accept-able	Conditionally acceptable	Unacceptable
House, home unit, flat, caravan park	<80	80 - 90	>90	<75	75 - 85	>85
Hotel, Motel, hostel	<85	85 - 95	>95	<80	80 - 90	>90
School, university	<80	80 - 90	>90	<75	75 - 85	>85
Hospital, nursing home	<80	80 - 90	>90	<75	75 - 85	>85
Public building	<85	85 - 95	>95	<80	80 - 90	>90
Commercial Building	<90	90 - 100	>100	<80	80 - 90	>90
Light industry	<95	95 - 105	>105	<90	90 - 100	>100
Heavy industry	No limit	No limit	No limit	No limit	No limit	No limit

Source: AS2021-2000

The INM model itself contains a detailed database of aircraft performance and noise characteristics that have been determined from actual detailed measurements of the required parameters. In fact a part of the certification process for new aircraft types is that the manufacturer is required to undertake the required measurements to support the model. The user of the INM is required to supply all other required data, typically covering aircraft operations over an average day with this day representing the average aviation activities for a whole year. The data required includes:

- Physical data; descriptions of runways and flight tracks and location of any sites that specific results are required for;
- Detailed flight characteristics for any non-standard aircraft operations to be modelled;
- A detailed description of all aircraft flights for the typical, or average, day being modelled; and
- Any variations to the standard output metrics that is required.

Apart from the ANEF contours that are used for land use-planning guidelines at Australian aerodromes there is a wide range of other metrics that can be calculated using the INM. These include:

- Eight A-weighted metrics (used for standard noise analysis where aircraft noise spectra are modified by depressing noise levels in the low and high frequency bands to approximate the response of the human ear). These metrics include Day-night average sound level (the AS2021 Section 4-2 average exposure level) and LAMAX (the AS2021 Section 4-2 maximum exposure level);

- Three C-weighted metrics (used for low-frequency noise analysis where aircraft noise spectra are modified by depressing noise levels in the low and high bands but to a lesser degree than A-weighting); and
- Five perceived tone-corrected noise metrics (used for noise analysis based on aircraft noise certification tests where aircraft noise spectra are modified by depressing noise levels in the low and high frequency bands and elevating metric levels if there are tonnes in the spectra). This family of metrics includes the ANEF contours.

In the last few years there have been supplementary indices developed to help better describe aircraft noise in terms more readily understood by members of the public. These indices include N70, Flight Track Frequency charts and Single Event Contours.

The N70 contour chart is commonly used to supplement an aerodrome's ANEF charts. The N70 is calculated using the INM and indicates the number of aircraft noise events that exceed 70 dB (A). The 70 dB(A) value is used, as that is the external noise level that will be at the disturbance threshold of people in an average residence with doors and windows closed. These contour types can be calculated for whatever noise value is required. For airports with mainly GA movements in regional areas where background noise levels may be lower and people may spend more time outdoors, the N60 level is more likely to be indicative of the noise regime.

6.2 ANEC Charts

Australian Noise Exposure Concepts (ANEC) has been prepared for each of the three passenger demand levels shown in Table 5.1. (A fourth ANEC, without any civil jet activities, has been included for comparative purposes.) The three passenger demand level ANECs provide for annual Code 4C jet aircraft movements of:

- 6,536;
- 19,608; and
- 32,680.

For each ANEC, RAAF aircraft movements have been assumed to remain constant at the forecast 2014 level of approximately 16,500. These movements have been assumed to comprise operations by the home based squadron of C130 aircraft and various RAAF and civil activities. The annual RAAF aircraft activities generally occur on the 240 operational days for RAAF Bases however the home based squadron of C130 aircraft is liable to call-out at any time. Civil activities will generally occur over weekends and holiday periods. The current activities are not limited to the main runway with the cross runway and some outlying flight strips being occasionally utilized.

The 2014 forecast was modified slightly by removing the Boeing 707 aircraft: a very noisy aircraft that is unlikely to be in operation by 2014. Also it is noted that there are no movements by the Super Hornet (just coming into service) but the forecast standard Hornet activities are a reasonable substitute.

For simplicity, the flight paths used for the ANEC are based on straight ahead departures and arrivals. In a practical sense it may be possible to initiate turns at an early stage in the departure phase (i.e. after reaching 500 feet above ground) in order to mitigate noise impacts over the Windsor and Richmond urban areas. This would have an effect on the shape and coverage of the ANEC contours. The RAAF already employ noise abatement procedures incorporating these practices.

The four ANEC charts indicate that there would be only a small increase in the size of the ANEC contours as the civil passenger activities increase however it should be noted that there would be a noticeable increase in the overall flight activities at the Base with the 1 million passenger forecast resulting in a 25% increase in average daily movements; the 3 million passenger forecast resulting in an 80% increase of average daily movements and the 5 million passenger forecast an increase of 130% in average daily movements.

Figures 6.1 to 6.5 show the respective ANECs (with the B707 movements removed in each case):

- Figure 6.1 – ANEF Military Traffic only (the 2014 ANEF without the B707);
- Figure 6.2 – ANEC Military Traffic with Civil operations to 1 million passengers added;
- Figure 6.3 – ANEC Military Traffic with Civil operations to 3 million passengers added;
- Figure 6.4 – ANEC Military Traffic with Civil operations to 5 million passengers added;
- Figure 6.5 – Comparison of the above four ANEC/ANEF cases – Comparison of the ANEF Military Traffic (the 2014 ANEF) with Military Traffic with Civil operations to 5 million passengers added.

Note that the 2014 ANEF included a glider strip and a cross runway. These have been retained in the INM as they do not significantly affect the illustration of the impact of adding civilian operations to the main runway and as little change as possible was made to the existing Military ANEF, other than removing the noisy B707 which no longer operates at RAAF Base Richmond.

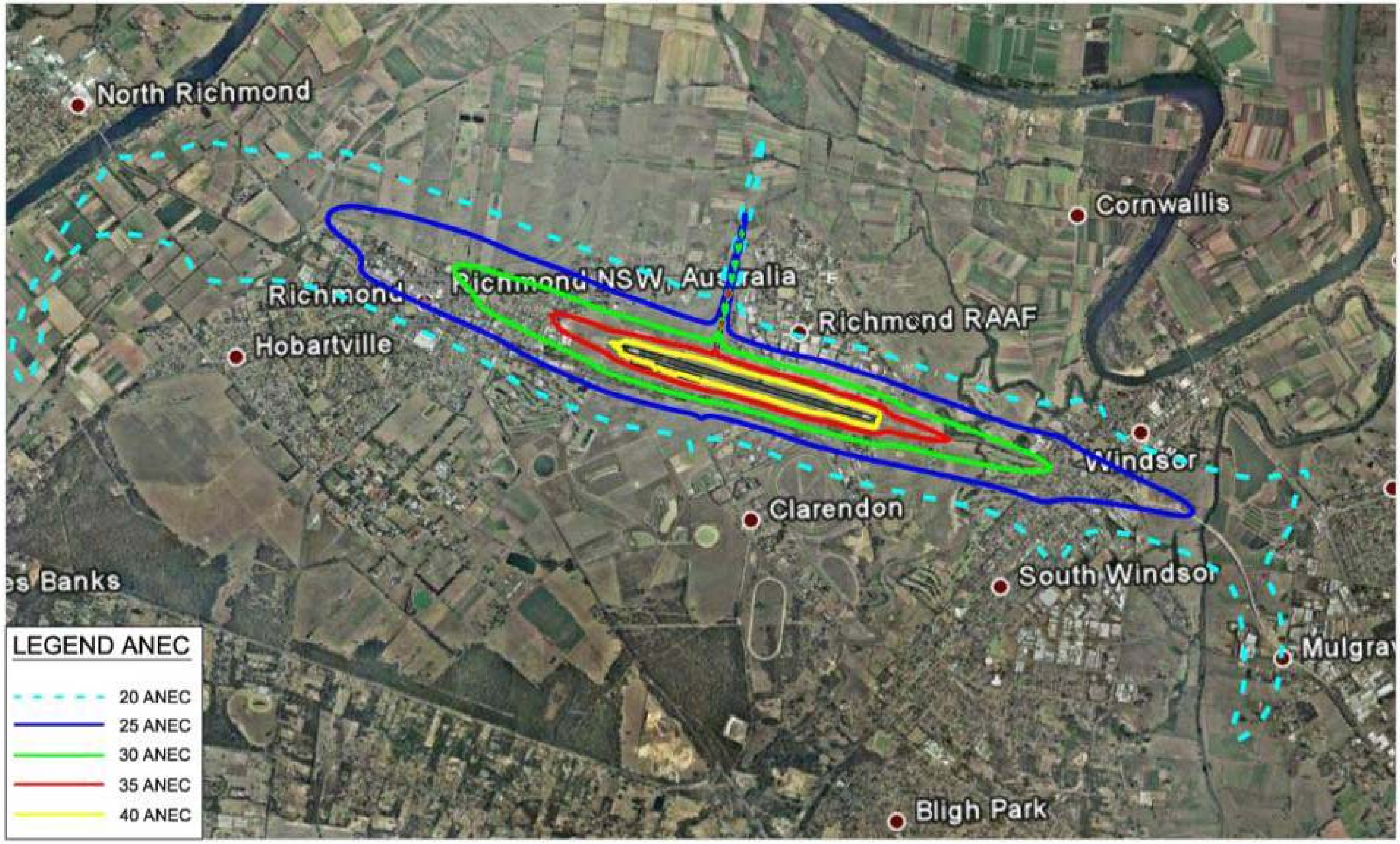


Figure 6.1 – ANEF Military Traffic only (the 2014 ANEF without the B707)

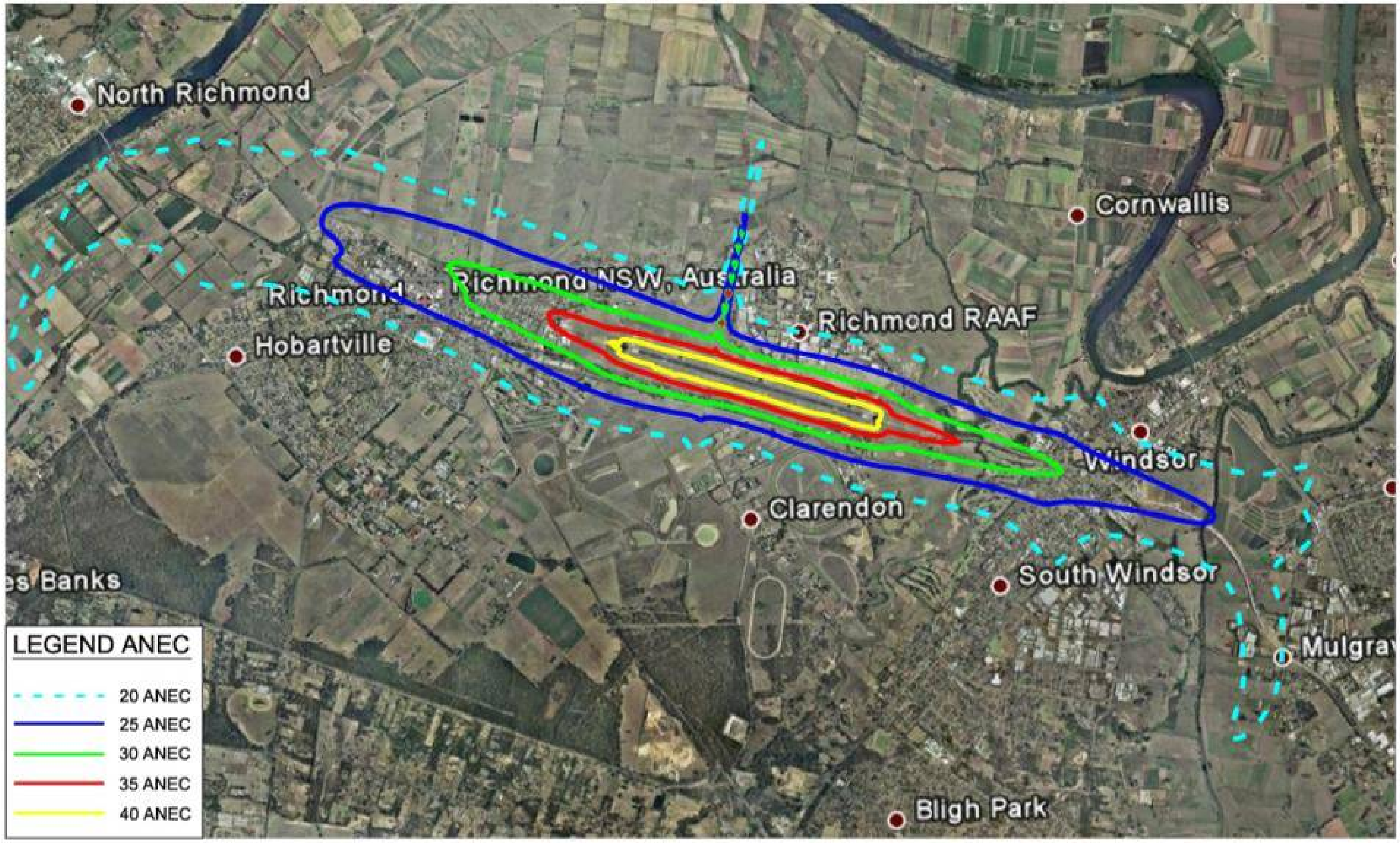


Figure 6.2 – ANEC Military Traffic with 1 Million Civil Passengers ANEC (6,536 civil movements)

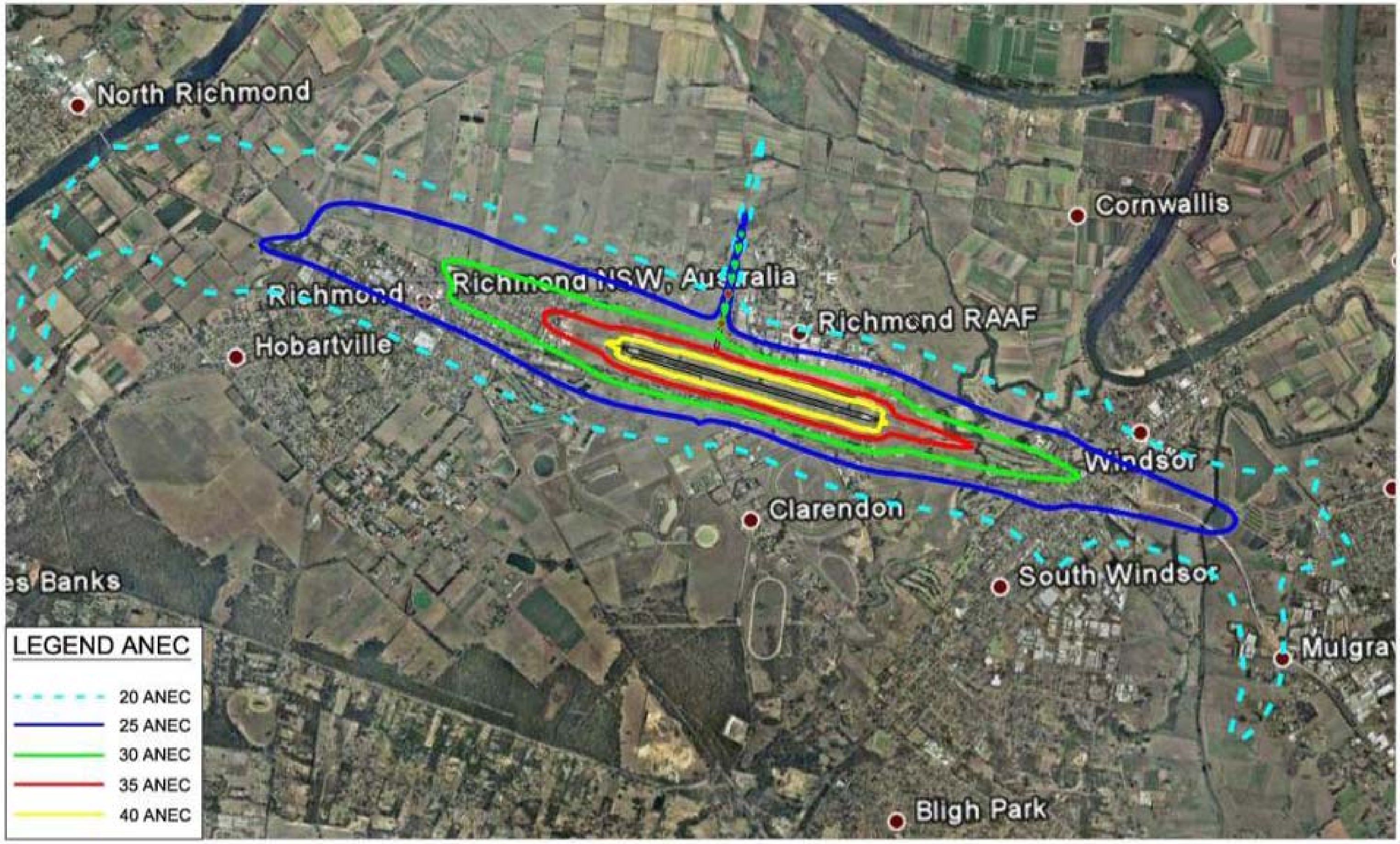


Figure 6.3 – ANEC Military Traffic with 3 Million Civil Passengers ANEC (19,608 civil movements)

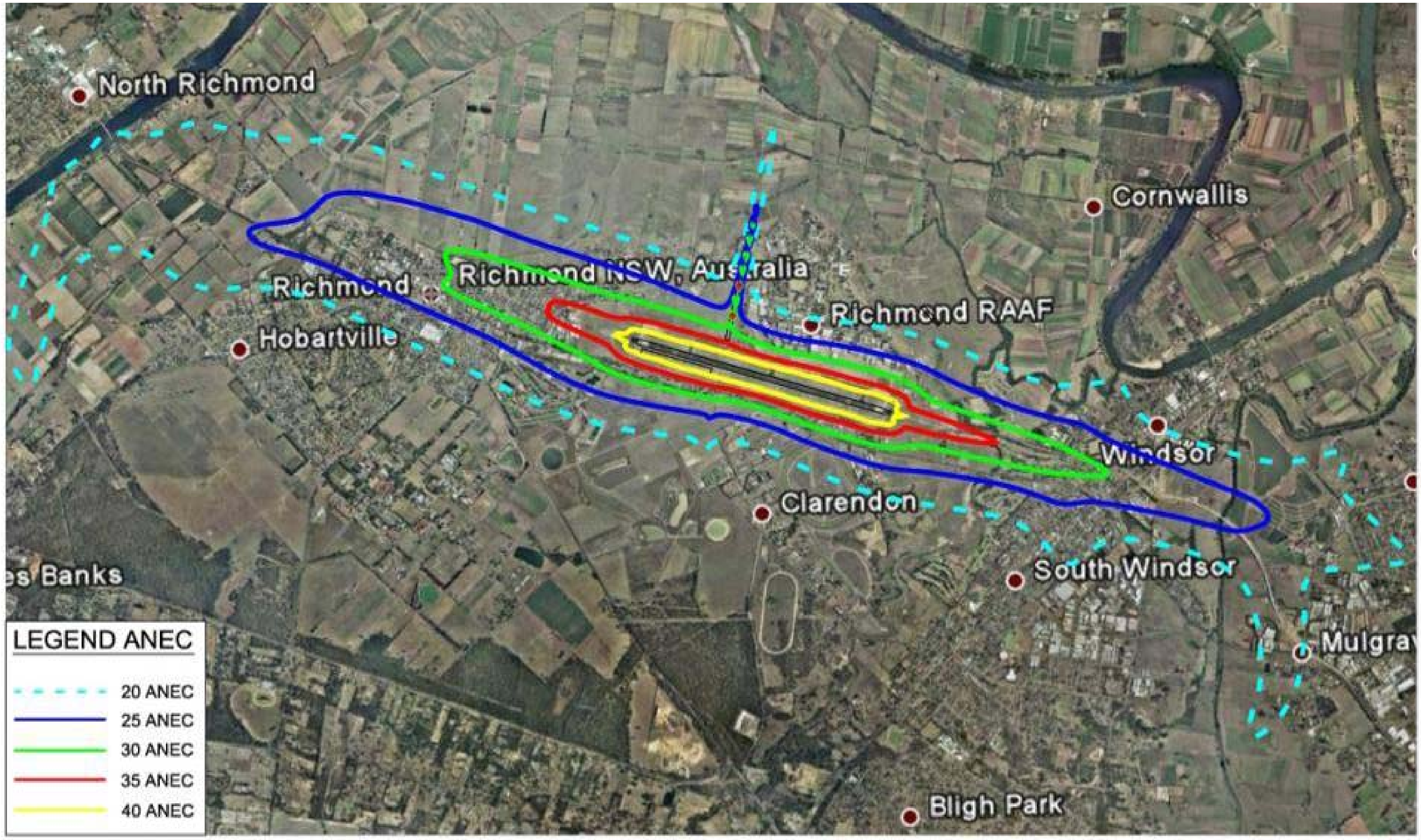


Figure 6.4 – ANEC Military Traffic with 5 Million Passengers ANEC (32,680 civil movements)

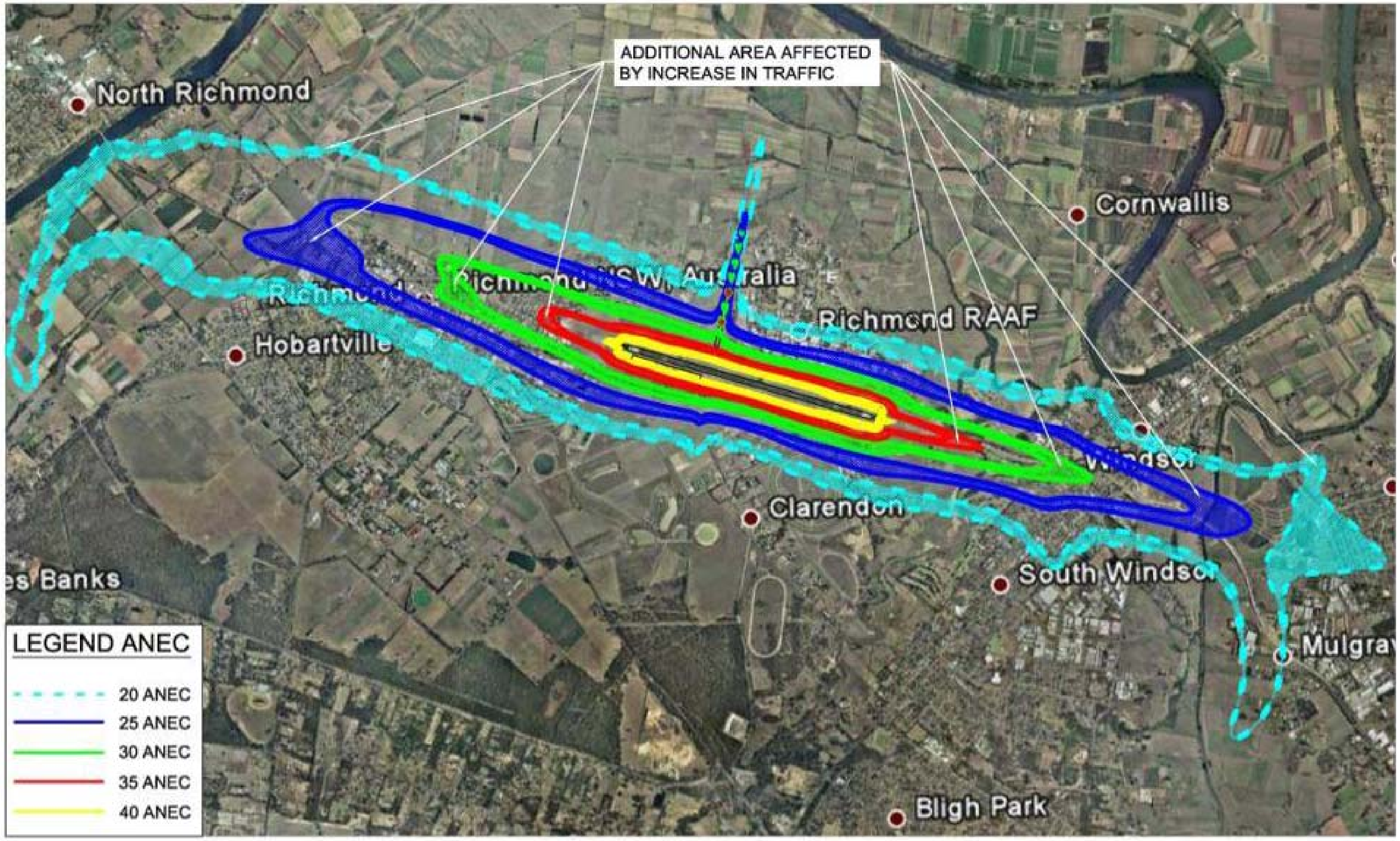


Figure 6.5 – Comparison of the ANEC Military Traffic (Modified) with Military Traffic (Modified) plus Civil Operations to 5 Million Passengers Added

As can be seen from Figures 6.1 to 6.5 there is a general but slight increase to the extent and coverage of the areas under the contours compared to the 2014 Military only ANEC, as would be expected from the increased numbers of aircraft movements. In terms of impacts on residential areas the 25, 30 and 35 ANEC contours extend marginally to the west over Richmond urban areas with the increasing levels of civil traffic compared to the base case (Military 2014 ANEC). To the east the 25 and 30 ANEC contours extend to a larger extent over Windsor Urban areas with the increasing levels of civil traffic. The extent of the increase in aircraft noise affected areas compared to the base case (Military 2014 ANEC) is not large.

As noted above there has been no attempt in this preliminary study to design noise abatement tracks for the civil jet movements: they were assigned to tracks landing ‘straight-in’ and departing ‘straight-ahead’. With the progressive introduction to Australian airports of the Required Navigation Performance procedures it could be expected that noise abatement flight tracks (perhaps similar to those flown by the RAAF) and aircraft operational procedures would be adopted to reduce aircraft noise exposure to the maximum extent possible.

The RNP require suitably equipped aircraft flown by qualifies crew to accurately fly flight-tracks designed to avoid the most noise sensitive areas while simultaneously reduce aircraft generated noise to the maximum practical extent. The adoption of RNP procedures could be expected to reduce the aircraft noise exposure from that shown in the current initial study

6.3 N70 Charts

As the ANEF is a relatively insensitive measure N70 contours have also been produced as discussed below.

Figures 6.6 to 6.10 depict N70s (with the B707 movements removed in each case):

- Figure 6.6 – N70 Military Traffic only (the 2014 ANEF without the B707);
- Figure 6.7 – N70 Military Traffic with Civil operations to 1 million passengers added;
- Figure 6.8 – N70 Military Traffic with Civil operations to 3 million passengers added;
- Figure 6.9 – N70 Military Traffic with Civil operations to 5 million passengers added;
- Figure 6.10 – Comparison of the N70 Military Traffic (modified) with Military Traffic (modified) plus Civil operations to 5 million passengers added.

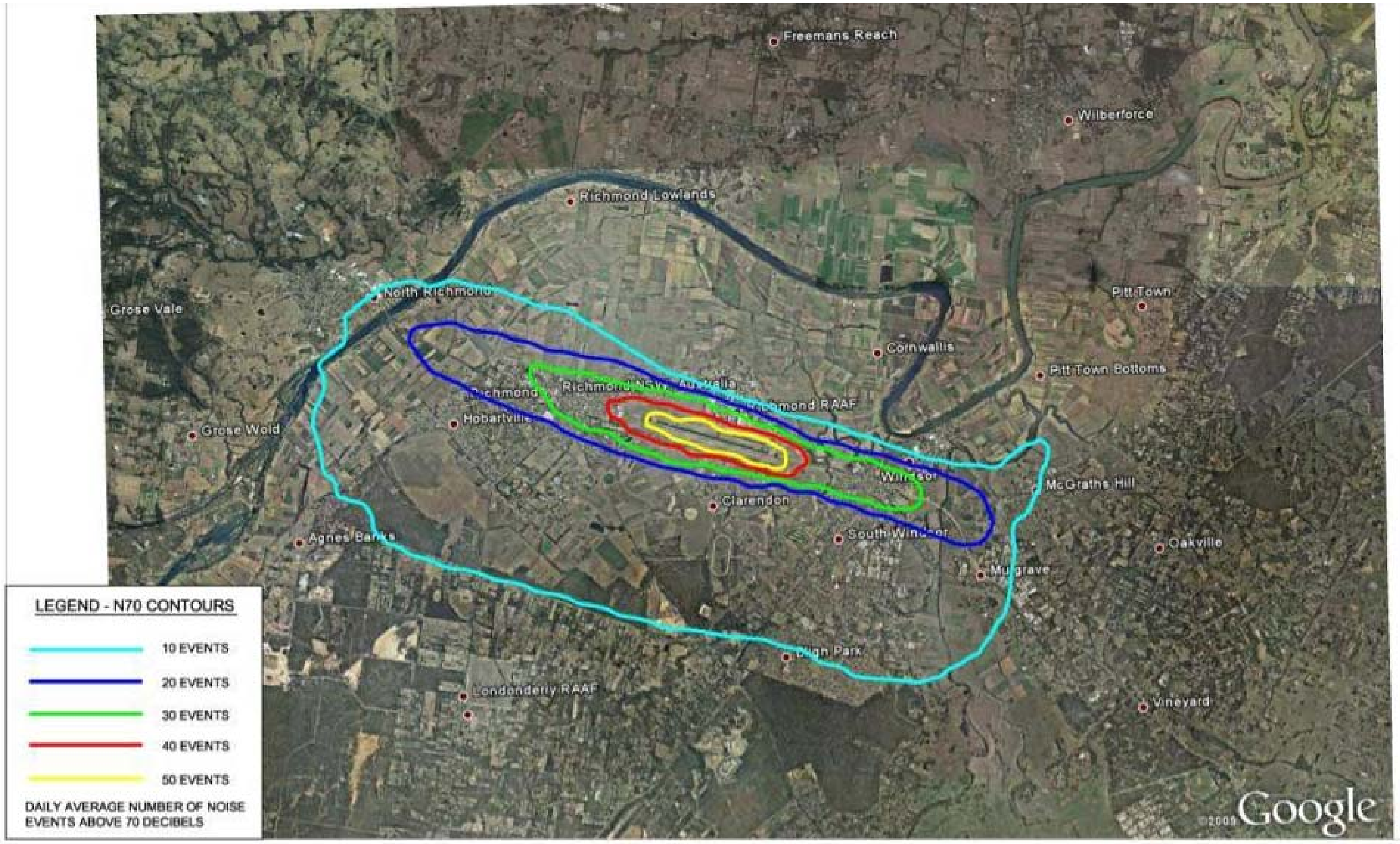


Figure 6.6 – N70 Military Traffic only (the 2014 ANEF without the B707)

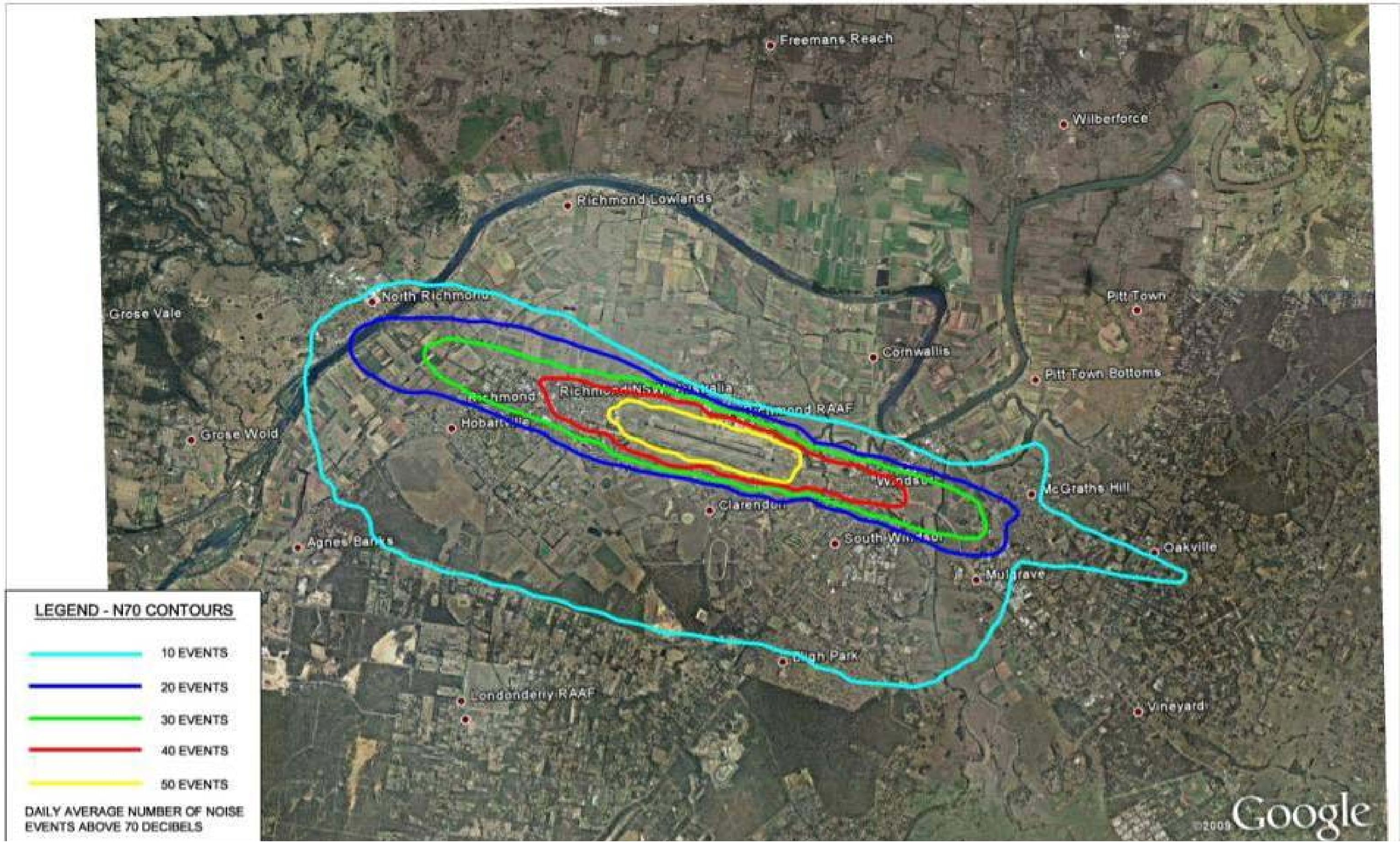


Figure 6.7 – N70 Military Traffic with Civil operations to 1 million passengers added

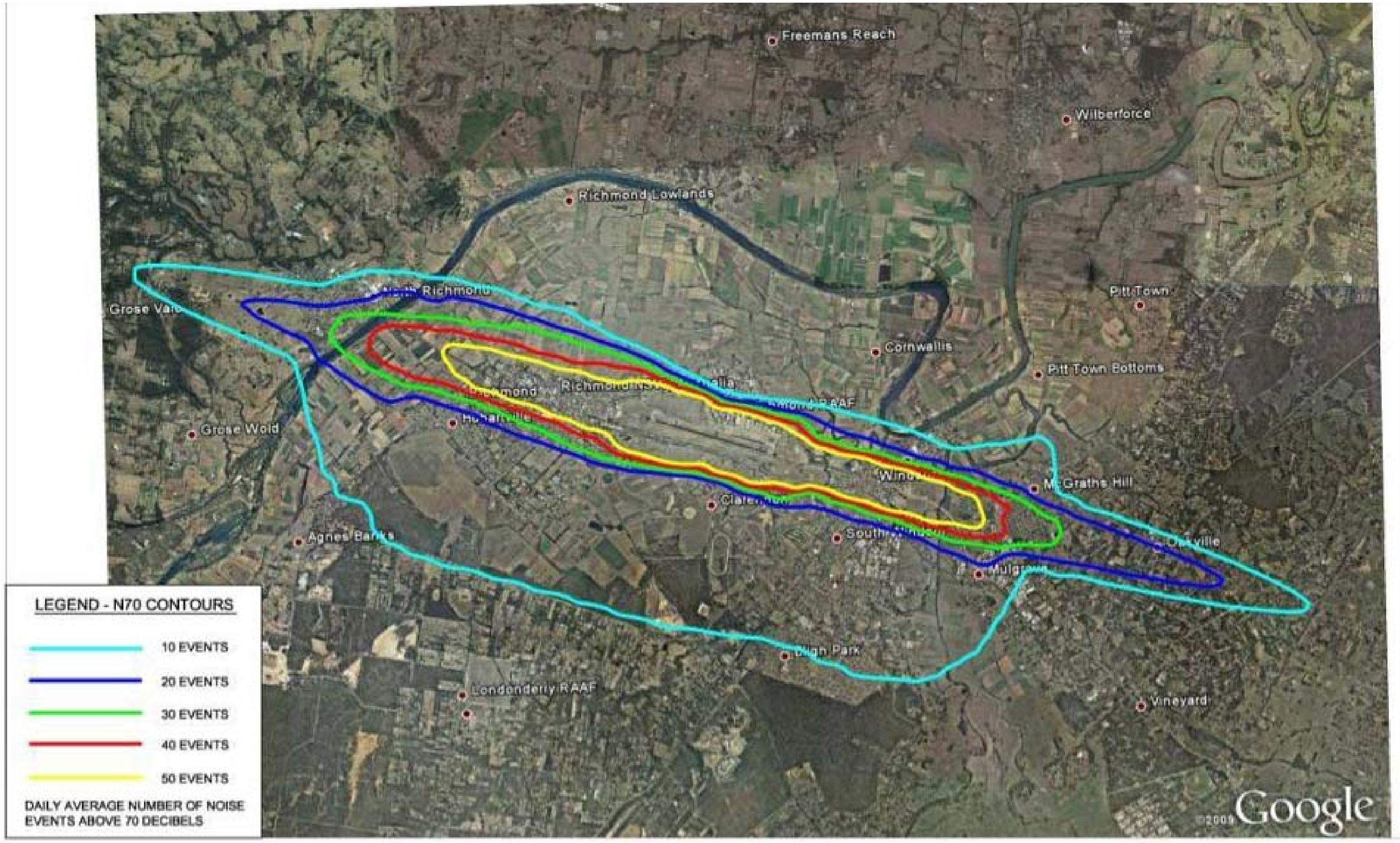


Figure 6.8 – N70 Military Traffic with Civil operations to 3 million passengers added

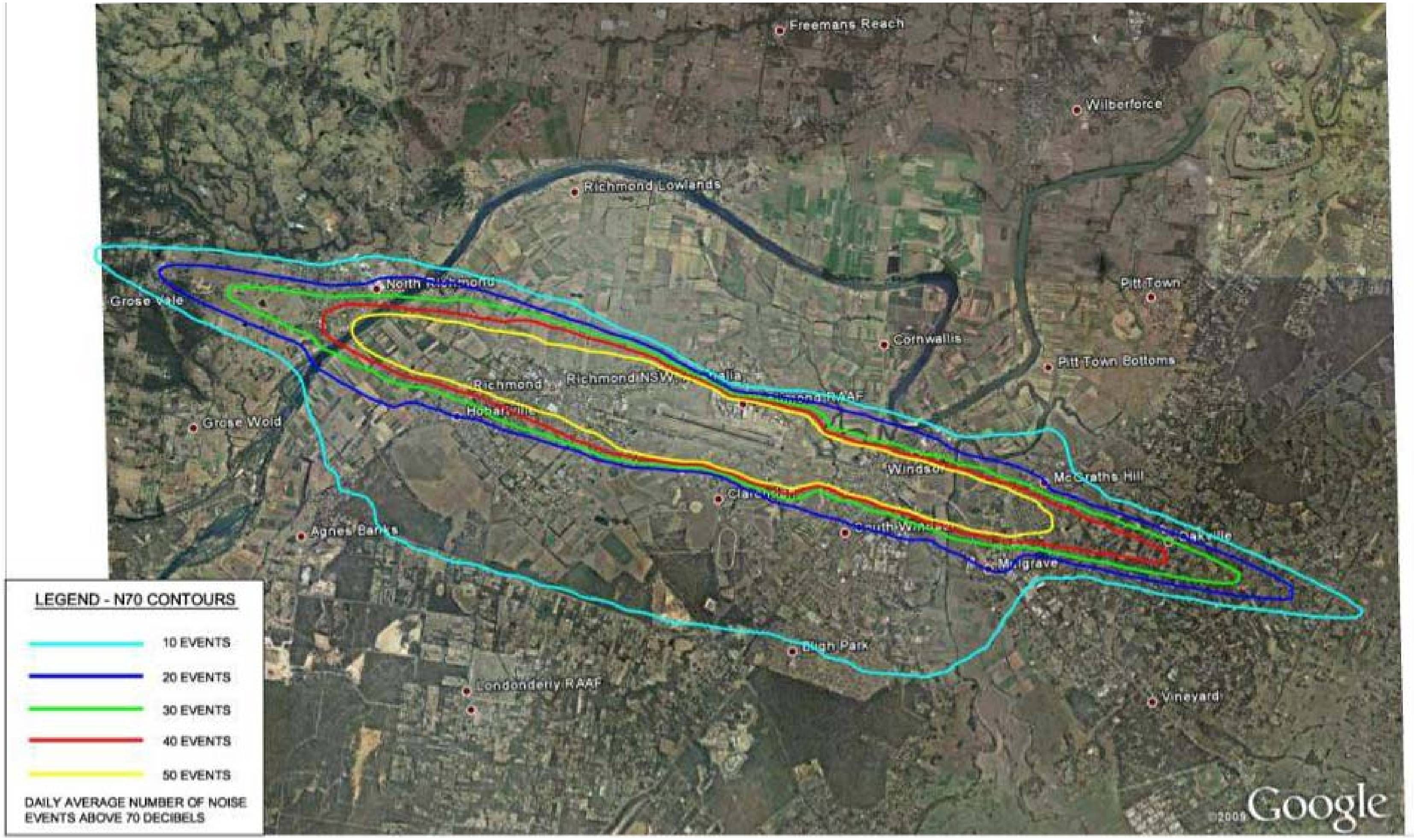


Figure 6.9 – N70 Military Traffic with Civil operations to 5 million passengers added

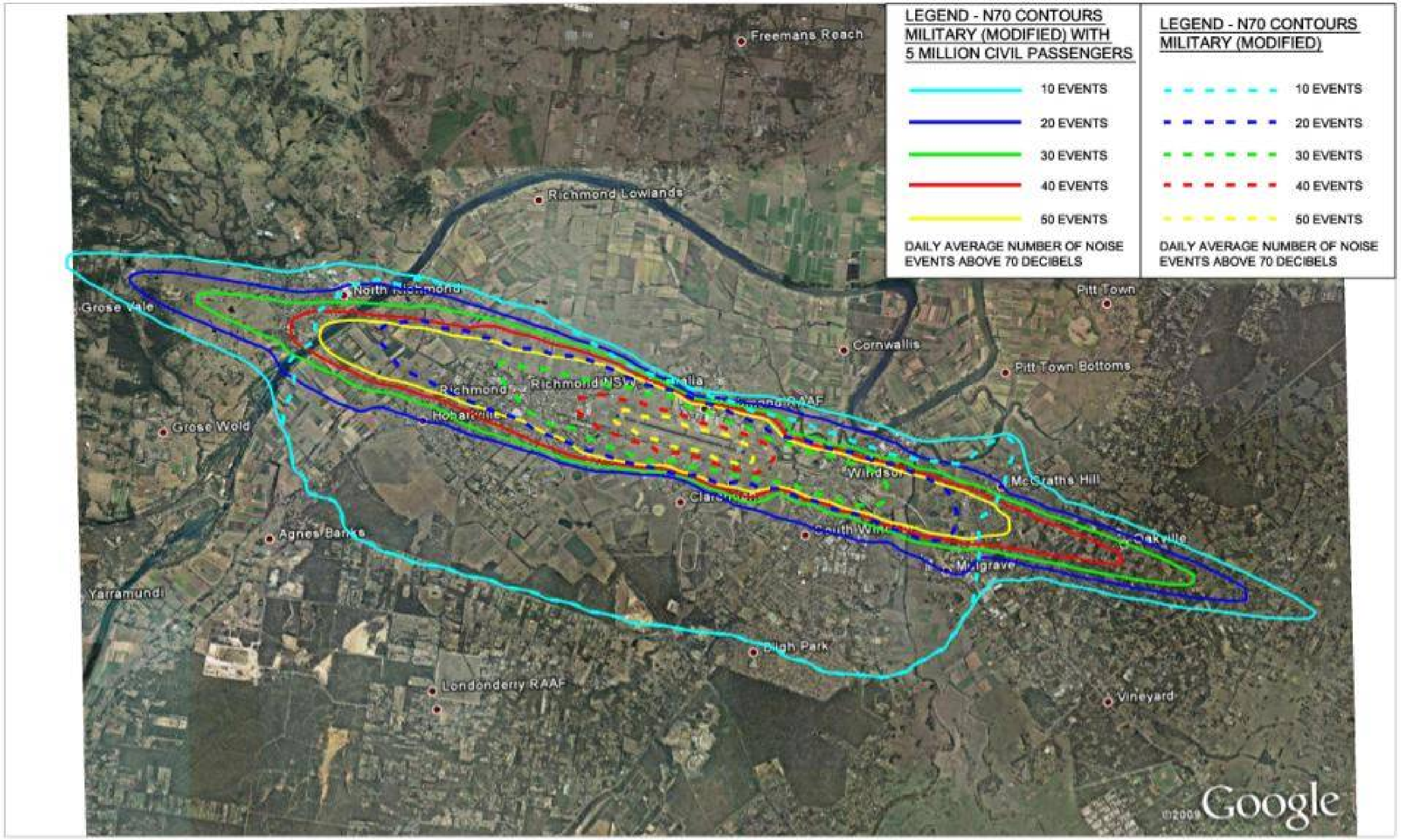


Figure 6.10 – Comparison of the N70 Military Traffic (modified) with Military Traffic (modified) plus Civil operations to 5 million passengers added

As expected the N70 contours show a larger area of impact than the ANEF contours. For example the 40 N70 contour for the base case (Military modified 2014 ANEC) lies at the eastern end of the Richmond urban area. With increasing levels of civilian traffic the 40 N70 contour extends to the western side of the Nepean River. To the east the 40 N70 contour for the base case ends close to the airport boundary. With increasing levels of civilian traffic the 40 N70 contour extends to about 4 kilometres east of the Windsor urban area.

Residents of both Richmond and Windsor urban areas will experience more over flights than predicted for the base case (Military modified 2014 ANEC).

7 DEVELOPMENT SCENARIO A

7.1 Key Features

A single development concept has been prepared for Scenario A, which is shown in Figure 7.1. Scenario A assumes RAAF operations remain, with the development concept aiming to provide physical separation between the civil and RAAF areas. Key features are as follows:

- 300m wide runway strip provided for Runway 10/28;
- Provision of mandatory civil RESA;
- Full length Code E parallel taxiway replacing Taxiway Z1 to Z4;
- New civil RPT apron, terminal and car park in the north-west sector of the base;
- New civil fuel farm;
- Provision for small scale GA, freight and aircraft maintenance facilities;
- Relocated control tower and fire station;
- Relocated RAAF aircraft wash bay;
- Replacement C130 apron in the north-west sector to compensate that lost due to the Code E parallel taxiway;
- Relocated OLA apron in the north-east sector and associated taxiway link; and
- Provision for a VOR/DME in the north-east sector.

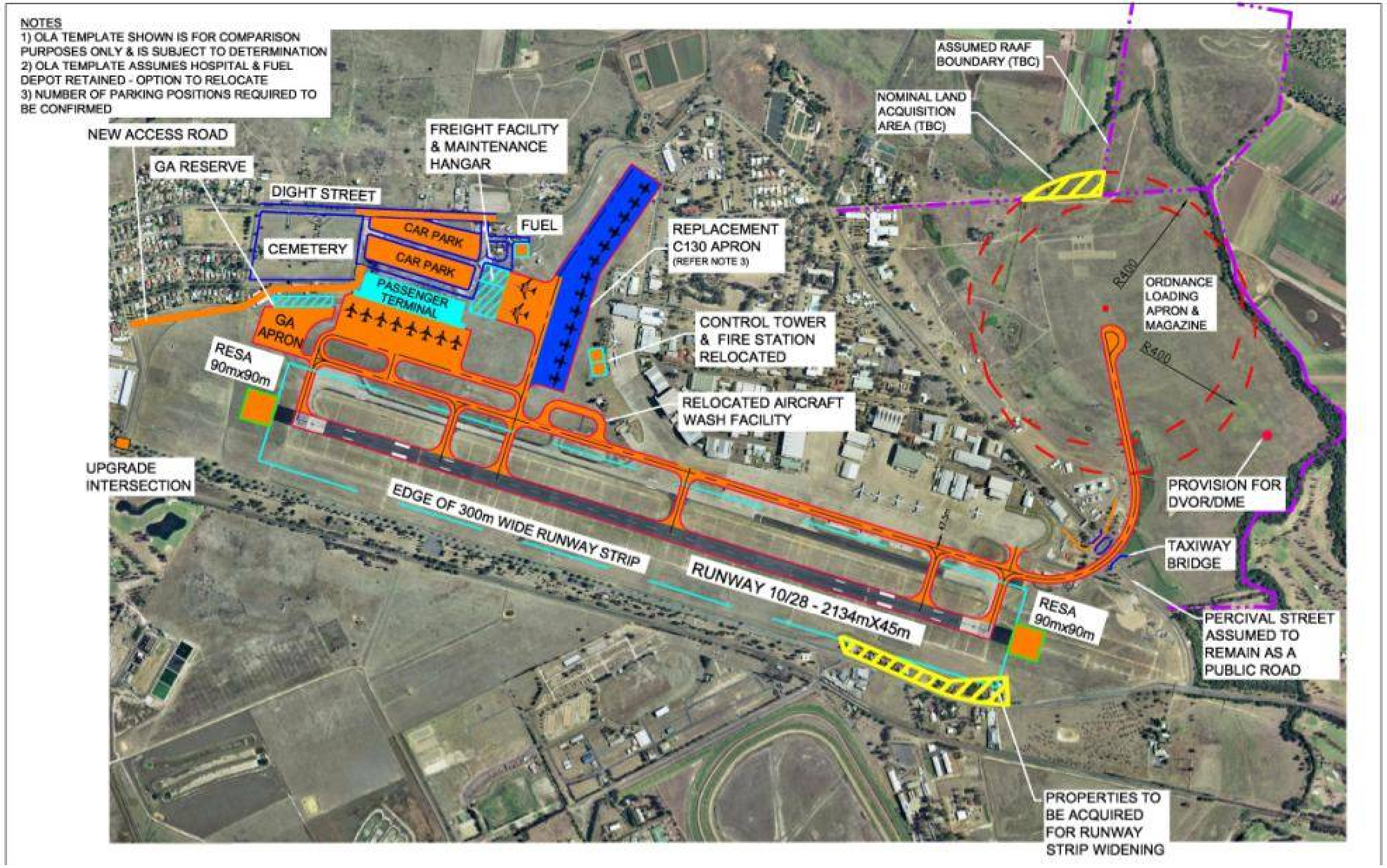


Figure 7.1 – Development Concept A
Source: Base Image Google Earth Pro 2010 (Image Date January 2007)

8 DEVELOPMENT SCENARIO B

8.1 Key Features

Three development concepts have been prepared for Scenario B, which are shown in Figures 8.1 to 8.3. Scenario B assumes RAAF operations remain, with the development concept aiming to provide physical separation between the civil and RAAF areas.

For all Development Concepts B, new civil RPT apron, part parallel and link taxiways, terminal and car park are proposed to be located to the south of the base on the UWS lands and affect the current alignments of Hawkesbury way and the Richmond rail line.

Other key common features of Development Concepts B are as follows:

- 300m wide runway strip provided for Runway 10/28;
- Provision of mandatory civil RESA;
- Full length Code E parallel taxiway replacing Taxiway Z1 to Z4;
- New civil fuel farm;
- Provision for small scale GA, freight and aircraft maintenance facilities;
- Relocated control tower and fire station;
- Relocated RAAF aircraft wash bay;
- Provision for a VOR/DME in the north-east sector.

Development Concepts B1 and B2 differ only in the manner in which the OLA and C130 apron facilities are relocated. However, Development Concept B3 differs from B1 and B2 in the way it is arranged and its effect on the current alignments of Hawkesbury Way and the Richmond Rail line.

Features specific to Development Concept B1 are:

- At-grade relocation of Richmond Road and the rail line to the south of the new terminal and provision of a new rail station adjacent to and integrated with the terminal;
- Replacement C130 apron in the north-east sector to compensate that lost due to the Code E parallel taxiway; and
- Relocated OLA apron and taxiway in the north-west sector, aimed at minimising OLA implications on runway operations.

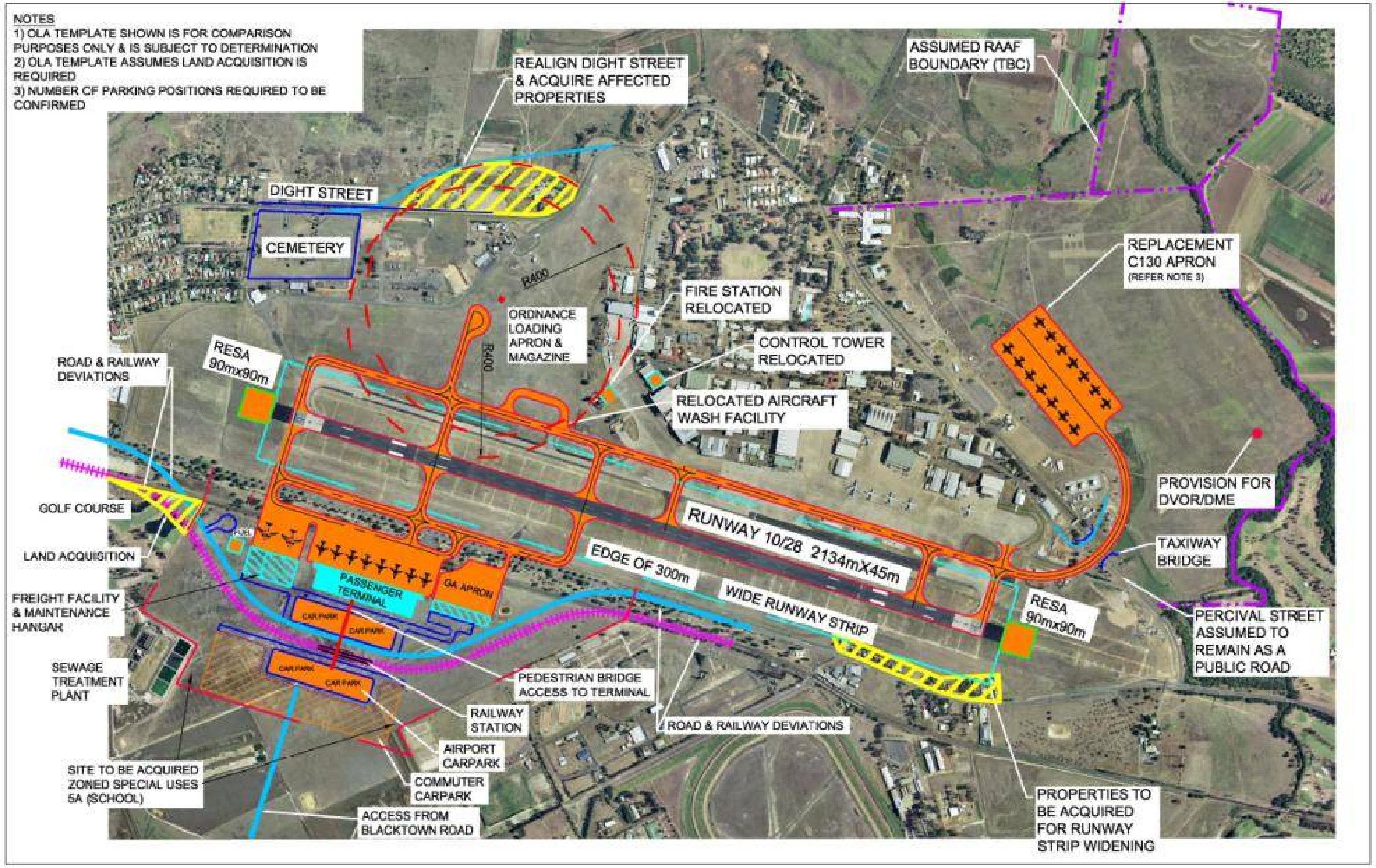


Figure 8.1 – Development Concept B1
Source: Base Image Google Earth Pro 2010 (Image Date January 2007)

Features specific to Development Concept B2 are:

- At-grade relocation of Richmond Road and the rail line to the south of the new terminal and provision of a new rail station adjacent to the terminal;
- Replacement C130 apron in the north-west sector to compensate that lost due to the Code E parallel taxiway; and
- Relocated OLA apron in the north-east sector of the base in the Rickaby's Creek area and associated taxiway link;

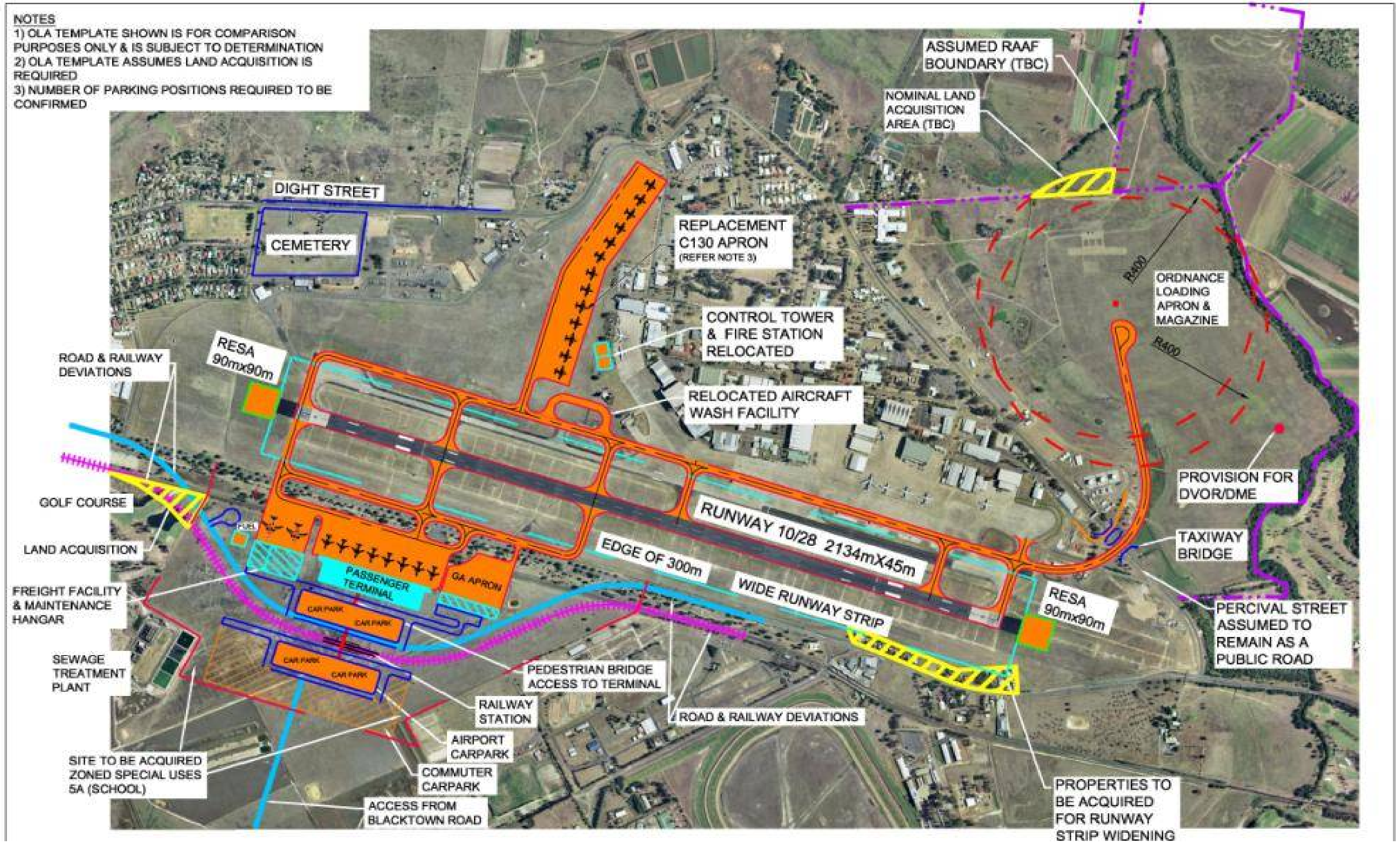


Figure 8.2 – Development Concept B2
Source: Base Image Google Earth Pro 2010 (Image Date January 2007)

Features specific to Development Concept B3 are:

- Undergrounding of part of Richmond Road and the rail line to the north of the new terminal and provision of a new rail station adjacent to the terminal;
- Replacement C130 apron in the north-east sector of the base in the Rickaby's Creek area to compensate that lost due to the Code E parallel taxiway; and
- Relocated OLA apron and taxiway in the north-west sector aimed at minimising OLA implications on runway operations;

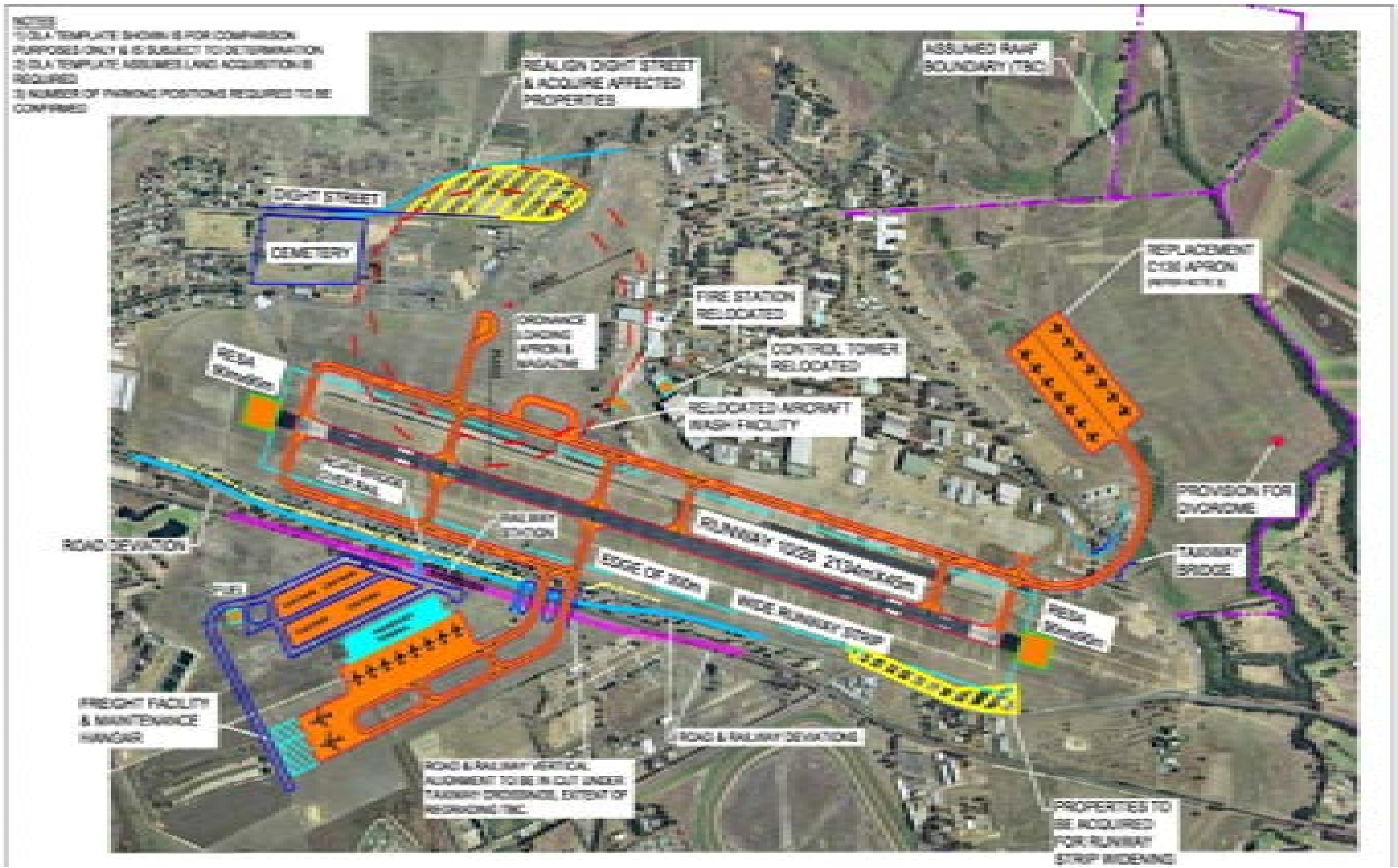


Figure 8.3 – Development Concept B3
Source: Base Image Google Earth Pro 2010 (Image Date January 2007)

As with Development Concepts B1 and B2, it would be possible to swap the OLA and C130 apron to create A Development scenario B4, should that configuration be preferred by RAAF and in the event that this configuration of the civil terminal area was preferred.

The key disadvantages of B3 as compared to B1 and B2 are considered to be:

- The high cost to place both a deviated road and the railway into trenches to permit aircraft to cross on bridges linking the airfield and the terminal precinct;
- The impact on rail operations in order to create the trench and place the railway in it;
- The vulnerability of those trenches to minor flooding during major local storm events and to potentially complete inundation during a 1:100 year or PMF flood event in the Hawkesbury Valley;
- The higher cost of infrastructure to create those trenches and to provide airport access for road users across them;

The key advantages of B1 and B2 over B3 are considered to be:

- The more complete integration of the civil precinct into the airport overall and reduce security perimeter issues;
- The lower cost of maintaining the relocated road and rail at grade and the ability to construct these largely in a “green fields” location, outside the airport fence and to connect these deviations up to the existing road and railway in weekend possessions, with minimal impact on normal operations and road and rail users;
- The ability to create an alternative access from Blacktown Road and additional carparking south of the relocated railway and thereby create a major transportation interchange for both airport and rail users; This precinct would be connected via pedestrian bridges to both the station and to the airport terminal.;

9 DEVELOPMENT SCENARIO C

9.1 Key Features

Two development concepts have been prepared for Scenario C, which are shown in Figures 9.1 and 9.2. Scenario C assumes RAAF operations are relocated to another airport. In particular this applies to the ordnance loading activities as this activity would need to be fully removed before facilities for RPT operation could commence in the absence of its prior relocation to the Rickaby's Creek area as envisaged in Scenario A2 and B2. However, it is further assumed that the need to create a civil capability at Richmond would precede any complete withdrawal of RAAF as such the RAAF precinct would not be available to develop a civil operation and terminal precinct. The effect of this is that the required Civil RPT precinct would have to be developed in a location as per Scenario A or B until RAAF had withdrawn completely. If this large area was not then adapted for use for an RPT terminal, this would yield a large precinct in which to locate aviation support industries and, to the extent this would be compatible with RPT and RAAF activities, general aviation activities and enterprises.

Key features of Development Concept C1 are as follows:

- 300m wide runway strip provided for Runway 10/28;
- Provision of mandatory civil RESA;
- Full length Code E parallel taxiway replacing Taxiway Z1 to Z4;
- New civil RPT apron, terminal and car park in the north-west sector of the base;
- New civil fuel farm;
- Provision for small scale GA, freight and aircraft maintenance facilities;
- Relocated control tower and fire station;
- RAAF areas adapted for other aviation related uses; and
- Provision for a VOR/DME in the north-east sector.

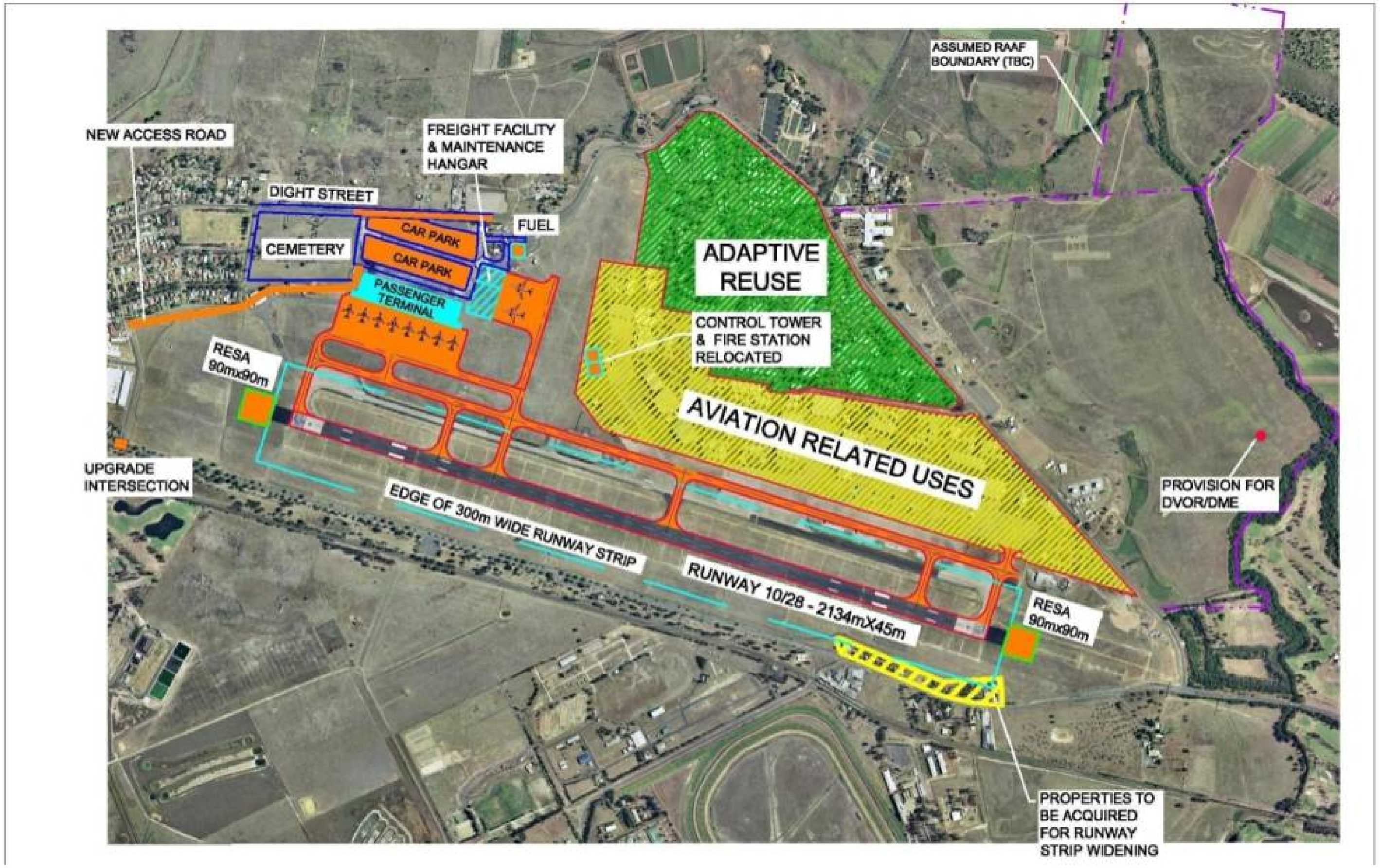


Figure 9.1 – Development Concept C1
Source: Base Image Google Earth Pro 2010 (Image Date January 2007)

Key features of Development Concept C2 are as follows:

- 300m wide runway strip provided for Runway 10/28;
- Provision of mandatory civil RESA;
- Full length Code E parallel taxiway replacing Taxiway Z1 to Z4;
- New civil RPT apron, part parallel and link taxiways, terminal and car park located to the south of the base on the UWS lands;
- At-grade relocation of Richmond Road and the rail line to the south of the new terminal and provision of a new rail station adjacent to the terminal;
- New civil fuel farm;
- Provision for small scale GA, freight and aircraft maintenance facilities;
- Relocated control tower and fire station;
- RAAF areas adapted for aviation related uses; and
- Provision for a VOR/DME in the north-east sector.

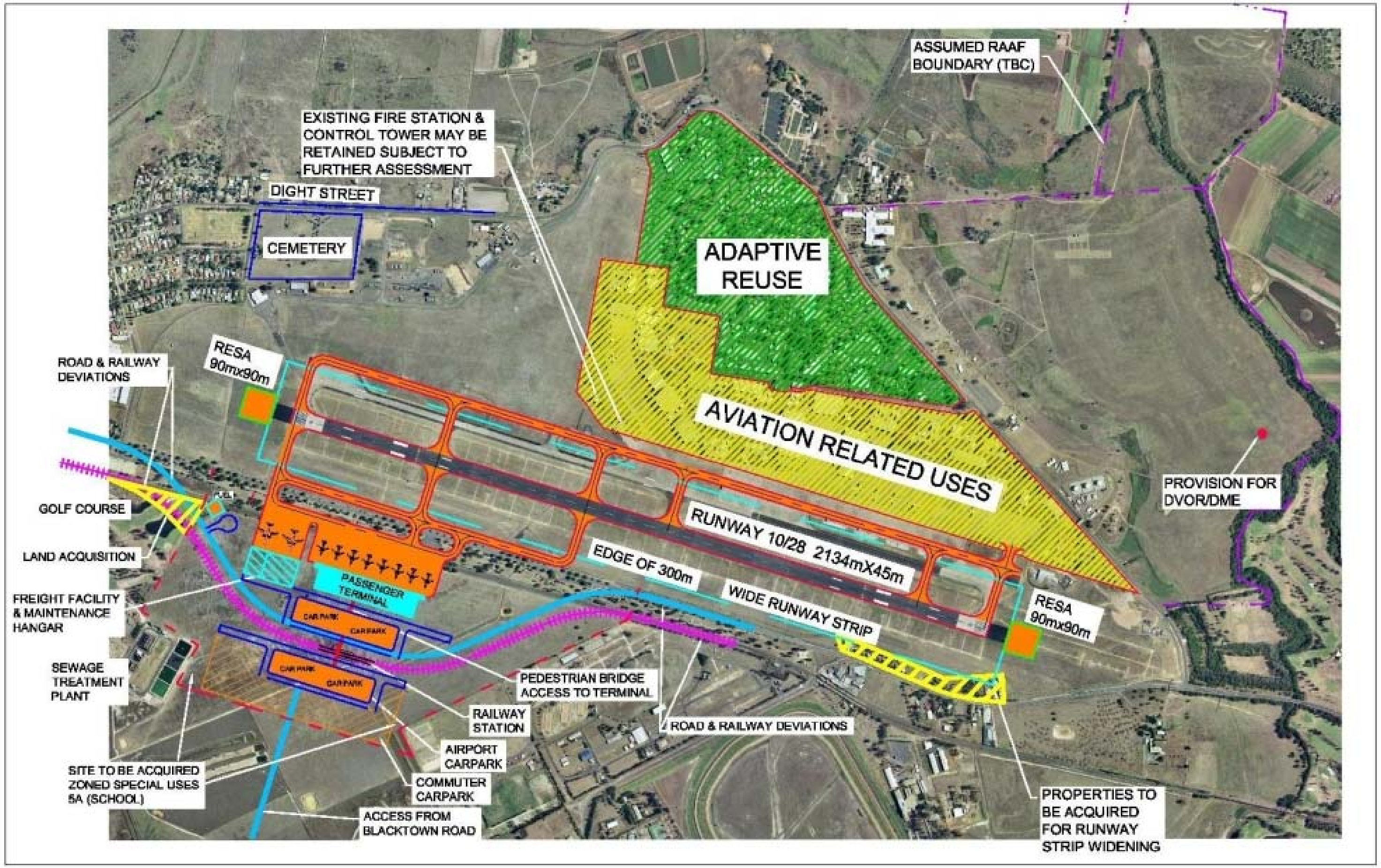
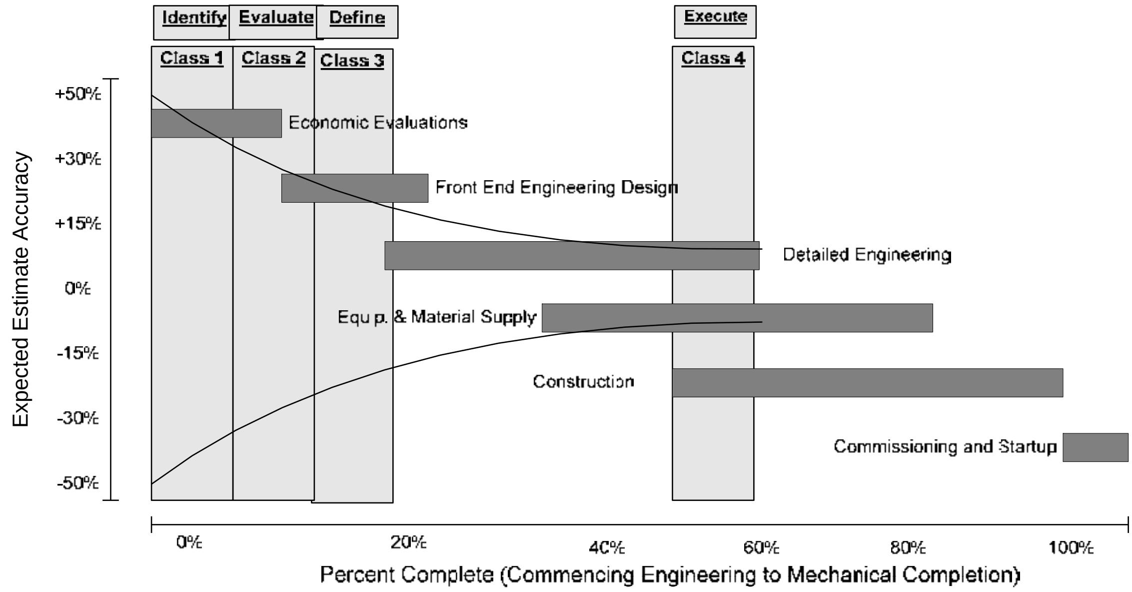


Figure 9.2 – Development Concept C2
Source: Base Image Google Earth Pro 2010 (Image Date January 2007)

10 INDICATIVE COST ESTIMATES

10.1 Type of Estimate

WorleyParsons employs four basic types of cost estimates that are used to evaluate, approve, and/or fund projects. The estimate types vary according to purpose, applicable project phase, anticipated accuracy, available data, time available for preparation, method of pricing and work processes. The graphic below depicts the WorleyParsons standard estimate classifications as related to typical project events over time.



On the basis of the level of work which the Department wished to be undertaken at this stage, a resulting cost estimate would not be better than a Class 1 estimate and should be assumed to have a 50% probability of being exceeded. Additionally for this class of estimate, a contingency in the range 20% to 25% should be allowed. At this stage, estimates of this calibre are usually used for screening or comparing alternative concepts and cannot be regarded as investment grade or suitable for budgetary purposes, particularly given the number and degree of possible items which are unassessed and uncosted at this stage.

10.2 Scenarios Estimated

For the purposes of this report only Scenario A has been costed to provide an indication of the order of cost of developing an RPT operation at RAAF Base Richmond. Scenario A does not involve major relocation of civil infrastructure in and around the airport. An estimate was prepared for each of two variants of Scenario A, being:

- A minimalist approach which would permit a low cost type carriers to commence a startup type operation to and from Richmond assuming say 1 million passengers per annum
- A developed RPT usage of Richmond by RPT carriers assuming say 5 million passengers per annum.

10.3 Basis of estimate for Scenario A variants

Qualifications about the estimates which are common to both variants are as follows:

- Estimates are in 2010 dollars;
- Maintenance and operational works are excluded;
- Land acquisition and compensation costs are not included;
- Government fees, charges and levies are to be determined;
- Indicative costs comprise some items for which only allowances have been provided and are subject to detailed investigation and input from other engineering disciplines;
- Indicative costs are provided without detailed survey and with only preliminary grading design;
- No allowance for land contamination or remediation has been made;
- No allowance for flood mitigation or environmental works has been made;
- No allowance for off airport works has been made.

For the minimalist development scenario to enable a startup operation, the following assumptions were made:

- There would be minimal works to accommodate two Code C aircraft on an apron and appropriately sized terminal;
- The existing 154 m wide strip (military) (but calculated as 150m for civil operations) , control tower, fire station would be remain unaltered;
- The existing parallel taxiway “Zulu” and RAAF aircraft wash facilities are retained unchanged with the consequence that by retention of Taxiway Z there could be operational restrictions in IMC arrivals
- It would be acceptable for the strip width of 150m to limit instrument approaches to Non-Precision only or possibly Instrument Precision in the 28 direction with a higher minima to compensate for the narrower strip width and with the consequence that higher numbers of diversions of RPT operations could occur when instrument landing conditions prevail;
- No relocation of security sensitive RAAF functions;
- external roadworks improvements are limited to a minor intersection improvement at Dight Street only, ie. no major roadworks improvements.

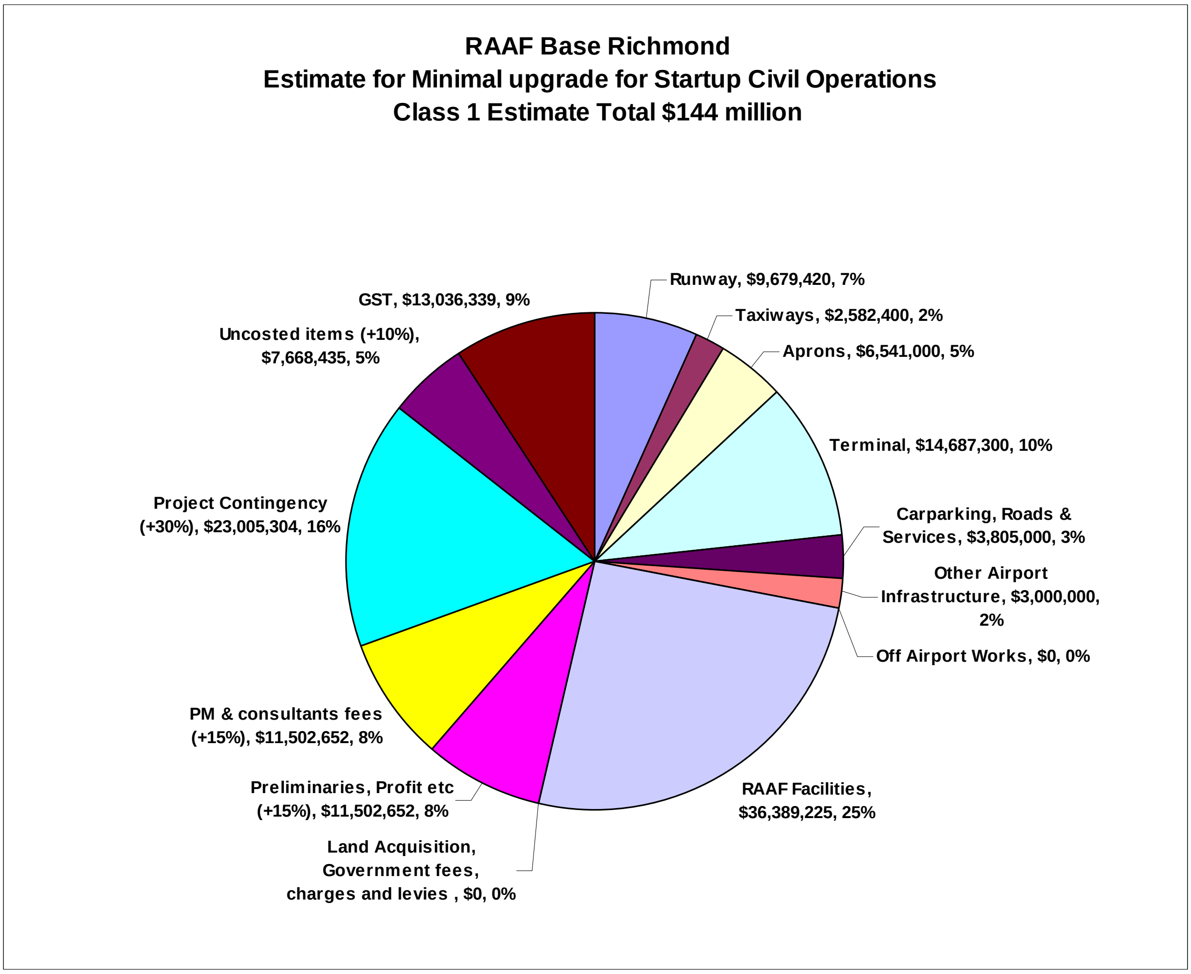
10.4 Summary Estimate – Minimal Scenario A

Following is a summary estimate for a minimal Scenario A start up facility with 2 aircraft parking bays, catering, for say, 1 million passengers per annum.

Details of the estimate are provided in Appendix 2.

BUDGET ESTIMATE for SCENARIO A – 1MILLION PASSENGERS PER ANNUM Aircraft CODE C OPERATIONS - (150 m strip)		
No.	**Item Description**	**$ Cost**
A.1.0	Runway	9,679,420
A.2.0	Taxiways	2,582,400
A.3.0	Aprons	541,000
A.4.0	Terminal	14,687,300
A.5.0	Car parking, Roads & Services	3,805,000
A.6.0	Other Airport Infrastructure	3,000,000
A.7.0	Off Airport Works	NOT COSTED
A.8.0	RAAF Facilities	36,389,225
		76,684,345
	Say basic development costs	$77 million
	Land Acquisition, Government fees, charges and levies	not costed
	Preliminaries, Profit etc (+15%)	11,502,652
	PM & consultants fees (+15%)	11,502,652
	Project Contingency (+30%)	23,005,304
	Uncosted items (+10%)	7,668,435
	On costs and Allowances Sub-total $	53,679,042
	Indicative Cost (excl. GST & items not costed)	130,363,387
	GST $	13,036,339
	TOTAL INDICATIVE COST	143,399,725
	Class 1 Cost estimate for Minimalist Scenario A, say	$144 million

As indicated in the table above and shown in the chart below the basic development costs are assessed at around $77 million of which costs associated with relocation of RAAF facilities are about $36 million or about 47%. This cost is entirely associated with the need to construct a new Ordnance loading facility in the Rickaby's Creek area.



10.5 Summary estimate for Scenario A

Following is a summary estimate for a Scenario A development, catering, for say, 5 million passengers per annum.

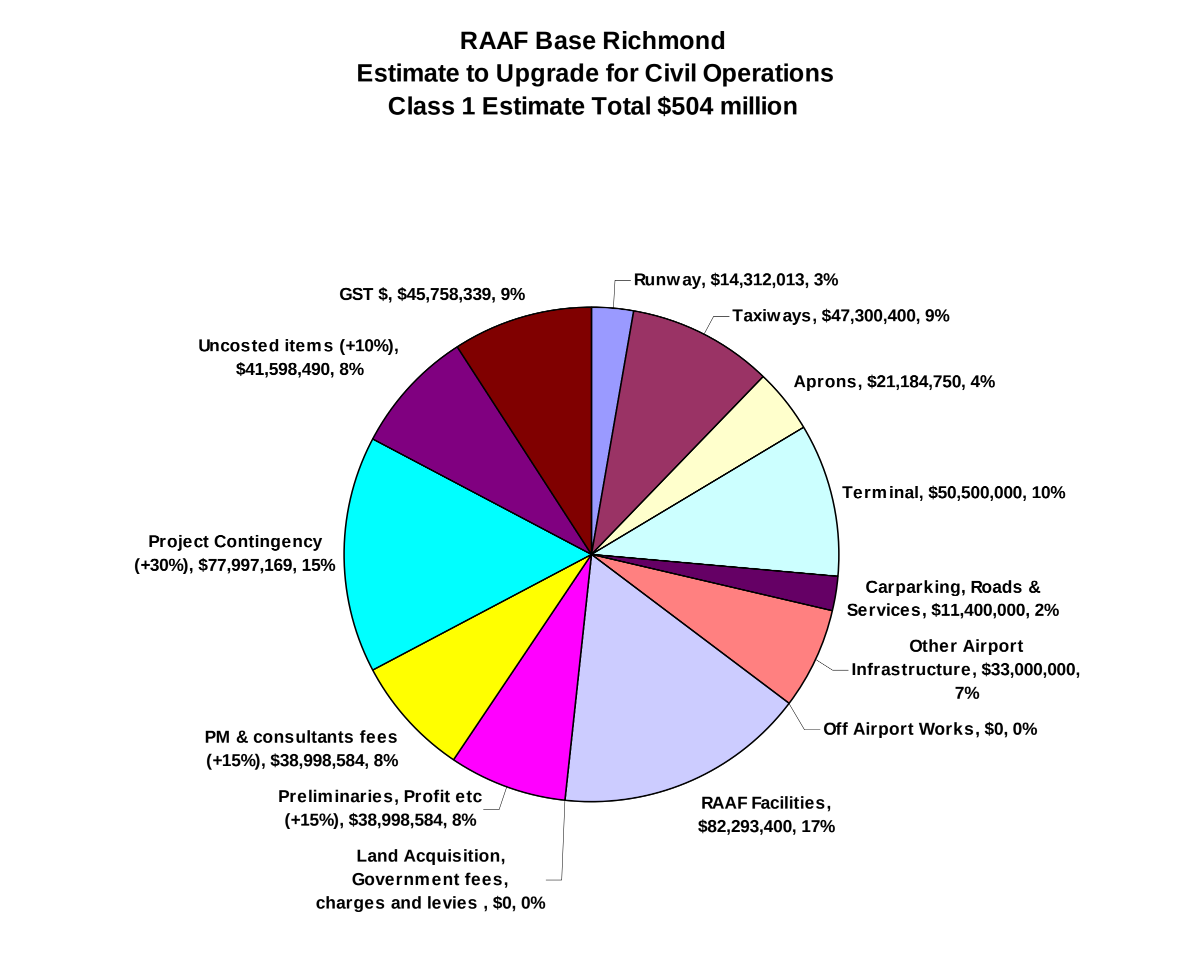
Details of the estimate are provided in Appendix 4.

BUDGET ESTIMATE for SCENARIO A – 5 MILLION PASSENGERS PER ANNUM Aircraft CODE E OPERATIONS - (300m strip)		
No.	**Item Description**	**$ Cost**
A.1.0	**Runway**	14,312,013
A.2.0	**Taxiways**	47,300,400
A.3.0	**Aprons**	21,184,750
A.4.0	**Terminal**	50,500,000
A.5.0	**Car parking, Roads & Services**	11,400,000
A.6.0	**Other Airport Infrastructure**	33,000,000
A.7.0	**Off Airport Works**	NOT COSTED
A.8.0	**RAAF Facilities**	82,293,400
		259,990,563
	Say basic development costs	$260 million
	Land Acquisition, Government fees, charges and levies	not costed
	Preliminaries, Profit etc (+15%)	38,998,584
	PM & consultants fees (+15%)	38,998,584
	Project Contingency (+30%)	77,997,169
	Uncosted items (+10%)	41,598,490
	On costs and Allowances Sub-total $	197,592,828
	Indicative Cost (excl. GST & items not costed)	457,583,390
	GST $	45,758,339
	TOTAL INDICATIVE COST	503,341,729
	Class 1 Cost estimate for Scenario A, say	**504,000,000**

As indicated in the table above and shown in the chart below the basic development costs[7] are assessed at around $260 million of which costs associated with relocation of RAAF facilities are about

[7] I.e. excluding on costs, contingencies and the like.

$82 million or about 32%. This cost is mostly associated with the need to construct a new ordnance loading facility in the Rickaby's Creek area and new apron parking areas for C130 and other aircraft.



10.6 Other scenarios

Cost estimates for Scenarios B1 and B2 and C1and C2 were not specifically assessed.

Scenario B2 however is assumed to be comparable to Scenario A but would involve additional cost associated with:

- land acquisition mostly from the University of Western Sydney and a small parcel possibly from Richmond Golf Club;
- relocation of the railway and construction of a new Airport Station, pedestrian footbridge together with associated additional parking and access from Blacktown Road;
- Relocation of Hawkesbury Valley Way;
- Reconstruction of one hole on Richmond Golf club.

These additional costs would be assessed as a part of Stage 2 of this Study.

Scenarios C1 and C2 are essentially the same as Scenarios A and B2 but would not involve any cost associated with relocation of RAAF infrastructure, assessed to be up to $160 million when on costs, contingencies and the like are included. Any costs associate with reconfigured or adaptive reuse of existing RAAF infrastructure is not included.

11 CONSULTATION WITH RAAF AND DEFENCE

On 9 September a presentation of the concepts for development of a civil precinct at Richmond was given to representatives of the Department of Defence, representatives of senior RAAF officers and RAAF Base Richmond based officers.

In summary, the key issues identified by RAAF and Defence are as follows.

- RAAF must be able to continue all current activities which occur at Richmond in a secure manner, being:
  - Unimpeded C-130 operations;
  - Movement of Explosive Ordnance;
  - Fighter aircraft diversion;
  - Allied air transport support.
- Ordnance loading areas would have to be relocated from its current position and the location shown in Scenarios B1 and B3 is not considered possible as it is within 800m of the civil housing development to north west of the Base. The location in Rickaby's Creek area shown in Concepts A and B2 appears feasible but expensive to construct:
- If taxiway Zulu is reconstructed in a position north of its current position in order to increase separation from the runway, there appears to still be adequate apron parking space for RAAF requirement. If additional space was required, it would be preferred in the locations shown in Scenarios A and B2 ie Rickaby's Creek drop zone;
- Of all the scenarios, RAAF express a preference for Scenario B2 as this provides the maximum separation of civilian activities from those of the Defence and RAAF, in similar manner to Williamtown, as well as locating the OLA in the preferred location.
- In regard to Scenario C, Defence note that it was not considered as it adopted the precondition of RAAF having vacated the site – this appears to indicate an intention for RAAF to remain at Richmond for the foreseeable future;
- The suggestion is made that, in the first instance the requirement for a 300m wide strip could be accommodated by managing the parking of aircraft on the RAAF apron and by ATC management of aircraft usage of the existing Taxiway Zulu. If possible then, this could enable reconstruction of Taxiway Zulu to be deferred and/or staged.
- In the event of civil operations occurring at RAAF Base Richmond expressed the view that GA light aircraft traffic would not be compatible with C130 operations but some forms of Business jet activities could be possible.

12 DISCUSSION AND CONCLUSIONS

This study and inputs made to it has shown that:

- There are several alternate ways to provide a civil operation at RAAF Base Richmond;
- RAAF are apparently intending to remain at Richmond, preferably with full functionality;
- This rules out either of the Scenarios C;
- RAAF have expressed a firm preference for maximizing the separation between civilian and military precincts, operations and access. As a result of this Scenario A is considered unacceptable;
- Of the two Scenarios B, B2 is preferred by RAAF, as retention of the OLA in its current location or in it proposed relocation in B1 is not considered feasible as required clearance distances are infringed by one or other form of civil land usage;
- An alternative location for the OLA in Defence owned land in the Rickaby's Creek considered technically feasible by RAAF.

As a result, development of a civil RPT facility is considered most feasible if located in the southwest quadrant of the location as shown below.

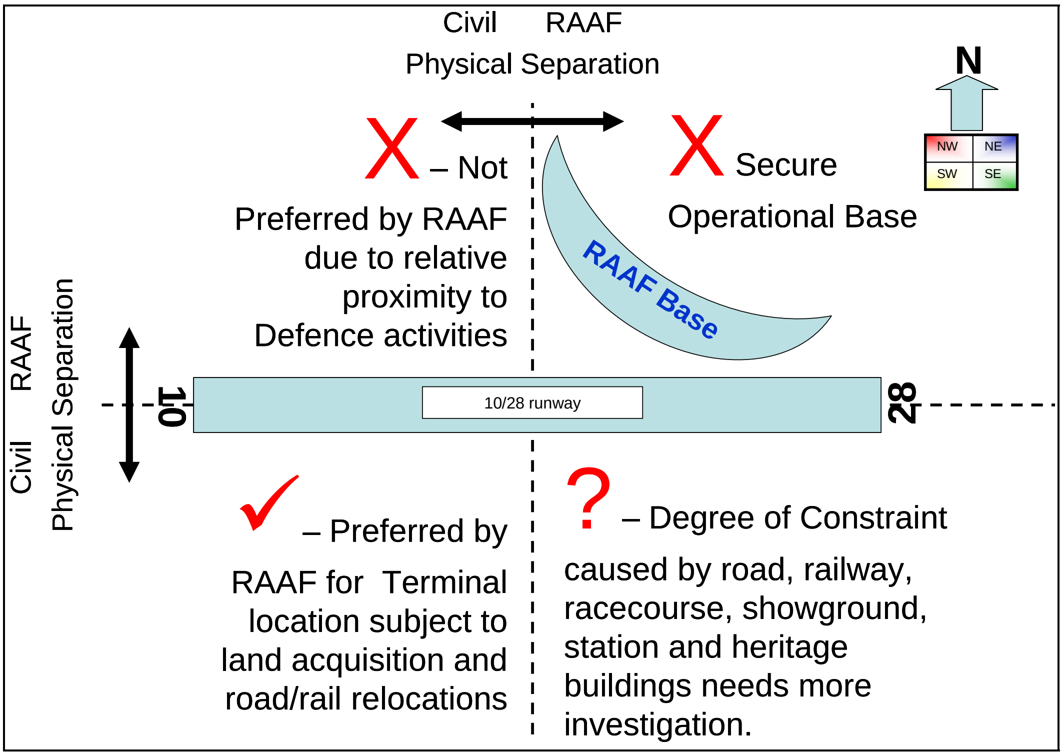


Figure 12.1 Basic Planning Principles Post Consultation with RAAF

If Scenarios B were to be adopted, it is evident that further and more detailed work to develop this into a practical option is required.

Particular considerations would include:

- Removal of the replacement C130 apron proposals as shown in Scenarios A, B1 and B2 and a closer investigation of remodeling of the existing C130 apron including possible rationalization of building if need to accommodate the required aircraft parking bays;
- More detailed assessment of the effect of the OLA remaining in the north west quadrant and what would be needed to allow this to happen – eg acquisition of civil properties that are unacceptably close to the OLA. This may be a more practical and less expensive option than relocation to Rickaby's Creek;
- More detailed assessment of road and rail relocation as originally envisaged would occur in a Stage 2 of this study;
- More detailed consideration of staging to achieve a minimalist infrastructure upgrade and hence cost of enabling RPT operations to commence at Richmond – this would need to be accompanied by more detailed assessments of operational aspect and risks of RPT operations being affected by RAAF operations and adverse weather.

A further area for investigation is the south east quadrant as shown in Figure 12.1. While this was initially considered unlikely to be able to accommodate airport development by virtue of the perceived degree of effect on existing land uses, it became apparent that under any Scenario for the full development of Richmond for Civil RPT operation using Runway 10/28, it would be necessary to provide a 300 m wide strip. This would involve the attendant and unavoidable consequence of property in this quadrant having to be acquired.

Additionally the question of developing a full length taxiway on the south side of runway 10/28 was raised:

- By RAAF/Defence as achieving a further separation of military and civil usage of the airport;
- By the Department as being preferably to eliminate crossing movements of Runway 10/28;

In order to achieve this, the configuration as shown in Scenario B4 (Figure 12.2) would be required with the consequence of yet greater property acquisition in the south east quadrant and a more substantial relocation of both the road and railway infrastructure. However, this would enable a larger civil RPT precinct to be created with the potential to accommodate yet greater expansion of the apron and terminal areas. Given these issues and the relative scale of any civil development of RAAF Base Richmond, development in the south east quadrant and its effects should be further considered.

During this study, the question of whether a notionally "North South" Runway could be constructed at Richmond was raised. If of interest to the Commonwealth, this should be the subject of a separate investigation which will need to consider, inter alia:

- Relocation of the OLA as any "North South" runway would probably either intersect the existing OLA's physically or would cause Civil RPT operation within the 3 dimensional restricted space surrounding the OLA;

- The extent to which a suitably long “North South” runway could be accommodated within lands owned by Defence or other Commonwealth agencies and the extent to which it would cause dislocation of other existing land uses and transport systems.

Certainly, it is apparent that a “North South” runway could be oriented such that the noise footprint from most RPT operations, and also possible most aircraft movements including RAAF, would not intersect the urban areas of Windsor and Richmond townships, which effectively “book end” the current 10/28 runway.

In summary, RAAF Base Richmond appears to offer a number of possibilities for redevelopment to allow introduction of RPT operations under a scenario where RAAF continues its presence and full operational functionality provided the issue of ordnance loading and safety areas can be resolved, land can be acquired and existing transportation links reorganized.

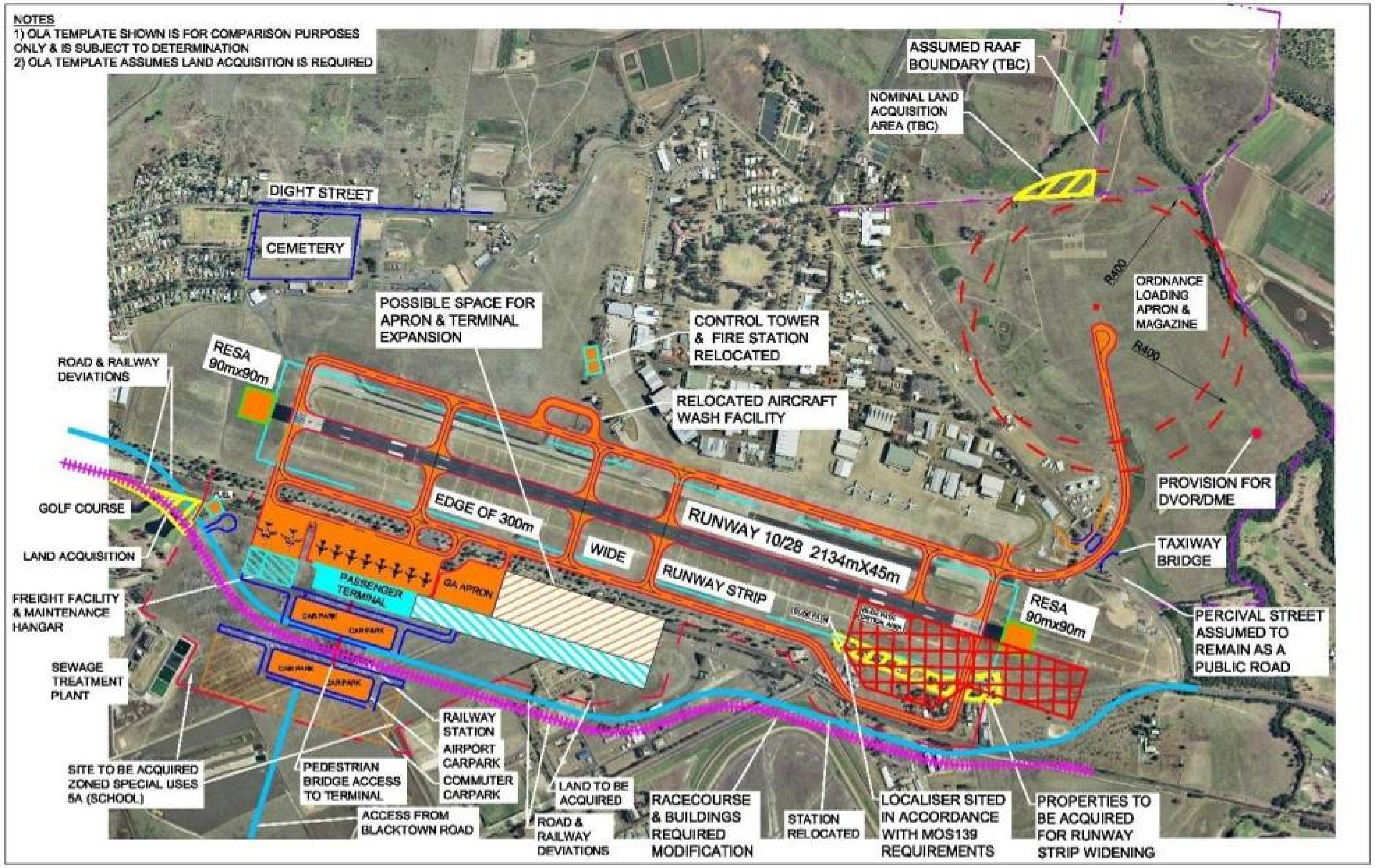


Figure 12.2 – Development Concept B4
Source: Base Image Google Earth Pro 2010 (Image Date January 2007)

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Appendix 1 – Cost Estimate - Minimal Scenario A

RAAF RICHMOND INDICATIVE COSTS
MINIMAL CODE C OPERATIONS (150m STRIP)

No.	Item Description	Unit	Rate	Quantity	$ Cost
A.1.0	**Runway**				9,679,420
A.2.0	**Taxiways**				2,582,400
A.3.0	**Aprons**				6,541,000
A.4.0	**Terminal**				14,687,300
A.5.0	**Carparking, Roads & Services**				3,805,000
A.6.0	**Other Airport Infrastructure**				3,000,000
A.7.0	**Off Airport Works**				NOT COSTED
A.8.0	**RAAF Facilities**				36,389,225
				Sub-total $	76,684,345
	Land Acquisition, Government fees, charges and levies				not costed
	Preliminaries, Profit etc (+15%)				11,502,652
	PM & consultants fees (+15%)				11,502,652
	Project Contingency (+30%)				23,005,304
	Uncosted items (+10%)				7,668,435
				Sub-total $	53,679,042
				Indicative Cost (excl. GST & items not costed)	130,363,387
				GST $	13,036,339
				TOTAL INDICATIVE COST	143,399,725
				SAY	**$ 144,000,000.00**

RAAF RICHMOND INDICATIVE COSTS
MINIMAL CODE C OPERATIONS (150m STRIP)
Item A1 - Runway

No.	Item Description	Unit	Rate	Quantity	$ Cost
A1.1.0	**Earthworks - Strip Widening**				
1.01	Site Establishment	Item			
1.02	Clearing & grubbing	m2			
1.03	Strip topsoil & stockpile	m3			
1.04	Cut to fill	m3			
1.05	Replace & trim Topsoil & grassing	m2			
				S-Total	0
A1.2.0	**Pavements**				
	Asphalt Overlay				
2.1	60mm Asphalt overlay	m2	60	96030	5761800
2.2	Shoulder - 50mm Asphalt max.	m2	55	25608	1408440
2.3	Temp. Ramps - place and remove	Allow			150000
2.4	Runway Grooving	m2	6	96030	576180
2.5	Blast Protection at Runway Ends	m2	55	3600	198000
2.6	Allowance for night works & staging	Item			200,000
2.7	Place topsoil on flanks	m3	10	2000	20000
2.8	Trim Topsoil & grassing	m2	3	27000	81000
2.9	Lay & fix reinforced turf grassing	m2	12	27000	324000
				S-Total	8,719,420
A1.3.0	**Stormwater & Subsoil Drainage**				
3.1	Allowance only, subject to design	Item			
				S-Total	0
A1.4.0	**Navaids & Electrical Allowances**				
4.1	Airfield Lighting - Runway (adjust extg.)	Item			150000
4.2	New Ducting	Item			80000
				S-Total	230,000
A1.5.0	**MISCELLANEOUS ITEMS**				
5.1	Demolition	Item			5000
5.2	Adjustment to Hook cable arrestors	Item			50000
5.3	Linemarking & markers	Item			220000
5.4	Erosion & Sediment Controls	Item			50000
5.5	RESA	m2	25	16200	405000
5.6	Land Acquisition				NIL
				S-Total	730,000
				Sub-total $	9,679,420

NOTES

Refer to the attached general notes

RAAF RICHMOND INDICATIVE COSTS
MINIMAL CODE C OPERATIONS (150m STRIP)
Item A2 - Taxiways

No.	Item Description	Unit	Rate	Quantity	$ Cost
A2.1.0	**Pavements**				
1.01	New Taxiway Pavement	m2	250	5750	1,437,500
1.02	New Taxiway Shoulder	m2	125	5250	656,250
1.03	Allowance for night works & staging	Item			15,000
1.04	Temp. Ramps - place and remove	Item			10,000
1.05	Place topsoil on flanks	m3	12	200	2,400
1.06	Trim Topsoil & grassing	m2	3	1250	3,750
1.07	Lay & fix reinforced turf grassing	m2	12	2500	30,000
				S-Total	2,154,900
A2.2.0	**Stormwater & Subsoil Drainage**				
2.1	Allowance only, subject to design	Item			100000
				S-Total	100000
A2.3.0	**Navaids & Electrical Allowances**				
3.1	Airfield Lighting - Taxiway (new)	m	880	250	220000
3.2	New Ducting	Allow			10000
3.3	Holding Point lighting	Allow			12500
3.4	MAGS	Allow			60000
				S-Total	302,500
A2.4.0	**MISCELLANEOUS ITEMS**				
4.1	Demolition extg pavements	m2			0
4.2	Linemarking	Item			15000
4.3	Erosion & Sediment Controls	Item			10000
				S-Total	25,000
				Sub-total $	2,582,400

NOTES

1 Refer to the attached general notes

RAAF RICHMOND INDICATIVE COSTS
MINIMAL CODE C OPERATIONS (150m STRIP)
Item A3 - Aprons

No.	Item Description	Unit	Rate	Quantity	$ Cost
A3.1.0	**General Aviation Apron**				
1.01	Apron & Taxilane Pavement	m2			
1.02	Taxilane shoulders				
1.03	Stormwater Drainage & Pollution Control	Allow			
1.04	Taxilane lighting	m			
1.05	Apron floodlighting	No.			
1.06	Linemarking	Allow			
1.07	Roads/carparking	m2			
				S-Total	0
A3.2.0	**Aircraft Hangars**				
					NOT COSTED
A3.3.0	**Main Apron**				
3.1	Apron Pavement	m2	250	4699	1174750
3.2	Shoulders	m2	125	250	31250
3.3	Stormwater Drainage & Pollution Control				20000
3.4	Apron Lighting	No.	100000	3	300000
3.5	Linemarking	Allow			5000
3.6	Roads/carparking/GSE parking	m2	50	200	10000
				S-Total	1,541,000
A3.4.0	**Miscellaneous Items**				
4.1	Refuelling system	Allow			5000000
4.2	Land decontamination or remediation				NOT COSTED
4.3	Replacement of RAAF facilities required by construction of new civil facilities				NOT COSTED
				S-Total	5,000,000
				Total $	6,541,000

NOTES
Refer to the attached general notes page

RAAF RICHMOND INDICATIVE COSTS
MINIMAL CODE C OPERATIONS (150m STRIP)
Item A4 - Terminal

No.	Item Description	Unit	Rate	Quantity	$ Cost
A4.1.0	**Terminal**				
1.1	Includes for a single level building with engineering services & fitout	m2	2700	4,699	12,687,300
A4.2.0	**Baggage Handling System**	Item			2,000,000
				Total $	14,687,300

NOTES
Refer to the attached general notes page

RAAF RICHMOND INDICATIVE COSTS
MINIMAL CODE C OPERATIONS (150m STRIP)
Item A5 - Carparking, Roads & Services

No.	Item Description	Unit	Rate	Quantity	$ Cost
A5.1.0	**Carparking**				
1.1	Includes for circulating roads, stormwater, water mains, earthworks, landscaping	m2	150	7200	1080000
1.2	General Demolition - within Raaf Area	m2	100	6000	600000
				S-Total	1,680,000
A5.2.0	**Access Roads**				
2.01	New access road from Hobart St	m			
2.02	Interection upgrades at Dight & Hobart Sts	No.	100000	1	100000
2.03	Traffic Lights & intersection upgrade - Hobart St/Windsor Richmond Rd	Item			
				S-Total	100,000
A5.3.0	**Other Infrastructure**				
3.1	Upgrade Power Reticulation to site	Allow			1000000
3.2	Upgrade Stormwater downstream of site	Allow			25000
3.3	Sewage Reticulation	Allow			500000
3.4	Electrical Reticulation	Allow			500000
				S-Total	2,025,000
				Sub-total $	3,805,000

NOTES

Refer to the attached general notes page

RAAF RICHMOND INDICATIVE COSTS
MINIMAL CODE C OPERATIONS (150m STRIP)
Item A6 - Other Airport Infrastructure

No.	Item Description	Unit	Rate	Quantity	$ Cost
A6.1.0	**Control Tower & Fire Station**	Item			NIL
A6.2.0	**Navaids**				
3.1	DVOR/DME	Item			2,500,000
3.2	Upgrade existing ILS to Cat 2	Item			NIL
3.3	PAPI	Item			500,000
				S-Total	3,000,000
				Total $	3,000,000

NOTES

Refer to the attached general notes page

RAAF RICHMOND INDICATIVE COSTS
MINIMAL CODE C OPERATIONS (150m STRIP)
Item A7 - Off Airport Works

No.	Item Description	Unit	Rate	Quantity	$ Cost
A7.1.0	**Noise Insulation**				Assumed Not Req'd
A7.2.0	**Tree Clearing within OLS Surfaces**				Assumed Not Req'd
A7.3.0	**Obstacle Marking/Lighting/Relocation within OLS**				Assumed Not Req'd
				Total $	

NOTES

Refer to the attached general notes page

RAAF RICHMOND INDICATIVE COSTS
MINIMAL CODE C OPERATIONS (150m STRIP)
Item A8 - RAAF Facilities

No.	Item Description	Unit	Rate	Quantity	$ Cost
A8.1.0	**Replacement C130 Apron**				
1.01	Apron & Taxilane Pavement (concrete)	m2			
1.02	Taxilane shoulders	m2			
1.03	Stormwater Drainage & Pollution Control	Allow			
1.04	Refuelling Facility				
1.05	Taxilane lighting	m			
1.06	Apron floodlighting	No.			
1.07	Linemarking	Allow			
1.08	Roads	m			
1.09	Upgrade Power Reticulation to site				
1.10	Upgrade Stormwater downstream of site	Allow			
				S-Total	0
A8.2.0	**Aircraft Hangars**				NOT COSTED
A8.3.0	**Aircraft Wash Bay**				
3.1	Pavement demolition & grassing	m2			
3.2	Pavements	m2			
3.3	Shoulders	m2			
3.4	Hydraulics & Water supply	Allow			
				S-Total	0
A8.4.0	**Ordnance Loading Apron & Magazine**				
4.01	Earthworks	m3	15	1118750	16781250
4.02	Apron & Taxiway Pavement	m2	200	20735	4147000
4.03	Taxiway Shoulders	m2	125	13545	1693125
4.04	Stormwater Drainage				NIL
4.05	Taxiway Lighting	m	880	645	567600
4.06	Apron Lighting	No.	100000	2	200000
4.07	Taxiway Bridge	m2	7000	1496	10472000
4.08	Road Bridge	m2	5000	238	1190000
4.09	Magazine	Allow			200,000
4.10	Roads to site - rural - 2 lane sealed	m	175	790	138250
4.11	Supply Power to site	Allow			1000000
				S-Total	36,389,225
A8.5.0	**Miscellaneous Items**				
5.1	Land acquisition				NOT COSTED
5.2	Land decontamination or remediation				NOT COSTED
5.3	Replacement of RAAF facilities required by construction of new civil facilities				NOT COSTED
5.4	Replacement of RAAF dispersal areas				Not Req'd
				S-Total	0
				Total $	36,389,225

NOTES
Refer to the attached general notes page

Appendix 2 – Cost Estimates Full Scenario A

RAAF RICHMOND INDICATIVE COSTS

SCENARIO A

No.	Item Description	Unit	Rate	Quantity	$ Cost	% of Subtotal Cost	% 0f total indicative cost
A.1.0	**Runway**	96030	149.04	sq m	14,312,013	6%	3%
A.2.0	**Taxiways**	78030	606.18	sq m	47,300,400	18%	9%
A.3.0	**Aprons**	68000	311.54	sq m	21,184,750	8%	4%
A.4.0	**Terminal**	15000	3366.7		50,500,000	19%	10%
A.5.0	**Carparking, Roads & Services**	41250	276.36		11,400,000	4%	2%
A.6.0	**Other Airport Infrastructure**			item	33,000,000	13%	7%
A.7.0	**Off Airport Works**			item	NOT COSTED		
A.8.0	**RAAF Facilities**			item	82,293,400	32%	16%
				Sub-total $	259,990,563	100%	52%
	Land Acquisition, Government fees, charges and levies				not costed		
	Preliminaries, Profit etc (+15%)				38,998,584		8%
	PM & consultants fees (+15%)				38,998,584		8%
	Project Contingency (+30%)				77,997,169		15%
	Uncosted items (+10%)				41,598,490		8%
				Sub-total $	197,592,828		39%
				Indicative Cost (excl. GST & items not costed)	457,583,390		91%
				GST $	45,758,339		9%
				TOTAL INDICATIVE COST	503,341,729		100%
				SAY	**504,000,000**		

RAAF RICHMOND INDICATIVE COSTS
SENARIO A
Item A1 - Runway

No.	Item Description	Unit	Rate	Quantity	$ Cost
A1.1.0	**Earthworks - Strip Widening**				
1.01	Site Establishment	Item			25000
1.02	Clearing & grubbing	m2	0.7	91650	64155
1.03	Strip topsoil & stockpile	m3	10	50625	506250
1.04	Cut to fill	m3	12.5	84375	1054688
1.05	Replace & trim Topsoil & grassing	m2	7	337500	2362500
				S-Total	4,012,593
A1.2.0	**Pavements**				
	Asphalt Overlay				
2.1	60mm Asphalt overlay	m2	60	96030	5761800
2.2	Shoulder - 50mm Asphalt max.	m2	55	25608	1408440
2.3	Temp. Ramps - place and remove	Allow			150000
2.4	Runway Grooving	m2	6	96030	576180
2.5	Blast Protection at Runway Ends	m2	55	3600	198000
2.6	Allowance for night works & staging	Item			200,000
2.7	Place topsoil on flanks	m3	10	2000	20000
2.8	Trim Topsoil & grassing	m2	3	27000	81000
2.9	Lay & fix reinforced turf grassing	m2	12	27000	324000
				S-Total	8,719,420
A1.3.0	**Stormwater & Subsoil Drainage**				
3.1	Allowance only, subject to design	Item			600000
				S-Total	600000
A1.4.0	**Navaids & Electrical Allowances**				
4.1	Airfield Lighting - Runway (adjust extg.)	Item			150000
4.2	New Ducting	Item			80000
				S-Total	230,000
A1.5.0	**MISCELLANEOUS ITEMS**				
5.1	Demolition	Item			25000
5.2	Adjustment to Hook cable arrestors	Item			50000
5.3	Linemarking & markers	Item			220000
5.4	Erosion & Sediment Controls	Item			50000
5.5	RESA	m2	25	16200	405000
5.6	Land Acquisition				Not Costed
				S-Total	750,000
				Sub-total $	14,312,013

NOTES

Refer to the attached general notes

RAAF RICHMOND INDICATIVE COSTS
SCENARIO A
Item A2 - Taxiways

No.	Item Description	Unit	Rate	Quantity	$ Cost
A2.1.0	**Pavements**				
1.01	New Taxiway Pavement	m2	250	78030	19,507,500
1.02	New Taxiway Shoulder	m2	125	67830	8,478,750
1.03	Allowance for night works & staging	Item			150,000
1.04	Temp. Ramps - place and remove	Item			100,000
1.05	Place topsoil on flanks	m3	12	2000	24,000
1.06	Trim Topsoil & grassing	m2	3	12250	36,750
1.07	Lay & fix reinforced turf grassing	m2	12	24500	294,000
				S-Total	28,591,000
A2.2.0	**Stormwater & Subsoil Drainage**				
2.1	Allowance only, subject to design	Item			1000000
				S-Total	1000000
A2.3.0	**Navaids & Electrical Allowances**				
3.1	Airfield Lighting - Taxiway (new)	m	880	4130	3634400
3.2	New Ducting	Allow			100000
3.3	Holding Point lighting	Allow			125000
3.4	MAGS	Allow			600000
				S-Total	4,459,400
A2.4.0	**MISCELLANEOUS ITEMS**				
4.1	Demolition extg pavements	m2	150	87000	13050000
4.2	Linemarking	Item			150000
4.3	Erosion & Sediment Controls	Item			50000
				S-Total	13,250,000
				Sub-total $	47,300,400

NOTES

1. Refer to the attached general notes
2. Assumed that 900m of existing concrete apron is suitable for new taxiway pavement

RAAF RICHMOND INDICATIVE COSTS
SCENARIO A
Item A3 - Aprons

No.	Item Description	Unit	Rate	Quantity	$ Cost
A3.1.0	**General Aviation Apron**				
1.01	Apron & Taxilane Pavement	m2	125	22000	2750000
1.02	Taxilane shoulders				NIL
1.03	Stormwater Drainage & Pollution Control	Allow			50000
1.04	Taxilane lighting	m	880	200	176000
1.05	Apron floodlighting	No.	3	100000	300000
1.06	Linemarking	Allow			15000
1.07	Roads/carparking	m2	50	1000	50000
				S-Total	3,341,000
A3.2.0	**Aircraft Hangars**				
					NOT COSTED
A3.3.0	**Main Apron**				
3.1	Apron Pavement	m2	250	46000	11500000
3.2	Shoulders	m2	125	750	93750
3.3	Stormwater Drainage & Pollution Control				200000
3.4	Apron Lighting	No.	100000	9	900000
3.5	Linemarking	Allow			50000
3.6	Roads/carparking/GSE parking	m2	50	2000	100000
				S-Total	12,843,750
A3.4.0	**Miscellaneous Items**				
4.1	Refuelling system	Allow			5000000
4.2	Land decontamination or remediation				NOT COSTED
4.3	Replacement of RAAF facilities required by construction of new civil facilities				NOT COSTED
				S-Total	5,000,000
				Total $	21,184,750

NOTES

Refer to the attached general notes page

RAAF RICHMOND INDICATIVE COSTS
SCENARIO A
Item A4 - Terminal

No.	Item Description	Unit	Rate	Quantity	$ Cost
A4.1.0	**Terminal**				
1.1	Includes for a single level building with engineering services & fitout	m2	2700	15,000	40,500,000
A4.2.0	**Baggage Handling System**	Item			10,000,000
				Total $	50,500,000

NOTES
Refer to the attached general notes page

RAAF RICHMOND INDICATIVE COSTS
SCENARIO A
Item A5 - Carparking, Roads & Services

No.	Item Description	Unit	Rate	Quantity	$ Cost
A5.1.0	**Carparking**				
1.1	Includes for circulating roads, stormwater, water mains, earthworks, landscaping	m2	150	36000	5400000
1.2	General Demolition - within Raaf Area	m2	100	30000	3000000
				S-Total	8,400,000
A5.2.0	**Access Roads**				
2.01	New access road from Hobart St	m	200	750	150000
2.02	Intersection upgrades at Dight & Hobart Sts	No.	100000	3	300000
2.03	Traffic Lights & intersection upgrade - Hobart St/Windsor Richmond Rd	Item			300000
				S-Total	750,000
A5.3.0	**Other Infrastructure**				
3.1	Upgrade Power Reticulation to site				1000000
3.2	Upgrade Stormwater downstream of site	Allow			250000
3.3	Sewage Reticulation				500000
3.4	Electrical Reticulation				500000
				S-Total	2,250,000
				Sub-total $	11,400,000

NOTES

Refer to the attached general notes page

RAAF RICHMOND INDICATIVE COSTS
SCENARIO A
Item A6 - Other Airport Infrastructure

No.	Item Description	Unit	Rate	Quantity	$ Cost
A6.1.0	**Control Tower & Fire Station**	Item			20,000,000
A6.2.0	**Navaids**				
3.1	DVOR/DME	Item			2,500,000
3.2	Upgrade existing ILS to Cat 2	Item			10,000,000
3.3	PAPI	Item			500,000
				S-Total	13,000,000
				Total $	33,000,000

NOTES

Refer to the attached general notes page

RAAF RICHMOND INDICATIVE COSTS
SCENARIO A
Item A7 - Off Airport Works

No.	Item Description	Unit	Rate	Quantity	$ Cost
A7.1.0	**Noise Insulation**				NOT COSTED
A7.2.0	**Tree Clearing within OLS Surfaces**				NOT COSTED
A7.3.0	**Obstacle Marking/Lighting/Relocation within OLS**				NOT COSTED
				Total $	

NOTES

Refer to the attached general notes page

RAAF RICHMOND INDICATIVE COSTS
SCENARIO A
Item A8 - RAAF Facilities

No.	Item Description	Unit	Rate	Quantity	$ Cost
A8.1.0	**Replacement C130 Apron**				
1.01	Apron & Taxilane Pavement (concrete)	m2	400	80000	32000000
1.02	Taxilane shoulders	m2	125	7125	890625
1.03	Stormwater Drainage & Pollution Control	Allow			500000
1.04	Refuelling Facility				5000000
1.05	Taxilane lighting	m	880	735	646800
1.06	Apron floodlighting	No.	14	100000	1400000
1.07	Linemarking	Allow			75000
1.08	Roads	m	350	735	257250
1.09	Upgrade Power Reticulation to site				1000000
1.10	Upgrade Stormwater downstream of site	Allow			250000
				S-Total	40,437,425
A8.2.0	**Aircraft Hangars**				NOT COSTED
A8.3.0	**Aircraft Wash Bay**				
3.1	Pavement demolition & grassing	m2	150	7100	1065000
3.2	Pavements	m2	400	7100	2840000
3.3	Shoulders	m2	125	7350	918750
3.4	Hydraulics & Water supply	Allow			1,000,000
				S-Total	5,823,750
A8.4.0	**Ordnance Loading Apron & Magazine**				
4.01	Earthworks	m3	15	1118750	16781250
4.02	Apron & Taxiway Pavement	m2	200	20735	4147000
4.03	Taxiway Shoulders	m2	125	13545	1693125
4.04	Stormwater Drainage				NIL
4.05	Taxiway Lighting	m	880	645	567600
4.06	Apron Lighting	No.	100000	2	200000
4.07	Taxiway Bridge	m2	7000	1496	10472000
4.08	Road Bridge	m2	3500	238	833000
4.09	Magazine	Allow			200,000
4.10	Roads to site - rural - 2 lane sealed	m	175	790	138250
4.11	Supply Power to site				1000000
				S-Total	36,032,225
A8.5.0	**Miscellaneous Items**				
5.1	Land acquisition				NOT COSTED
5.2	Land decontamination or remediation				NOT COSTED
5.3	Replacement of RAAF facilities required by construction of new civil facilities				NOT COSTED
5.4	Replacement of RAAF dispersal areas				NOT COSTED
				S-Total	0
				Total $	82,293,400

NOTES

Refer to the attached general notes page

Appendix 3 General Glossary of Aviation and Airport Planning terms

ACN	Aircraft Classification Number: a number expressing the relative effect of an aircraft on a pavement for a specified standard subgrade category.
ANEC	Australian Noise Exposure Concept: used as a planning tool to investigate likely changes to aircraft noise exposure resulting from proposed changes to conditions at an airport. Those changes include, among other things, changes to aircraft types or numbers.
ANEF	Australian Noise Exposure Forecast: the only metric approved and promoted by the Federal Government for use in determining the suitability of land use in regards to aircraft noise. The ANEF is generally provided for a 20-year time frame, is updated regularly and there can be only one approved set of ANEF contours at a given time. The approving authority is Airservices Australia.
ANEI	Australian Noise Exposure Index: provides historical data on aircraft noise exposure. Normally one year's actual traffic at an airport is used to generate the ANEI and the approval process is the same as that for the ANEF.
ARC	Aerodrome Reference Code: a convenient method of specifying the standards for individual aerodrome facilities which are suitable for use by airplanes within a range of performances and sizes. The Code is composed of two elements: element 1 is a number related to the airplane reference field length; and element 2 is a letter related to the airplane wingspan and outer main gear wheel span as per the table below. A particular specification is related to the more appropriate of the two elements of the Code or to an appropriate combination of the two Code elements. Typical examples are the B737 which is a Code 4C airplane, while the B747 is a Code 4E airplane. The Code letter or number within an element selected for design purposes is related to the critical airplane characteristics for which the facility is provided. There could be more than one critical airplane, as the critical airplane for a particular facility, such as a runway, may not be the critical airplane for another facility, such as the taxiway.

Aerodrome Reference Code				
Code Element 1		**Code Element 2**		
Code Number	**Airplane Reference Field Length**	**Code Letter**	**Wing Span**	**Outer Main Gear Span**
1	Less than 800m	A	Up to but not including 15m	Up to but not including 4.5m
2	800m up to but not including 1200m	B	15m up to but not including 24m	4.5m up to but not including 6m
3	1200m up to but not including 1800m	C	24m up to but not including 36m	6m up to but not including 9m
4	1800m and over	D	36m up to but not including 52m	9m up to but not including 14m
		E	52m up to but not including 65m	9m up to but not including 14m
		F	65m up to but not including 80m	14m up to but not including 16m

Source: CASA 2008

ARFFS	Aerodrome Rescue and Fire Fighting Services: a special category of firefighting that involves the response, hazard mitigation, evacuation and possible rescue of passengers and crew of an aircraft involved in (typically) an airport ground emergency.
ARFL	Aerodrome Reference Field Length: the minimum field length required for take-off at maximum certificated take-off mass, sea level, standard atmospheric conditions, still air and zero runway slope, as shown in the appropriate airplane flight manual prescribed by the certificating authority or equivalent data from the airplane manufacturer. The determination of the ARFL is solely for the selection of a Code number and must not be confused with the actual runway length requirement for a particular operation which may influenced by other factors.
ATC	Air Traffic Control: a service provided by ground-based controllers who direct aircraft on the ground and in the air.
AWIS	Automatic Weather Information Service: a system which provides information on a range of current parameters and made available via phone or discrete radio frequency.
CTAF	Common Traffic Advisory Frequency: a procedure which assigns common radio frequencies to geographic areas and used for the purpose of air to air and air to ground pilot communications.
DME	Distance Measuring Equipment: a ground-based navigation aid which provides a pilot with the slant distance from the aircraft to the DME ground transmitter.
ERSA	En-Route Supplement Australia: a document which provides a range of aeronautical information including information for aerodromes.
GNSS	Global Navigation Satellite System: generic terminology to identify all satellite navigation systems where the user performs onboard position determination from satellite information. The widely known Global Positioning System (GPS) is one form of GNSS.
IATA	International Air Transport Association: the peak international body which represents most of the world's airline's interests.
ICAO	International Civil Aviation Organization; the United Nations body to which Australia is a signatory, which codifies the principles and techniques of international air navigation and fosters the planning and development of international air transport to ensure safe and orderly growth.
IMC	Instrument Meteorological Conditions, expressed in terms of visibility, distance from cloud, and ceiling, less than the minimum specified for visual meteorological conditions.
INM	Integrated Noise Model: the software published by the US Federal Aviation Administration used to derive aircraft noise contours.
IFR	Instrument Flight Rules: regulations and procedures for flying aircraft by referring only to aircraft instruments for navigation. Scheduled airline flights operate under IFR.
IWDI	Illuminated Wind Direction Indicator: a ground based visual navigation aid which provides an estimate of wind speed and direction to pilots and illuminated for night use.
MAGS	Movement Area Guidance Signs: mandatory, direction and information signs placed adjacent to runways, taxiways and aprons which provide operational information to pilots.
MTOW	Maximum Take-off Weight: the maximum weight at which the pilot of the aircraft is allowed to attempt to take off, due to structural or other limits.
NDB	Non-Directional Beacon: a ground-based radio navigation aid that provides a pilot with relative bearing information to the NDB station.

N60	Number of daily flights above 60 dB (A): noise contours based on the estimate of daily flights.
N70	Number of daily flights above 70 dB (A): noise contours based on the estimate of daily flights.
OLS	Obstacle Limitation Surfaces: a series of planes associated with each runway at an aerodrome that defines the desirable limits to which objects may project into the airspace around the aerodrome so that aircraft operations at the aerodrome may be conducted safely.
PANS-OPS	Procedures for Air Navigation Services – Aircraft Operations: a term denominating rules for designing instrument approach and departure procedures.
PAPI	Precision Approach Path Indicator system; a lighting array which provides pilots with visual approach slope guidance for landing.
PCN	Pavement Classification Number: a number expressing the bearing strength for unrestricted operations by aircraft with ACN value less than or equal to the PCN.
RESA	Runway End Safety Area: an area symmetrical about the extended runway centre line and adjacent to the end of the strip, primarily intended to reduce the risk of damage to an airplane undershooting or overrunning the runway. RESA are a mandatory requirement for Code 3 and 4 runways.
RNAV	Area Navigation: a method of navigation which permits aircraft operation on any desired flight path within the coverage of station-referenced navigation aids, or within the limits of the capability of self-contained aids, or a combination of these.
RNP	Required Navigation Performance: a statement of the navigation performance necessary for operation within a defined airspace. It is part of a broader concept called "Performance-based Navigation or PBN." RNP is a method of implementing routes and flight paths that differs from previous methods in that not only does it have an associated performance specification that an aircraft must meet before the path can be flown, but it must also monitor the achieved performance and provide an alert in the event that this fails to meet the specification. It is the monitoring and alerting facility that distinguishes RNP from RNAV from which it developed.
RPT	Regular Public Transport: a generic term which signifies scheduled air passenger transport operations.
RWS	Runway Strip: a defined area including the runway and stopway, (if provided), intended to reduce the risk of damage to aircraft running off a runway and to protect aircraft flying over it during take-off or landing operations.
WDI	Wind Direction Indicator: a ground based visual navigation aid which provides an estimate of wind speed and direction to pilots for day time use.

Sydney (Kingsford-Smith) Airport current capacity and potential capacity enhancement

Air traffic management implications of the civil use of RAAF Base Richmond

C6

JOINT STUDY ON AVIATION CAPACITY FOR THE SYDNEY REGION

AIRSERVICES AUSTRALIA

SYDNEY (KINGSFORD-SMITH) AIRPORT CURRENT CAPACITY AND POTENTIAL CAPACITY ENHANCEMENT

AIR TRAFFIC MANAGEMENT IMPLICATIONS OF THE CIVIL USE OF RAAF BASE RICHMOND

Executive Summary

As part of a joint Commonwealth and NSW State Government initiative to develop an Aviation Strategic Plan for the Sydney region, Airservices Australia has been requested to undertake analysis in relation to aviation capacity in the Sydney region. Specifically, the tasks undertaken include:

- An analysis of the current capacity of Sydney airport;
- An analysis of potential enhancements to the future capacity of Sydney airport; and
- An analysis of the air traffic management implications for the use of Richmond as an additional civilian airport within the Sydney region.

This report is not intended for circulation beyond the Department of Infrastructure and Transport and the Joint Study Steering Committee.

Airservices provides no warranty or guarantee as to the accuracy or completeness of this report. Readers should rely on their own enquiries and seek independent advice.

Airservices makes no representation, warranty or guarantee concerning any findings in this report. Any findings are to be treated as indicative only, and based on Airservices limited role in the overall study.

This report represents the view of Airservices and not the view of any individual person.

Assumptions

A number of assumptions have been applied in developing the analysis. Specifically, it should be noted that the currently legislated cap of 80 aircraft movements per hour and the aerodrome curfew between the hours of 2300 and 0600 local time have been applied to all analyses where relevant. Additionally, this analysis is limited to consideration of airspace, runways, taxiways and navigation infrastructure. Matters such as apron design and capacity and terminal and gate design and capacity or the interaction with airfield efficiency have not been analysed within this report.

Key Findings

The key findings of the analysis to date include:

- The theoretical maximum capacity of Sydney airport is 496,000 movements per annum.
- The current application of the Long Term Operating Plan (LTOP) is not a capacity constraint.
- Weather is the major limit on theoretical capacity at Sydney airport.
- Weather is estimated to reduce Sydney airport capacity from the theoretical level by around 10% to a practical capacity of 446,000 movements per annum.
- According to BITRE aircraft movement forecasting, scheduling at the practical capacity level will occur in the 2030 - 2031 financial year.
- According to Booz&Co aircraft movement forecasting, scheduling at the practical capacity level will occur in the 2038 - 2039 financial year.
- The anticipated difficulty in operating at, or close to, 80 movements per hour over a sustained period of time requires further investigation, particularly as it has the potential to bring forward the date at which practical capacity will be reached.
- The anticipated difficulty for schedules to be recovered following disruption events such as emergency, significant weather etc. in an acceptable timeframe requires further investigation, particularly as it has the potential to bring forward the date at which practical capacity will be reached.
- The availability of LTOP noise respite modes of operation will degrade as practical capacity is approached.
- Future enhancements to the practical capacity level at Sydney will largely relate to improvements in all-weather operations and are estimated to not exceed an additional 25,000 movements per annum.
- Any significant increase in aviation activity at Richmond, particularly jet aircraft operations, should be assessed against the maintenance of capacity and efficiency of Sydney.

- Further analysis is required to quantify any projected increase in aviation activity at Richmond and its consequent effect on capacity at Sydney.
- Any development of Richmond aerodrome as an additional civilian airport with traffic levels and mix similar to Newcastle would impact Sydney airport operations requiring airspace redesign.
- Any significant increase in aviation activity at Richmond will necessitate a redesign of LTOP.
- Any development of Richmond aerodrome as an additional civilian airport would require an integrated airspace operating plan to be developed to ensure safe and efficient airspace architecture in the Sydney region.

Study Purpose

To support the Joint Study on Aviation Capacity for the Sydney Region, Airservices Australia has undertaken analysis on the current capacity of Sydney airport, the potential enhancements to the future capacity of Sydney airport and analysis of the air traffic management implications for the use of Richmond as an additional civilian airport within the Sydney region. This paper represents the preliminary work on these topics.

Assumptions

The key assumptions applied in this investigation are:

1) That the currently legislated cap of 80 aircraft movements per hour; and
2) The aerodrome curfew between the hours of 2300 and 0600 local time;

were maintained in the analysis of current or future capacity.

As work progressed, further assumptions were applied and these are documented below.

Exclusions

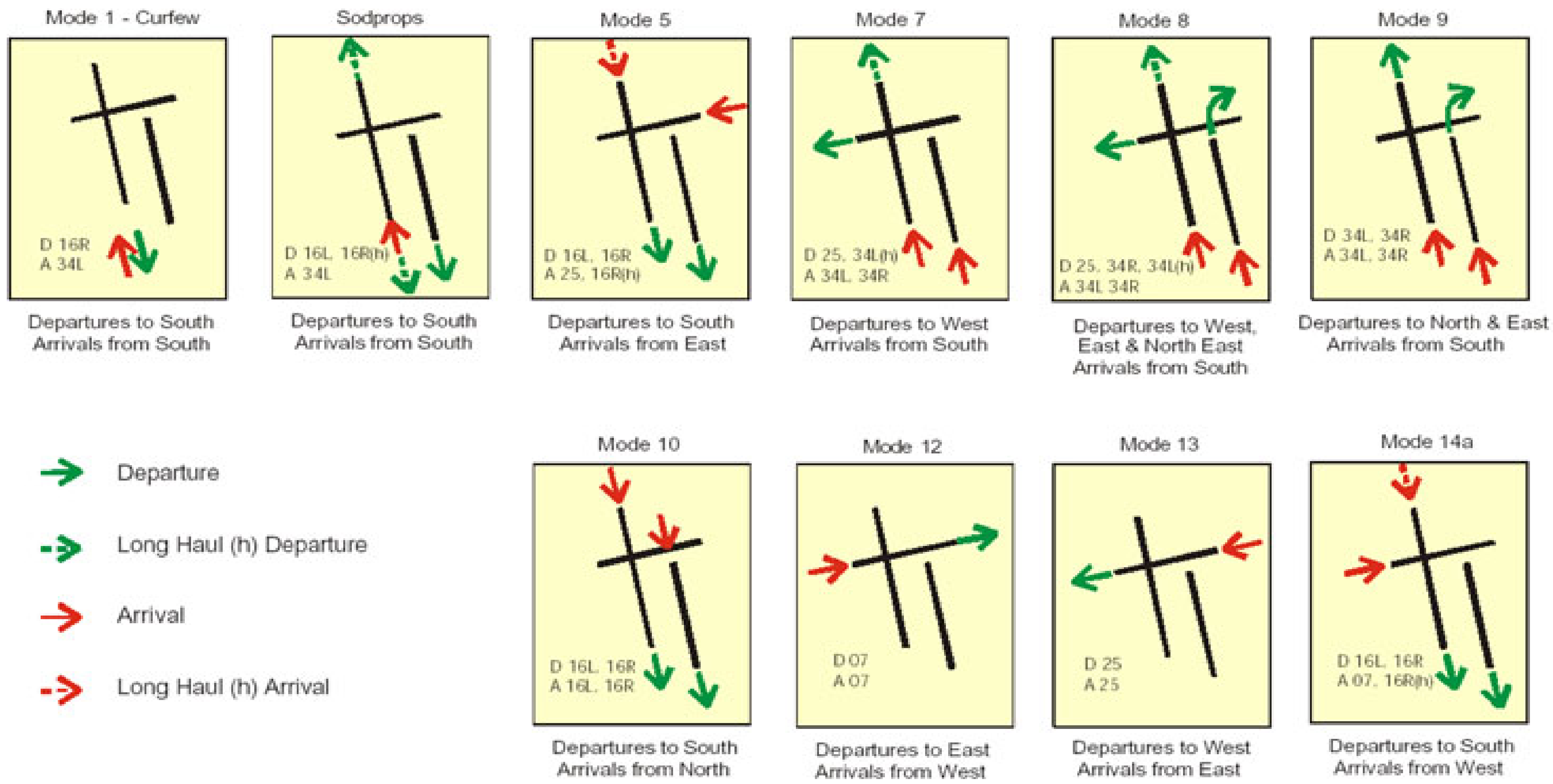
This analysis is limited to consideration of airspace, runways, taxiways and navigation infrastructure. Matters such as apron design and capacity and terminal and gate design and capacity or the interaction with airfield efficiency have not been analysed within this report. It is understood through discussions with the Department of Infrastructure, Transport, Regional Development and Local Government that these matters will be addressed separately.

Study Structure

The analysis has been addressed in three sections. Each section analyses a specific question and seeks to identify and conclude the major findings associated with the topic.

Long Term Operating Plan (LTOP)

Modes



Current Capacity at Sydney

Study Design

The study was designed around the following methodology.

1) Determination of a theoretical maximum capacity, including a proof of the major limiting factor(s).
2) Establish primary factors which deduct from this theoretical maximum.
3) Statistical analysis of a sample of past data to determine the effect of these factors on theoretical maximum, and calculation of a practical maximum. The 2007 calendar year was chosen for this sample, as it represented the last full year of data unaffected by significant outside factors such as the Runway End Safety Area (RESA) works which distorted the 2008 and 2009 data.

Data Collection

To determine the effect of the identified capacity constraints on the theoretical maximum, historical analysis of forecast arrival rates published via the strategic demand and capacity management system (Centralised Traffic Management System - CTMS) was conducted.

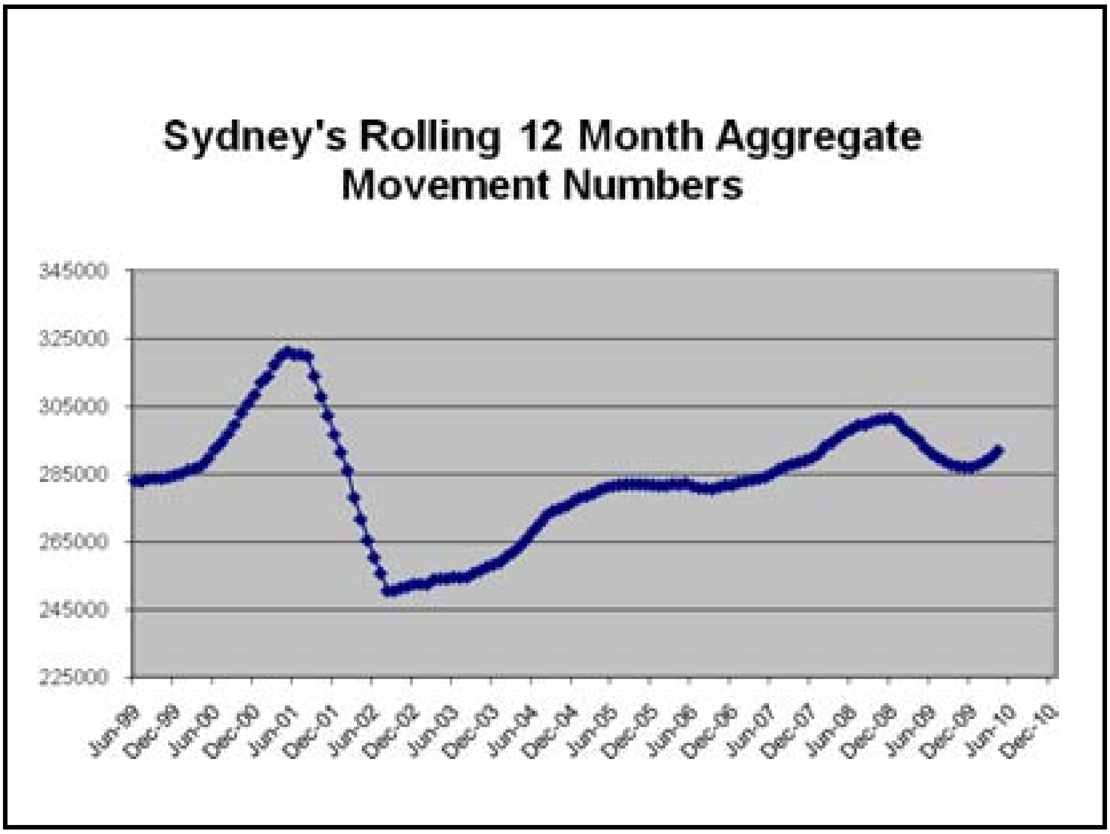
When considering movement rates that approach or equal maximum capacity, it would not be beneficial to contemplate or promote a situation whereby more aircraft present at an aerodrome than can be safely processed, necessitating mandatory diversions. Indeed, apart from highlighting the difficulty in achieving real-time, precise capacity very close to, or at, a hypothetical maximum and noting that the current systems, both internally and for other stakeholders, may still be incapable of supporting such an operation, this preliminary paper leaves it to a more detailed study to examine further.

Theoretical Maximum

The Long Term Operating Plan (LTOP) designates a mandatory hierarchy of runway usage modes to distribute aircraft noise more fairly. Whilst the modes often include the usage of a single arrival runway, and subsequently reduced overall movement rates, airborne delays that approach or exceed 20 minutes trigger a move back to a parallel runway mode. In practice, this means that as long as demand remains high (anything over approximately 55 movements per hour), Sydney airport is likely to remain on a parallel runway mode. Thus, in any discussion of airport capacity, LTOP as it is currently applied is not to be regarded as a capacity constraint.

There is ample evidence in Sydney's past operational statistics of rates of up to 80 movements per hour indicating that the airspace, runways and taxiways are capable of supporting movement rates at the legislated maximum. Sustainability of the maximum rate over longer periods of time requires further analysis, particularly in regard to the availability of apron space, airside and landside infrastructure, the mix of aircraft presenting at the aerodrome compared to runway suitability, and given that the last time these peak rates were obtained on a regular basis was around 10 years ago as per the graph below. Nevertheless, March 30th, 2001, saw 228 movements in a three hour period. This equates to an average of 76 per hour over a block of time traditionally assumed to encompass both an arrival and departure movement peak, suggesting that sustained rates around 80 are feasible.

On that basis, the theoretical maximum movement rate, excluding the curfew from 2300 – 0600L, and all other capacity limiting factors is deemed to be 80 x 17 hrs x 365 days = 496,000 movements per annum. Thus, Sydney's current rates of around 295,000 per annum represent around a 60% utilisation of theoretical maximum capacity.



Factors Which Deduct From Theoretical Maximum to Give Practical Maximum

Next, a determination had to be made of those factors which **significantly** altered the achievable movement rate.

The primary influence on reduced capacity at Sydney aerodrome is adverse weather. Movement rates in both the arrival and departure modes of flight are reduced during times of reduced visibility, cloud below 4000' and during periods of aircraft diversions around weather cells such as thunderstorms. The effect on achievable rates varies according to the severity of the weather but could be minor e.g. a reduction from 80 per hour to 74 per hour with cloud between 3000' – 4000' to more severe during times of weather-related single runway operations e.g. runway 07 only operations might drive capacity down to 45 per hour.

Factors that were considered but deemed negligible or not pertinent to the discussion included impact of occasional events such as scheduled flight testing of navigation aids, aircraft emergency or priority operations and closures of runways or taxiways due to Foreign Object Damage (FOD), pavement failures or disabled aircraft. Additionally, days where fog impacted operations at Sydney were assessed and at an average of 5 days per annum for approximately 2 hours per instance, this was not considered significant. It therefore follows that the introduction of a higher category Instrument Landing System (ILS) would not materially increase capacity at Sydney. These factors were expected to have a cumulative effect of negating around 1000 movements, or a small fraction of 1% of total capacity, across any given year.

Statistical Analysis

In analysing the effect of the key constraint on capacity – weather – it is pertinent to give some context on overall consequence. For example, we might discuss a reduction from 80 movements per hour to around 45 per hour on runway 07 or 25 only operations; however the period over which such a reduction occurs is highly relevant. An analysis of single runway operations on runway 07 and 25 for the last eight years of statistically valid data (2001-7 with 2008-9 excluded due Runway End Safety Area works on the cross runway) shows:

Year	Mode 12 (RWY 07 only)	Mode 13 (RWY 25 only)
2001	0.64%	2.83%
2002	0.99%	3.89%
2003	1.67%	2.71%
2004	0.72%	2.47%
2005	0.93%	2.74%
2006	0.67%	1.45%
2007	0.74%	1.54%
2008	0.10%	1.86%
2009	0.01%	1.07%
Average 2001-2007	**0.91%**	**2.52%**

Thus the cumulative usage of single runway operations over the last seven years of statistically valid data was 3.43% or the equivalent of 0.58 hours per day outside curfew. During those periods, runway usage rates would typically be in the order of 45-50/hour allowing for strong wind conditions, missed departure slots and go-arounds. Thus, taking the conservative figure, 1360 movements/day would be reduced by around 0.58 x (80 – 45) or 20 movements per day, which equates to around 7400 movements ‘lost’ from the 496,000 per annum, or only in the order of 1.5% of total capacity.

2002 represented the ‘worst’ year for single runway operations with approximately 5% of outside curfew movements conducted during single runway operations. This would have had the average effect of around a 30 movement per day reduction or somewhere around 2.1%.

Several points need to be noted about the data used for this analysis. CTMS covers arriving aircraft only and is generally programmed based on forecast weather one day prior to the day of operation. Therefore there are inevitably some variations between actual arrival rates and those programmed. Where significant variation occurs (generally more than four arrivals per hour) however, CTMS is reprogrammed to reflect the change. The data used was final CTMS data, hence these variations were captured. Also of note is that CTMS rates are generally two arrivals per hour higher than the corresponding Maestro (tactical flow) rates for that weather pattern, to provide a traffic ‘pressure factor’ and maintain a high level of efficiency in the arrival sequence i.e. no missed slots. The CTMS data available gives a representation of all weather scenarios. By analysing the programmed runway mode and assigned acceptance rate, it was possible to back-calculate the predicted weather condition and determine a corresponding Maestro rate. A corrective figure was applied to this rate to give a total practical movement rate as discussed below.

In theory and in practice, the general concept for parallel runway modes is one departure slot being utilised between each two arrivals, with a negative factor for 'slippage,' created by missed departure slots, go arounds, aircraft slow to vacate runways, aircraft under tow crossing the active runway etc..

Total practical movement rate = Maestro arrival rate x 2 – slippage

In regard to the slippage figure, preliminary analysis of past movement rates indicates that the practically achievable rate is typically five movements per runway per hour lower than the Maestro arrival rate times two.

> Example 1) A runway 34 Independent Visual Approach (IVA) scenario may have a Maestro programmed rate of 48 arrivals per hour. This would equate to a total movement rate of 48 x 2 – 10 = 86. However with a cap of 80 this becomes 80 movements per hour.
>
> Example 2) A runway 16 Instrument Landing System (ILS) Approach scenario with cloud below 2000' may have a Maestro programmed rate of 34 arrivals per hour. This equates to a total movement rate of 34 x 2 – 10 = 58 movements per hour.
>
> Example 3) Runway 25 only has a Maestro programmed rate of 25 arrivals per hour. This equates to a total movement rate of 25 x 2 – 5 = 45 movements per hour.

To expand the concept of weather affected movement rates, the calculated practical movement rates were estimated as follows:

Visibility/Cloud Base	IVAs 16/34	PRM 16/34	DVA* or ILS 16/34
>5000m and >4001'	80/80		
>5000m and between 3001'-4000'	74/80		
>5000m and between 2001'-3000'	66/70	70/74	
>5000m and between 1500'-2000'		70/74	58/58
>2000m and/or scattered <1500'		70/74	58/58
<2000m and/or broken <1500'		70/74	58/58
Thunderstorm Probability			50

**Dependent Visual Approach*

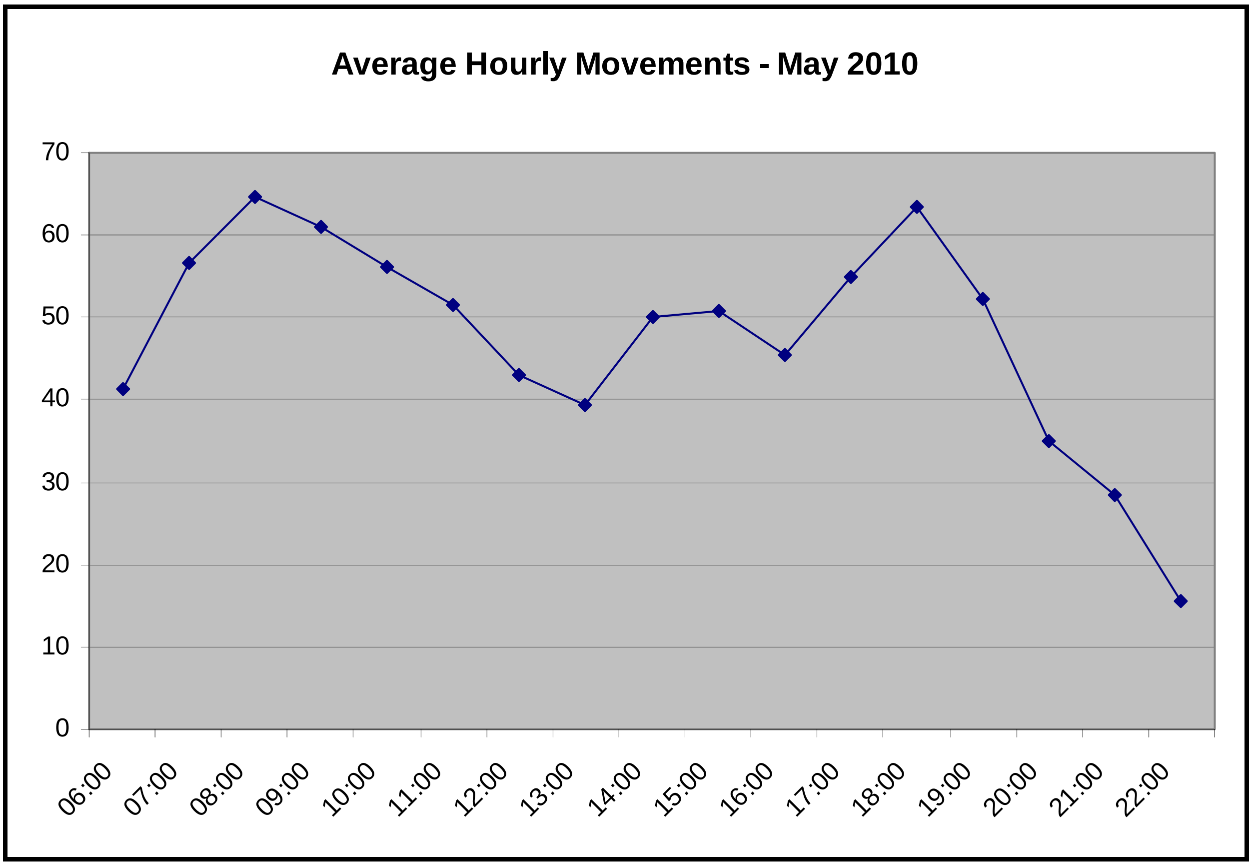
Using these figures, CTMS data for the period 2001-7 (excluding curfew operations) was analysed and a practically achievable rate for the forecast weather conditions was calculated. A month-by-month analysis would give an overview of the impact of seasonal weather variations and may be considered for future studies, however over the entire period a practical capacity of 446,000 per annum was determined. Thus, according to past

CTMS data with weather and operational slippage constraints applied, there was around a 10% reduction on the theoretical maximum of 496,000.

According to the Bureau of Infrastructure, Transport and Regional Economics Research Report 117 into projected aircraft movements, and given similar weather patterns similar to that which occurred in 2007, Sydney airport would reach its capacity limits in the 2028 - 2029 financial year. Independent aircraft movement forecasting conducted by Booz&Co indicates that the practical capacity will be reached in the 2030 – 2031 financial year[1]. In all likelihood the 80 per hour cap, cluster scheduling, non-willingness for airlines to utilise slots during the midday trough and later in the evening (see graph below) suggests that the practical limit will be reached earlier than those nominated years. Additionally, as practical capacity is approached the ability for schedules to be recovered following disruption events will be become significantly impacted, further reinforcing the likelihood that the practical capacity limit will be reached earlier than suggested.

[1] BITRE CAGR forecast 2.3% p.a.; Booz CAGR forecast 1.8% p.a.

Baseline sample day movements: 12/11/2010 – actual movement data supplied by Airservices.



Further Analysis

- Modelling of the possibility of sustained rates of 80 movements per hour, on taxiway congestion and runway crossings.
- Modelling of the possibility of sustained rates of 80 movements per hour on conflict resolution of aircraft over-flying the aerodrome to achieve balanced arrival runway movements.
- Any required internal and operator compliance systems or procedures for movements up to 80 per hour.

Major Findings

1. The theoretical maximum capacity is 496,000 movements per annum.
2. Weather is the major limit on practical capacity.

3. In the 2007 calendar year, weather had the effect of reducing capacity from the theoretical levels by around 10% to a practical capacity of 446,000.

4. According to BITRE figures, scheduling at that practical level will occur in the 2028 - 2029 financial year.

5. According to Booz&Co figures, scheduling at that practical level will occur in the 2030 – 2031 financial year.

6. The anticipated difficulty in operating at, or close to, 80 movements per hour over a sustained period of time warrants further investigation, particularly since it has the potential to bring forward the date at which practical capacity will be reached.

7. The anticipated difficulty for schedules to be recovered following disruption events such as emergency, significant weather etc. in an acceptable timeframe requires further investigation, particularly as it has the potential to bring forward the date at which practical capacity will be reached.

8. The availability of LTOP noise respite modes of operation will degrade as practical capacity is approached.

Future Capacity Enhancements

Context

This section identifies potential enhancements to current and projected capacity at Sydney airport. Importantly, within the context of the previous section it is evident that any significant future enhancements to capacity will largely relate to improvements to all-weather operations.

Capacity Enhancement Options

1. RNP Approach Procedures

- No effect on capacity enhancement but significant potential to deliver environmental benefits in terms of emissions savings and noise reduction. Additionally, RNP provides a capability to better distribute aircraft noise.

2. RNAV 1 SID and STAR design

- Delivers an Increase in terminal area capacity due to the ability to reduce the separation distance between flight-paths.
- Capacity increase not yet quantified.

3. Displaced Threshold Procedure, RWY 34 Left

- For propeller driven aircraft.
- Reduction in runway occupancy time.
- Small increase in capacity for this runway.
- Short term capacity solution - would not deliver a benefit when demand approaches the legislated movement cap.

4. HIAL RWY 34 Left

- Increases the availability of this runway in low visibility conditions from current 1500m to 800m visibility.

- Limited extra capacity gain – conditions requiring reduced visibility minimum is, on average, 6 days per year and for approximately 4 hours of those days.

5. Precision Runway Monitor Procedures

- Preliminary analysis indicates that PRM would be utilised on average, 5.6 hours per day when weather conditions are less than 5000m visibility and/or cloud base is less than 4001'.

- Annualised capacity is enhanced approximately 25,000 movements

- The expanded hours of Runway 16 PRM procedure usage is limited, by environmental approval, to the hours of 0700 and 1100 local time, Monday to Friday.

6. Parallel Runway Standards for GLS, RNAV and RNP

- Increased efficiency for parallel runway operations.

- Enabler for satellite based approach procedures with significant potential to deliver environmental benefits.

- Short term capacity solution - would not deliver a benefit when demand approaches the legislated movement cap.

7. Relaxation of aircraft type restrictions on Runways 16L and 34R

- Delivers enhanced runway utilisation balancing for parallel runway operations (moving aircraft from the long runway to the short runway) to enhance overall capacity.

8. Sydney Basin Airspace Re-design

- Delivers enhanced runway utilisation balancing for parallel runway operations (moving arriving aircraft from the long runway to the short runway) to enhance overall capacity.

- Delivers enhanced Continuous Descent Arrivals (CDA) and Continuous Climb Departures (CCD).

- Facilitates the environmental benefits of RNP procedures (arrival and departure) for emissions and noise sharing.

- Facilitates the integrated airspace management of primary and secondary aerodromes in the Sydney basin, including any second major airport.

Major Findings

1. The expansion of the hours of use of PRM procedures is the sole significant capacity enhancement available within the current operating plan for the airport.
2. A re-design of Sydney basin airspace procedures will be required to manage runway balancing as demand approaches the legislated movement cap.
3. An integrated terminal area design, utilising PBN, may need to be considered to accommodate projected traffic grown within the Sydney basin.

Utilisation of Richmond Aerodrome

Context

This section discusses specific operational implications if Richmond aerodrome was to be used as an additional civilian airport within the Sydney region.

Assumptions

1. Current aerodrome design and infrastructure is not altered.
2. The aerodrome would not be operating as joint user facility.
3. Airline operator utilisation at Richmond would be substantially similar to that which is occurring at Williamtown i.e. Low Cost Carriers and Regional Services.

Limitations

1. **Runways, Aprons and Taxiways**

   - The existing aerodrome layout and apron usage imposes limitations on the use of certain taxiways, depending on aircraft size. These limitations are noted in AIP ERSA. Aircraft up to ICAO Code D should not be affected by these limits (B767 type and below). Newer generation twin jet aircraft, such as the A330 and B787 are affected. Whilst this does not preclude these aircraft from operating at Richmond, it does affect traffic capacity and efficiency due to the need to backtrack the runway, with 180^{o} turns at the runway ends.
   - The distance between the flight strip and the parallel taxiway may not comply with CASA Part 139 MOS requirements for civil jet operations. A CASA compliance determination is required.
   - The aerodrome layout does not currently facilitate a precision approach (ILS) procedure below Category I.

2. **Runway Length**

   The runway length is 2134 metres, which will limit airline operator aircraft selection and payload. Further, given the proximity of Windsor, any significant extension of the runway would be problematic.

3. Terrain

Terrain to the west of Richmond precludes a precision approach (ILS) to RWY 10. Currently, there are no Civil Instrument approach procedures to this runway. Departures from RWY 28 are limited by a higher obstacle gradient.

4. Noise Abatement:

The townships of Richmond and Windsor are located in close proximity to the aerodrome, with a number of other communities within a 10 kilometre radius. Some of these communities are high growth population areas. Additionally a number of horse studs exist in the immediate and extant area, which the military currently treats as environmentally sensitive areas.

5. Radar Coverage

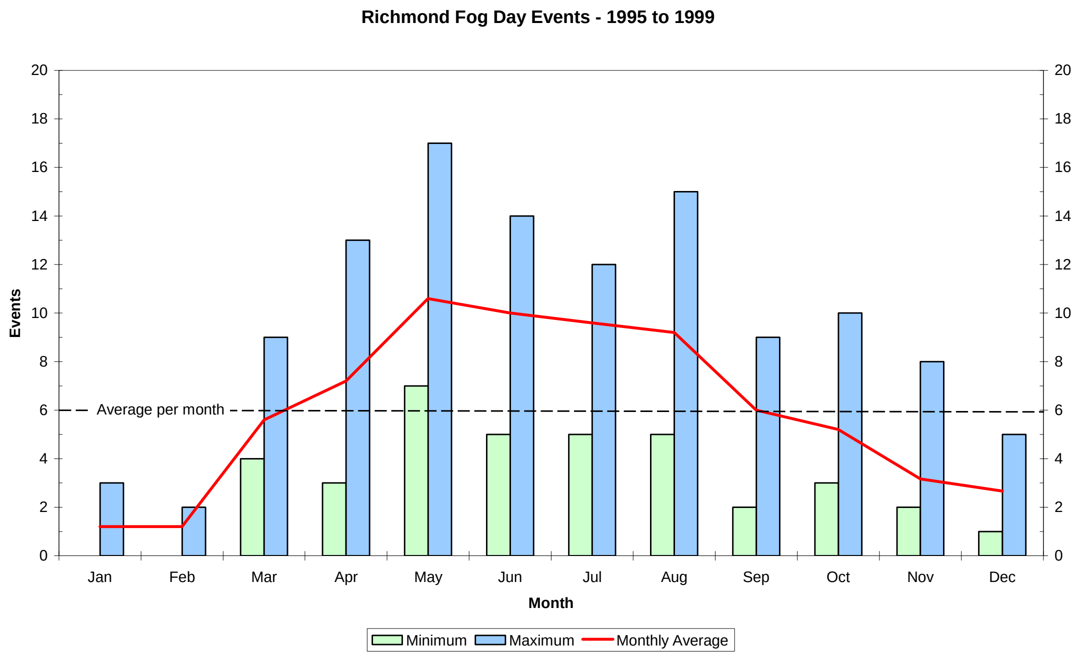
Radar coverage is unreliable below 2,000 Ft to the west and northwest of Richmond. This, combined with terrain, limits the availability of RWY 10 for arriving traffic.

Weather

Historical weather records require analysis to determine any sensitivity that needs to be applied to operational efficiency. Anecdotal evidence, however, indicates the aerodrome is affected by fog for longer periods and more often than that which affects Sydney, with a longer time to 'burn off'. These fog events are exacerbated by the surrounding river, creek and flood plain topography.

In summer, the region is affected by high daytime temperatures with reduced night cooling due to distance from coastal effects, effecting aircraft performance, and consequently payload.

Detailed analysis of the local weather trends and statistics would need to be sourced through the Bureau of Meteorology Climate Services in Sydney. Historic general data (not including fog) is available online (http://www.bom.gov.au/climate/averages/). For Richmond, this data is presented as pre 1994 and post 1993, associated with the commencement of the AWIS. Unverified data for the 5 years 1995 – 1999 indicates there are 6 days, on average, per month of recorded fog events:



Note: the severity, length or affect on Richmond aerodrome is not known.

Richmond is also affected by severe weather (thunderstorm) events, either directly at the aerodrome, the general Sydney basin, or the surrounding enroute airspace. It should be noted that due to the proximity of terrain west of the Richmond airfield, that an ILS is not viable for runway 10. It is possible that a higher category ILS for runway 28 would provide some benefit on some fog days, however this may impact the use of runway 16 PRM for Sydney and would require additional investigation. Further, a higher category ILS at Richmond would provide no benefit for other adverse weather events such as thunderstorms.

Current Operations

Current prime use of Richmond is by C130 aircraft conducting tactical and strategic support operations for the ADF, as well various operational training and conversion activities. C17 aircraft, based at RAAF Amberley, also contribute to this traffic.

Richmond is the primary diversion aerodrome for military aircraft operating at RAAF Williamtown. These aircraft also participate in exercise activities in the airspace to the immediate northwest of Richmond. Whilst this doesn’t directly affect the aerodrome ability to handle civil operations, it does affect airspace and route availability.

Other military aircraft operations occur on a semi-regular basis by Army and Navy, as well as overseas forces.

Some itinerant civil operations occur due to a civil aircraft maintenance facility.

Richmond is the primary instrument approach (ILS) training location in the Sydney basin.

A locally based aero club and gliding club operate during daylight hours on weekends.

The airspace above Richmond facilitates north-western departures from Sydney, which accounted for 12.1% of all departures as jets (approx 16,500), and 4.0% of all departures as non-jets (approx 5,600) in calendar year 2007. This airspace is also utilised by IFR aircraft departing and arriving Bankstown aerodrome from the north.

Existing airspace design and procedures enables the integration of all the above activities with minimal affect on Sydney airport operations, however, RWY 28 arrivals and RWY 10 departures are affected by Sydney circuit traffic around the Amaroo CTA step (an airspace release which accommodates Precision Runway Monitor circuits to Sydney).

Statistical information on runway selection is not readily known. Whilst historic data may provide guidance, these would relate to military aircraft operations, and would not necessarily easily translate to civil RPT jet operations (e.g. operations with downwind on wet runway limits). Critical analysis of weather patterns would need to be undertaken to determine these patterns.

Nominal Traffic Capacity

1. **Visual Meteorological Conditions (VMC) by day**
   The traffic handling ability of the runway has been assessed against what could be handled at Sydney aerodrome in a single runway configuration, in VMC by day, at 20 arrivals per hour. Departures would be interspersed between arrivals. However, in practical terms this rate may be lower due to airspace manoeuvring limitations created by terrain and adjacent airspace uses. Whether such a traffic rate can be accommodated with the existing apron infrastructure is not yet determined.

2. **VMC by night**
   Whilst the figures above could also be achieved on RWY 28 by night, they could not be achieved on RWY 10 due to terrain, radar limitations and the lack of a suitable instrument procedure to provide terrain protection. The current practice for aircraft arriving RWY 10 is by aircraft conduct a circling approach. Such procedures reduce arrival capacity and a subsequent effect on departure ability.

3. **Instrument Meteorological Conditions (IMC) RWY 28**
   In IMC, the arrival capacity would nominally reduce to approximately 15 arrivals per hour, on RWY 28. This would be to ensure cut-off distances with departures are protected, due to reduced radar coverage in the vicinity and west of the aerodrome. In circumstances where missed approaches are likely, this figure may further reduce as the missed approach path is to the north of the aerodrome (due to terrain) which affects the sequencing of following traffic. Again this has a flow on to the available departure capacity. It is also likely that if such conditions result in Sydney operating with RWY 16 arrivals, particularly PRM, the available vertical airspace for manoeuvring becomes a limiting factor.

4. **IMC RWY 10**
   If RWY 10 is required for landing, then the only option is to conduct an instrument approach to RWY 28 with circling procedure to RWY 10. Such an outcome would reduce arrival capacity to 5 – 6 movements per hour, and negate the ability to integrate departures.

   Note: *The Australian Defence Force (ADF) has a satellite based approach to RWY 10. However, this procedure also has the maximum final approach descent gradient of 6.5% which is significantly steeper than that used for civilian operations. Such a procedure would require assessment by CASA and airline operators.*

5. **RWY 10 Departures**

   RWY 10 departures can be problematic when Sydney requires use of the Amaroo CTA step during PRM operations. In this scenario, the procedure is for the departure to turn left. This departure path conflicts with arriving traffic, introducing departure delays.

6. Interaction with Sydney traffic

As noted in 'Current Operations' existing airspace, routes and procedures are integrated with Sydney traffic flows. A significant increase in traffic utilising Richmond would require airspace re-design within the Sydney basin, utilising Performance Based Navigation (PBN) principles.

7. Other airspace users

An increase in traffic demand at Richmond will restrict or exclude other current airspace operations:

a. Non powered (gliding) operations

b. Powered circuit training

c. Instrument training, and

d. Bankstown arrival and departures

8. Summarised Traffic Handling – Hourly Rate

RWY		**RWY 28**		**RWY 10**	
Weather	**Mode**	**Day**	**Night**	**Day**	**Night**
VMC	Arrivals	20	20	20	15
	Departures	20	20	20	10
IMC	Arrivals	15	15	5-6	5-6
	Departures	15	15	Nil	

Note: Departure capacity may increase with a reduction in arrival rates

Richmond Terminal Airspace

R468 and R493 combined (except during the activation periods of RWY 16 PRM at Sydney) provide sufficient dimensions to encompass instrument approaches.

Satellite based instrument flight procedures would be required:

- for operations west of the aerodrome due terrain
- for operations east of the aerodrome for lateral containment in controlled airspace

Current Route Structure

The current route structure within and around Richmond supports a range of operations. This includes a significant number of departure flights from Sydney and arrivals and departures at Bankstown. Additionally, there is significant military Restricted Airspace to the north-west of Richmond to support a number of military activities.

Current En-Route Sector Constraints

- Limited sector airspace
- Converging routes (Prop and Jet) into the Terminal Area for Sydney arrivals.
- R559 series activation (see below) restricts access to a significant amount of airspace
- Currently 3 airways outbound from RIC airspace
- Limited airspace available to establish segregated inbound routes converging on RIC.
- Major airway intersection at KAT, predominantly outbound from Sydney TMA routes

Military Restricted Areas

R559 series:

- R559 is a large military airspace series extending northwest of RIC, primarily used by RAAF WLM for military flying training.
    - Predominantly active up to 26,000'.
    - R559F, overlying R559A, normally active between 26,000' to 60,000'.
- Activation of these areas blocks access to a range of airways.
- When active, aircraft departing Sydney require re-routing through Sydney Terminal airspace.
- Long haul international aircraft departing Sydney have difficulty reaching vertical requirements above the restricted areas during high ambient air temperature conditions. A similar issue would occur with Richmond departures.

Major Findings

- Richmond aerodrome infrastructure must be assessed against CASA Part 139 standards (civil standards).

- Satellite based flight procedure design is required for airspace containment and terrain separation.

- Any significant increase in aviation activity at Richmond, particularly jet aircraft operations, should be assessed against the maintenance of capacity and efficiency of Sydney.
- Further analysis is required to quantify any projected increase in aviation activity at Richmond and its consequent effect on capacity at Sydney.
- Any significant increase in aviation activity at Richmond will necessitate a redesign of LTOP.
- An increase in aviation activity at Richmond will affect the viability of PRM operations to Runway 16 at Sydney with a consequent effect on the capacity at Richmond when weather conditions are less than 5000m visibility and/or cloud base is less than 4001'.
- An integrated Terminal Area operating plan is required for Sydney region airspace, utilising PBN design concepts.
- Any development of Richmond aerodrome as an additional civilian airport would require a review of current en-route air route and ATC sector architecture.
- R559 series military airspace restricts any operational plan that segregates Richmond traffic from Sydney traffic.
- Richmond presents a greater weather challenge than Sydney in terms of thunderstorms, fog and high ambient air temperatures which cannot be resolved by improvements in ILS capability.

Glossary of Terms

Term	Definition
AWIS	Automated Weather Information System – broadcast actual local weather conditions to aircraft
CTMS	Central Traffic Management System – strategic demand and capacity management system
CTA	Controlled Airspace
DVA	Dependant Visual Approach – parallel runway separation standard
GLS	GPS Landing System – a satellite based precision approach navigation system
HIAL	High Intensity Approach Lighting – runway lighting providing visual guidance to a runway threshold
ILS	Instrument landing System
IVA	Independent Visual Approach – parallel runway separation standard
IMC	Instrument Meteorological Conditions – a defined set of meteorological conditions requiring flight using aircraft instrumentation
LTOP	Long Term Operating Plan for Sydney Kingsford-Smith airport and surrounding airspace
MOS	Manual Of Standards – an expansion of CASA regulations
PBN	Performance Based Navigation – navigation to a level of accuracy defined for the operation being conducted
PRM	Precision Runway Monitor – high fidelity radar system which permits independent parallel approaches in IMC
RNAV	Area Navigation – navigation based upon satellite or internal

	aircraft navigation systems
RNP	Required Navigation Performance - a precise form f RNAV requiring on-board conformance monitoring systems
RWY	Runway
SID	Standard Instrument Departure - a predefined flight path utilised by aircraft navigation systems
STAR	Standard Arrival Route – a predefined flight path utilised by aircraft navigation systems
TMA	Terminal Area – airspace associated with arrivals and departures at major aerodromes
VMC	Visual Meteorological Conditions – a defined set of meteorological conditions permuting flight using visual reference

Effect of civil operations at RAAF Base Richmond on Sydney (Kingsford-Smith) Airport operations

C7

JOINT STUDY ON AVIATION CAPACITY FOR THE SYDNEY REGION

AIRSERVICES AUSTRALIA

ADDITIONAL REPORT ON THE EFFECT OF CIVIL OPERATIONS AT RAAF BASE RICHMOND ON SYDNEY (KINGSFORD-SMITH) AIRPORT OPERATIONS

Executive Summary

As part of a joint Commonwealth and NSW State Government initiative to develop an Aviation Strategic Plan for the Sydney region, Airservices Australia has been requested to undertake analysis in relation to aviation capacity in the Sydney region. Specifically, the task undertaken in this report comprises an analysis of the effect of the development of Richmond airport on Sydney airport operations.

This report is not intended for circulation beyond the Department of Infrastructure and Transport and the Joint Study Steering Committee.

Airservices provides no warranty or guarantee as to the accuracy or completeness of this report. Readers should rely on their own enquiries and seek independent advice.

Airservices makes no representation, warranty or guarantee concerning any findings in this report. Any findings are to be treated as indicative only, and based on Airservices limited role in the overall study.

This report represents the view of Airservices and not the view of any individual person.

Study Purpose

To support the Joint Study on Aviation Capacity for the Sydney Region, Airservices Australia has undertaken further analysis of the effect on Sydney airport operations of the use of Richmond as an additional civilian airport within the Sydney region. This paper represents the work on this topic.

Assumptions

A number of assumptions have been applied in developing the analysis. Specifically, it should be noted that the currently legislated cap of 80 aircraft movements per hour and the aerodrome curfew between the hours of 2300 and 0600 local time remain and that, for Richmond airport, the current alignment of runways remains and appropriate airport and transport link infrastructure is provided to support Regular Public Transport operations.

This report should be considered in conjunction with the "Utilisation of Richmond" findings contained in Part 3 of the Airservices Preliminary Report on Future Demand at Sydney (Kingsford Smith) Airport regarding airspace and air traffic management feasibility and requirements for the development of Richmond airport to accommodate Regular Public Transport operations.

This report should also be considered in conjunction with the demand/capacity findings contained in the Airservices Preliminary Report on Future Demand at Sydney (Kingsford Smith) Airport. In particular, the analysis in this report assumes available capacity at Sydney airport is maintained at 80 movements per hour. This capacity is reliant on weather conditions supporting current procedures to 80 per hour or future all-weather capability at Sydney.

The commercial implications of moving low cost carrier type operations from Sydney to Richmond are unclear to Airservices Australia. This requires further detailed analysis.

Further, the costs of associated infrastructure such as aircraft parking and maintenance, terminals, fuel facilities and transport links is unclear to Airservices Australia. This requires further detailed analysis.

The key assumptions applied in this report are:

1. That the currently legislated cap of 80 aircraft movements per hour is maintained at Sydney aerodrome.
2. The Long Term Operating Plan continues to be applied at Sydney aerodrome.
3. The current runway alignment is maintained at Richmond aerodrome.
4. The aerodrome would not be operating as joint user facility.
5. Airline operator utilisation at Richmond would be substantially similar to that which is occurring at Newcastle (Williamtown) and Avalon aerodromes i.e. Low Cost Carriers.
6. The traffic volume, aircraft type mix and schedules are applied from current Sydney schedules.
7. Turbo-prop services currently operating at Sydney would not move to Richmond.
8. Low cost carrier type operations are moved from Sydney to Richmond.

Exclusions

This analysis is limited to consideration of airspace and air traffic management. Matters such as airport terminal and apron development and consumer market research have not been analysed within this report.

Key Findings

The key findings of that analysis to date include:

9. Any significant increase in aviation activity at Richmond, particularly jet aircraft operations, should be assessed against the maintenance of capacity and efficiency of Sydney.

10. Any development of Richmond aerodrome as an additional civilian airport with traffic levels and mix similar to Newcastle would impact Sydney airport operations requiring airspace redesign.

11. Any significant increase in aviation activity at Richmond will necessitate a redesign of LTOP.

12. Any development of Richmond aerodrome as an additional civilian airport would require an integrated airspace operating plan to be developed to ensure safe and efficient airspace architecture in the Sydney region.

13. There will be no significant change to movement rates at Sydney airport in peak traffic hours.

14. There will be no significant change to the available hours for the operation of LTOP noise sharing modes of operation.

15. A variation to LTOP Modes 10 and 14A arrival tracks will be required to integrate operations at both airports.

16. A variation to LTOP Modes 5, 7, 8, 9, 13, 14A and SODPROPS departure tracks will be required to integrate operations at both airports.

17. Departures from Richmond Runway 10 and arrivals to Richmond Runway 28 conflict with aircraft conducting PRM approach circuits to Runway 16R at Sydney.

Exclusions

This analysis is limited to consideration of airspace and air traffic management. Matters such as airport terminal and apron development and consumer market research have not been analysed within this report.

Airspace and air traffic management feasibility and requirements

Aircraft

Current:

Current prime use of Richmond is by C130 aircraft conducting tactical and strategic support operations for the ADF, as well various operational training and conversion activities. C17 aircraft, based at RAAF Amberley, also contribute to this traffic.

Richmond is the primary diversion aerodrome for military aircraft operating at RAAF Williamtown.

Other military aircraft operations occur on a semi-regular basis by Army and Navy, as well as overseas forces.

Some itinerant civil operations occur due to a civil aircraft maintenance facility.

Richmond is the primary instrument approach (ILS) training location in the Sydney basin.

A locally based aero club and gliding club operate during daylight hours on weekends.

Future:

The study assumes that Richmond would become an additional civilian aerodrome for the Sydney region, servicing the low cost carrier market.

The following assumptions have been applied in the analysis of current Sydney schedules to determine which operations would conceivably relocate to Richmond:

a. The airport would mainly service a western Sydney, private consumer market.

b. The airport may service a limited business consumer market, also western Sydney based.

c. The airport may service a broader Sydney basin, domestic holiday, private consumer market.

d. Richmond would not be operated as a linked hub for Sydney airport.

e. Regional services are excluded as they substantially operate hub connections to Sydney airport.

f. The airport would cater for domestic flights only, with all international flights continuing to utilise Sydney airport.

Based on the above assumptions, the following airlines have been identified as potential operators in this analysis:

a. Tiger Airways operations in toto.

b. Jetstar Domestic operations in toto.

c. Virgin Blue operations:

    i. To domestic holiday destinations (such as Hamilton Island and Ballina).

    ii. All Embraer E170 and E190 services (destinations such as Canberra and Port Macquarie)

EFFECT ON SYDNEY AIRPORT OPERATIONS

Capacity

This table[1] provides an indication of the hourly capacity of Richmond airport in its current configuration.

The Airservices Preliminary Report on Future Demand at Sydney (Kingsford Smith) Airport provides detail on the drivers for capacity in each scenario.

For this report, it is assumed that a satellite based navigation solution (e.g. RNP or GLS) would deliver Runway 28 VMC rates to both runways in all conditions (20 arrivals and 20 departures per hour). This would vary the hourly rates listed in the table below.

Analysis of proposed traffic levels at Richmond (next page) indicates that the assumed future capacity will accommodate the estimated future demand.

Hourly Rates

RWY		RWY 28		RWY 10	
Weather	**Mode**	**Day**	**Night**	**Day**	**Night**
VMC	Arrivals	20	20	20	15
	Departures	20	20	20	10
IMC	Arrivals	15	15	5-6	5-6
	Departures	15	15	Nil	

Note: Departure capacity may increase with a reduction in arrival rates

[1] From the Airservices Preliminary Report on Future Demand at Sydney (Kingsford Smith) Airport.

Demand

Sample Richmond traffic by hour

Data sourced from a typical Sydney weekday schedule.[2] Movements are shown as a Richmond traffic amount against the total traffic amount for the hour. Example: between 0700 and 0800, scheduled Richmond arrivals numbered 4 out of a total scheduled arrival amount of 42.

Hour	Arrivals	Departures
0600 to 0700	1 of 19	3 of 21
0700 to 0800	4 of 42	5 of 33
0800 to 0900	6 of 40	8 of 47
0900 to 1000	3 of 30	5 of 34
1000 to 1100	6 of 31	2 of 31
1100 to 1200	2 of 31	8 of 32
1200 to 1300	5 of 19	2 of 27
1300 to 1400	6 of 20	5 of 21
1400 to 1500	5 of 37	3 of 25
1500 to 1600	5 of 23	8 of 42
1600 to 1700	5 of 25	0 of 20
1700 to 1800	8 of 36	6 of 35
1800 to 1900	6 of 43	6 of 40
1900 to 2000	4 of 21	5 of 28
2000 to 2100	1 of 27	2 of 14
2100 to 2200	5 of 24	2 of 16
2200 to 2300	3 of 15	0 of 10
Totals		
Richmond	75	70
All movements[3]	483	476

This data is analysed for two aspects of Sydney operations – the effect on morning and evening peak hours and the effect on the availability of LTOP noise sharing modes of operation.

Effect on peak hours

Peak period analysis concentrates on the 0700 to 0900 and 1800 to 1900 hours.

[2] Monday, 1st of August 2010

[3] Regional + all jets + itinerant and medical aircraft

Between 0700 and 0900, 162 movements[4] are scheduled, of which 23 are proposed Richmond operations. Slot allocation over these hours is currently at maximum levels (80 per hour) with latent demand for slots at 92 per hour.

Relocating 23 aircraft (logically) frees 23 slot allocations for other operators. Those vacant slots will be reallocated from latent slot demand. There will be no effect on the hourly movement rates in those hours.

Between 1800 and 1900, 83 movements[5] are scheduled, of which 12 are proposed Richmond operations. Slot allocation over this hour is also currently at maximum levels (80 per hour) with latent demand for slots at 88 per hour. The effect on movement rates in this hour will be minimal – around 4 slots after reallocation from latent demand.

Effect on LTOP

This analysis concentrates on the hours of 1100 to 1500L. Demand in the early morning and late evening shoulder periods is not significant enough to warrant detailed analysis.

The major constraint on the nomination of LTOP noise sharing runway modes of operation is the schedule of arriving aircraft to a single arrival runway mode (modes 5, 14A and SODPROPS). The acceptance rate for a single arrival runway is 24 arrivals per hour. The current criteria for abandonment of those modes of operation is currently set at 20 minutes of airborne holding for an individual aircraft, triggering the establishment of an arrival runway mode utilising parallel runway landings.

For analysis of the data presented in this report, it is reasonable to assume that a noise sharing runway mode of operation is of doubtful viability when scheduled movements exceed 55 in a given hour.

The sample schedule shows that the hours of 1100 to 1200 (31 arrivals) and 1400 to 1500 (37 arrivals) require airborne holding for a single runway arrival sequence.

The demand vs capacity difference for the 1100 hour is 7 aircraft. The time interval between arrivals is flowed at 2 minute gaps between each aircraft. The cumulative delay for 7 aircraft (2 minutes + 4 minutes + 6 minutes + etc, for each aircraft holding) is 56 minutes. The 20 minute trigger is reached when 4 aircraft are in consecutive holding (2 + 4 + 6 + 8 minutes).

By relocating the 2 proposed Richmond arrival operations, arrival demand is reduced to 29 movements. This will not change the current timing of change from a parallel runway mode to an LTOP noise sharing runway mode during the late morning shoulder period.

The demand vs capacity difference for the 1400 to 1500 hour is 13 arriving aircraft.

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[4] Note: scheduled by CTMS, not by ACA slot allocation.

[5] Note: scheduled by CTMS, not by ACA slot allocation.

By relocating the 5 proposed Richmond arrival operations, arrival demand is reduced to 32 movements. . This will not change the current timing of change from an LTOP noise sharing runway mode to a parallel runway mode during the early afternoon shoulder period.

Effect on LTOP flight-paths

The transfer of approximately 150 jet aircraft operations to Richmond will significantly change the current traffic patterns in Sydney basin airspace and will require an integrated airspace structure which maintains the capacity and efficiency of Sydney airport.

The following tracks will have additional traffic confliction areas requiring structured solutions which are not in the current operating plan for Sydney Terminal airspace:

Sydney Departures

1. Runway 34L jet departures via Richmond, Katoomba and Wollongong.
2. Runway 34L prop departures via Richmond, Katoomba and northwest NSW destinations.
3. Runway 25 jet departures via Richmond, Katoomba and northern destinations.
4. Runway 25 prop departures via Richmond, Katoomba and northwest NSW destinations.
5. Runway 16R jet departures via Richmond and Katoomba.
6. Runway 16R prop departures via Richmond, Katoomba and northwest NSW destinations.

Sydney Arrivals

1. Runway 07 arrival tracks from the north (BOREE and CALGA STARs).
2. Runway 16R arrival tracks from the southwest (RIVET and ODALE STARs).
3. Runway 34L arrival track from the north (BOREE STAR).

Richmond Departures

From both Runway 28 and Runway 10, all departure tracks will conflict with one or more of the above Sydney tracks.

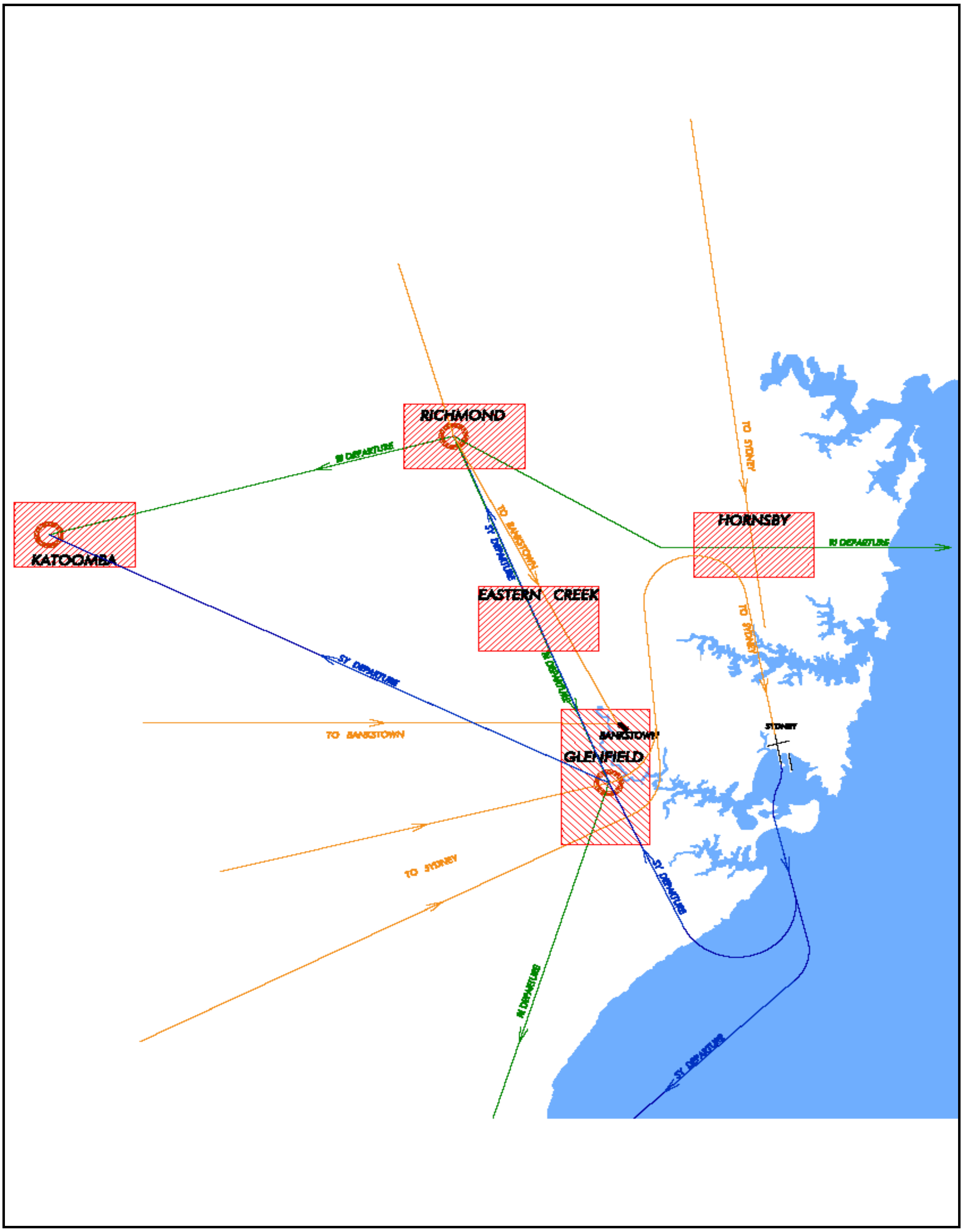
Departures from Runway 10 will be in immediate conflict with aircraft conducting PRM circuits to Runway 16R at Sydney.

Richmond Arrivals

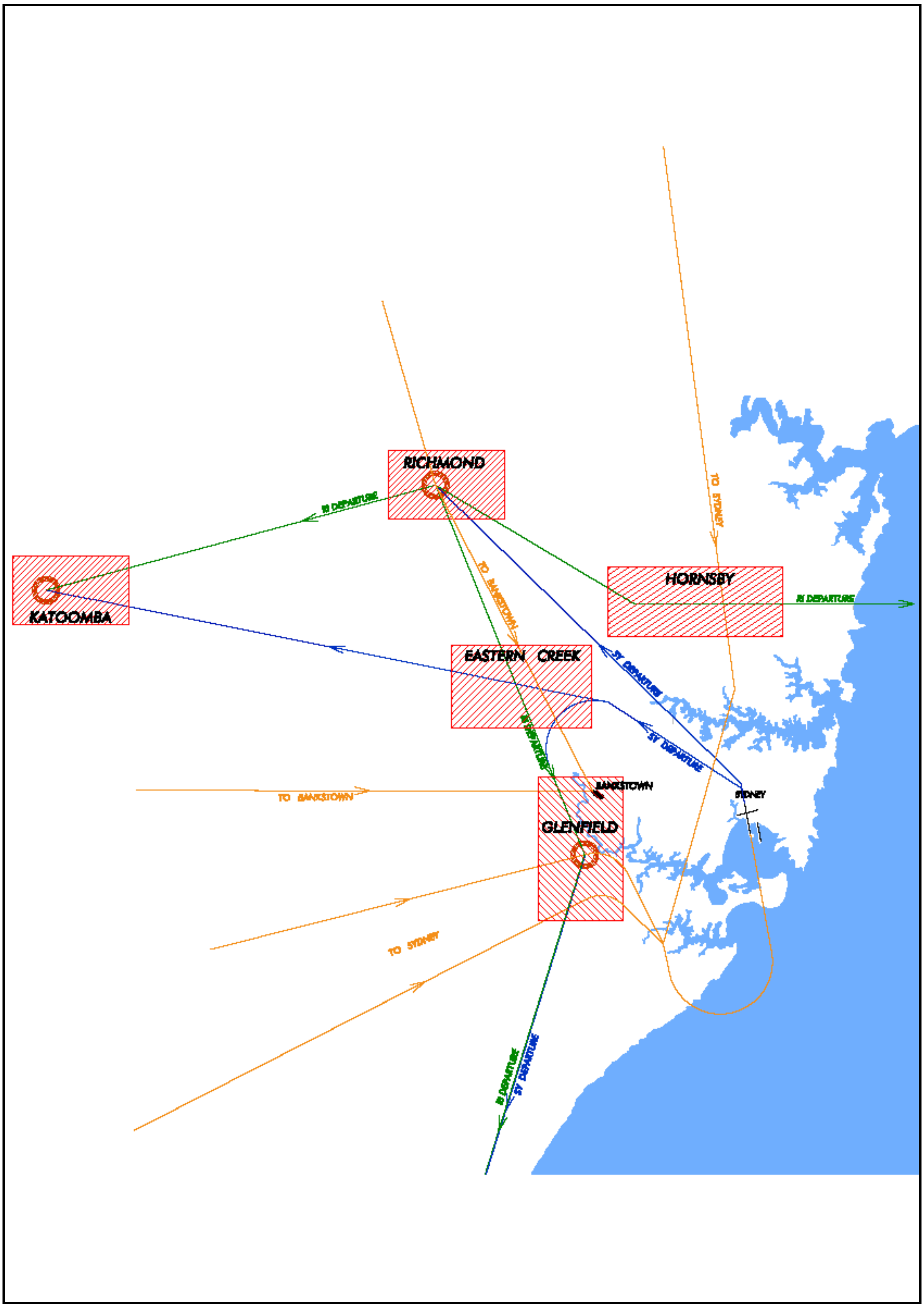
To both Runway 28 and Runway 10, all arrival tracks will conflict with one or more of the above Sydney tracks.

Arrivals to Runway 28 will conflict with aircraft conducting PRM circuits to Runway 16R at Sydney.

Major Confliction Areas – Sydney Runway 16 Operations



Major Confliction Areas – Sydney Runway 34 Operations



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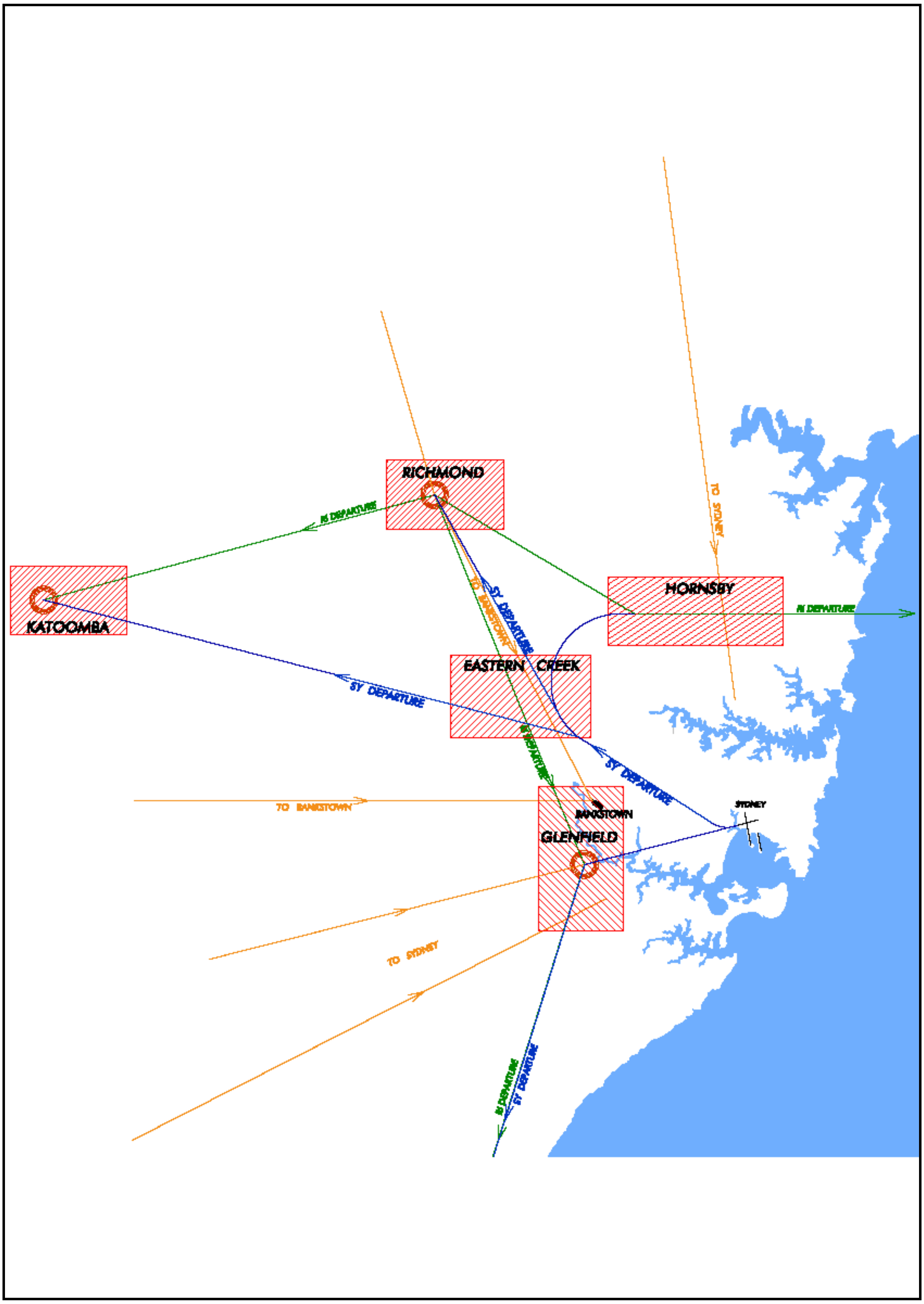
Major Confliction Areas – Sydney Runway 25 Operations



Forecast effect on LTOP

In this analysis, the sample day traffic[6] is extrapolated to provide an indication of the longer term effect on Sydney airport demand. The base hourly data is increased by the percentage assumed in the Sydney Airport Master Plan 2009, being 2% forecast per annum average for scheduled movements.

This rate is considered conservative compared with BITRE data[7] at 2.3% forecast per annum average for scheduled movements. The most recent forecasting, conducted by Booz&Co in 2011 indicates projected growth at 1.8% per annum to 2020 and 1.6% thereafter. For this report, it was considered that a 2% growth level should be applied, being the approximate mean of the various growth rates.

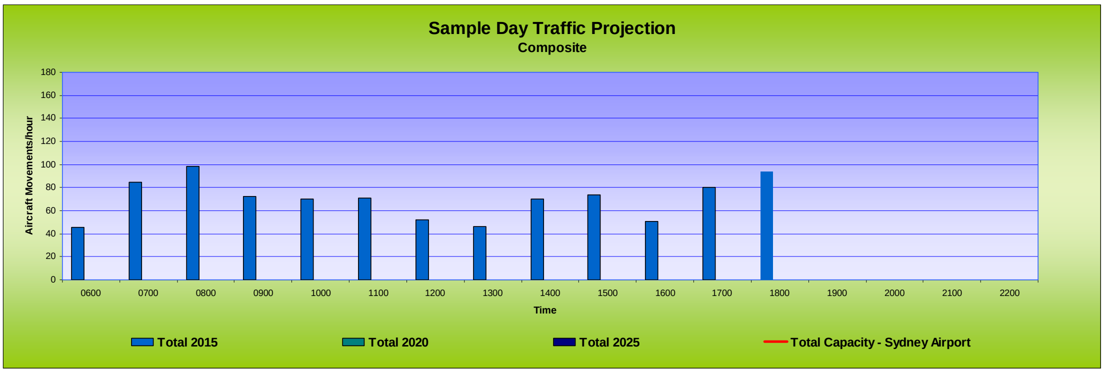
The following table shows the annualised result of 2% per annum growth from a 2009 baseline. It should be noted that the figures are averaged scheduled traffic over the entire year, taking into account the reduced traffic levels typical of weekends.

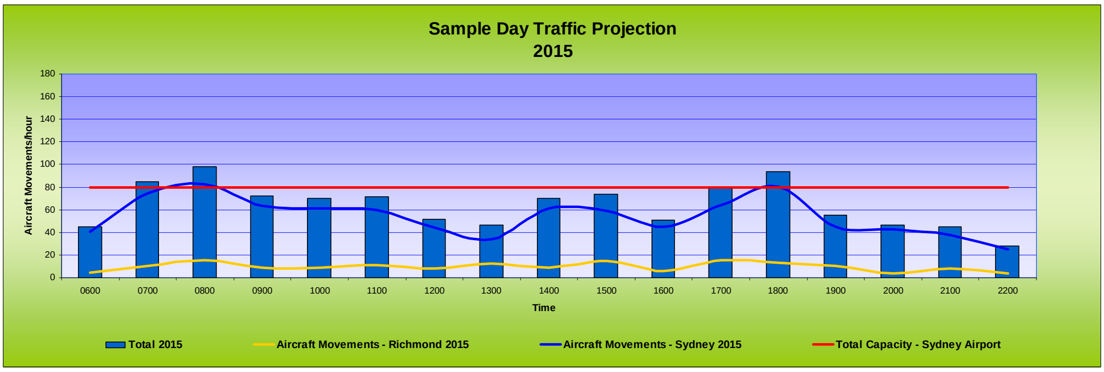
Sydney	**2009**	**2015**	**2020**	**2025**
Forecast 2% growth*	**285,000** ≈780/day	**322,000** ≈880/day +13%	**355,000** ≈970/day +24%	**396,000** ≈1100/day +41%

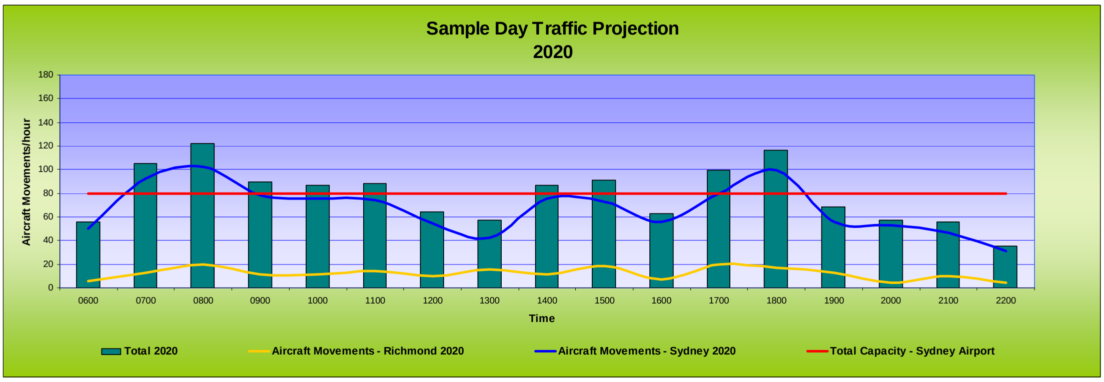
[6] Monday, 1st of August 2010

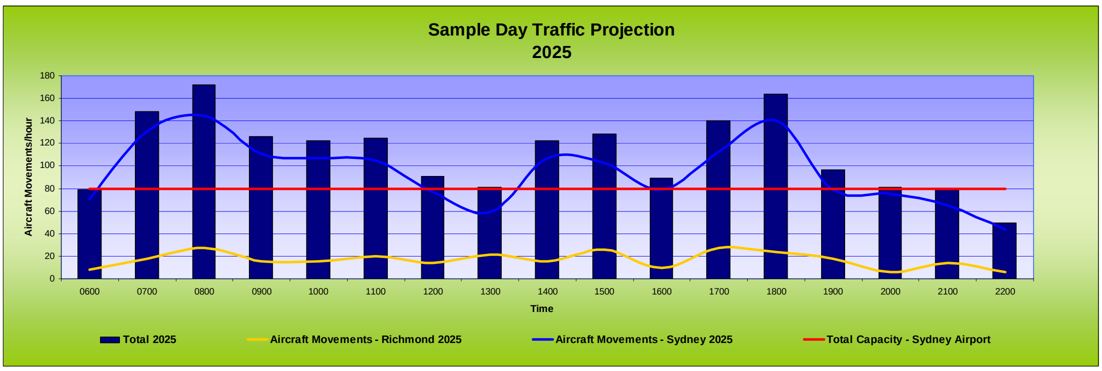
[7] BITRE Research Report 117

The following tables apply the above percentages to the sample traffic day.









Major Findings

1. There will be no significant change to movement rates at Sydney airport in peak traffic hours.
2. There will be no change to the available hours for the operation of LTOP noise sharing modes of operation.
3. A variation to LTOP Modes 10 and 14A arrival tracks will be required to integrate operations at both airports.
4. A variation to LTOP Modes 5, 7, 8, 9, 13, 14A and SODPROPS departure tracks will be required to integrate operations at both airports.
5. Departures from Runway 10 and arrivals to Runway 28 conflict with aircraft conducting PRM approach circuits to Runway 16R at Sydney.

Glossary of Terms

Term	Definition
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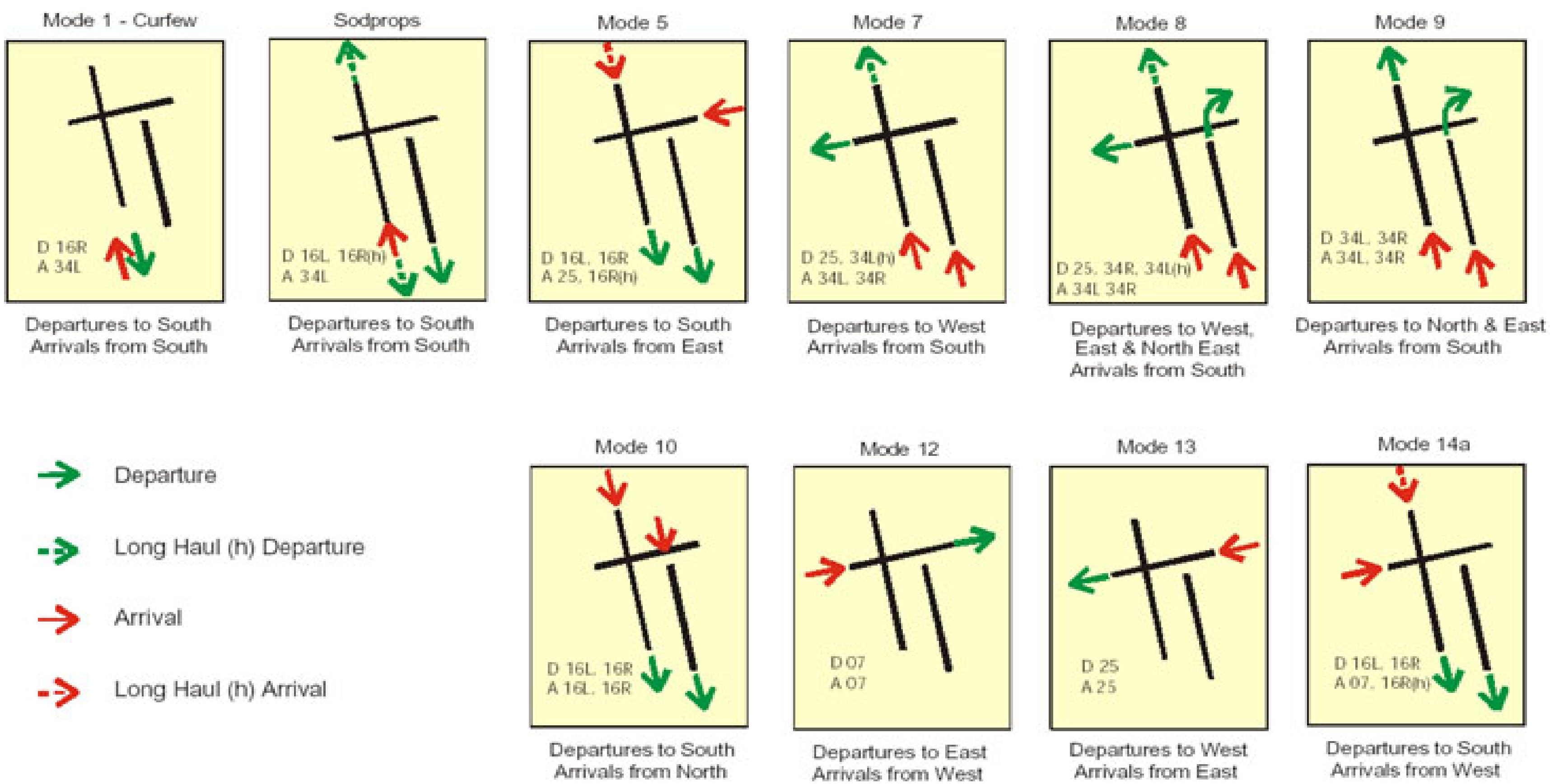
VMC	Visual Meteorological Conditions – a defined set of meteorological conditions permuting flight using visual reference

Long Term Operating Plan (LTOP) Modes



Nature and extent of unmet demand that could be accommodated at an additional regular passenger transport facility

C8

FINAL REPORT

Joint Study on Aviation Capacity for the Sydney Region

Nature and Extent of Unmet Demand that Could Be Accommodated

Canberra

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Important Note

Booz & Company has devoted its best professional efforts to this assignment and our findings represent our best judgment based on the information available.

In preparing our traffic forecasts for the Sydney region, we have relied upon the information provided by all entities. While we have checked our sources of information, data and assumptions, we will not assume responsibility for the accuracy of such data, information and assumptions received from any entity.

Any airport traffic forecast is subject to uncertainties. Inevitably, some assumptions used to develop the forecasts will not be realised, and unanticipated events and circumstances may occur. Therefore Booz & Company cannot provide any form of assurance that the forecasts documented in this report will be achieved. The actual traffic outcome will vary from that forecast and the variations may be material.

Specifically, the following factors could result in an actual outcome outside the forecast range:

- Lower than assumed economic growth rates in Australia and/or those countries expected to provide a significant source of inbound international air passengers
- Shifts in Government policy which directly, or indirectly, impact on Sydney region aviation activity
- Adverse impacts for Sydney region aviation activity associated with aviation industry developments
- A significant shift in the distribution of aviation traffic between Sydney region airports and competing international and domestic airports
- Significant changes in airline costs (e.g. a fuel price shock or carbon tax) which are passed on by way of significantly higher air fares
- External factors, including, but not limited to, natural disasters, political unrest, acts of terrorism and associated security concerns and labour disputes

This report was prepared for the exclusive use of the Department of Infrastructure and Transport, in advising the Steering Committee on the Joint Study on Aviation Capacity in the Sydney Region and in their advice to Government. The Report may be relied upon solely by Department of Infrastructure and Transport, Booz & Company disclaims all liability to any persons other than Department of Infrastructure and Transport for all costs, loss, damage and liability that the third party may suffer or incur arising from or relating to or in any way connected with the provision of the Report to a third party. You have agreed that you will not amend the Report without prior written approval from Booz & Company. If any person, company or Government Department or Agency, other than the Department of Infrastructure and Transport chooses to rely on the Report in any way, they do so entirely at their own risk.

Glossary of Terms

Expression	Definition
Air Services Australia data	Provides aircraft movements at specified airports
Connecting Passenger	Passenger movements that stopover at an intermediary airport on route to their intended destination
Generalised (Journey) Cost	Generalised cost is the end to end cost of a journey. It includes the fare paid, together with the estimated monetary value of the time spent completing the journey.
Hub Airport	An airport that offers multiple onward flight connections and is often a larger/capital city airport
MIDT	Market Information Data Tapes provides passenger ticketing data captured by the Global Distribution Systems (GDS), i.e. indirect passenger bookings
O-D Direct Passengers	Passenger movements that travel directly to their intended destination and do not stop on route (Direct Services)
O-D Market	Origin and Destination market is the country or city pairs where a passenger starts and ends their journey; any intermediary stops are not considered
Passenger movements	The arrival or departure of a passenger at an airport
SRS	SRS Analyser is an online tool allowing access to IATA"s Schedule Reference Service (SRS). SRS is a neutral source of schedule data that collects, validates, consolidates and distributes airline flight schedules and related data for over 900 airlines worldwide.
Sydney GMA	Sydney Greater Metropolitan Area as defined by the 38 Local Government Areas which constitute Sydney

1. Introduction

1.1 Background

This report investigates the potential impacts of Sydney (Kingsford-Smith) Airport not being able to provide sufficient capacity and services to meet the growth in market demand. Understanding existing aviation infrastructure and the role of airports in the Sydney region as well as Australia more broadly is an essential input to such considerations. This provides the foundation for exploring the potential redistribution of unmet Sydney (Kingsford-Smith) Airport demand for aviation services to an additional major RPT airport in the Sydney Region.

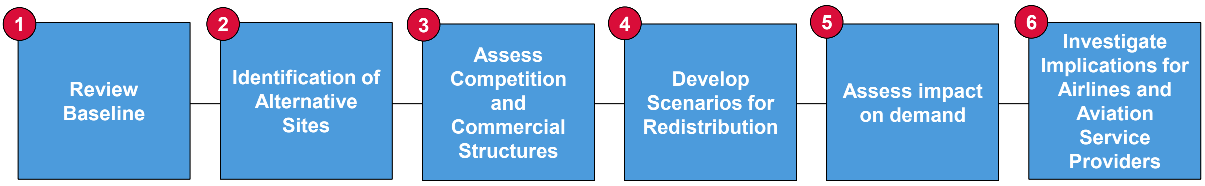
The focus of this report was to estimate the amount of passenger traffic which could be redistributed to an additional RPT major facility within the Sydney region. Passenger traffic which cannot readily be redistributed to an additional major RPT facility would be either suppressed (i.e. outbound international travel by Australian residents and domestic travel), redistributed to other airports within Australia or lost to foreign ports (i.e. inbound international travel by foreign residents).

2. Approach

2.1 Overview

This report examines the potential market implications of establishing an additional major RPT facility in the Sydney region. Figure 1 outlines the approach adopted to forecast demand for multiple airports in the Sydney Basin and estimates the potential redistribution of unmet demand from Sydney (Kingsford-Smith) Airport to an additional major RPT facility.

Figure 1: Overview of Approach



Source: Booz & Company, 2011

2.2 Review Baseline

This analysis started with the unconstrained demand for Sydney (Kingsford-Smith) Airport. Point-to-point demand for Sydney (Kingsford-Smith) Airport was used to determine the split between the two airports. The modelling assumes connecting passenger movements would occur of both airports hence the unconstrained demand including all connecting passenger movements over Sydney (Kingsford-Smith) Airport were used for the core analysis. A sensitivity was run with connecting passenger movements redistributed to direct services. The unconstrained forecasts were fed into the "patronage" model at a disaggregated level by market (e.g. international short, medium and long haul, by trip purpose, by ground access mode and by trip generation/attraction zone), isolating the number of passengers connecting through Sydney (Kingsford-Smith) Airport from those flying to and from Sydney (i.e. point-to-point passengers). The catchment for the Sydney region was disaggregated at the Statistical Local Area (SLA) level.

2.3 Identification of alternative sites

Analysis to identify potential sites for an additional major RPT facility in the Sydney region was undertaken separately in the Joint Study. The analysis identified a range of "greenfield" sites and existing airfields which could potentially be developed. Patronage modelling was undertaken for the site(s) identified.

2.4 Assess Competition and Commercial Structures

An assessment of a range of competitive arrangements was undertaken to identify the potential outcomes for passenger redistribution. The assessment included:

- The degree of duplication/overlap of airline networks and schedules, and the target market segments (e.g. LCC, premium, international, domestic, regional);

- The make-up of air service providers across the individual airports;
- The scale of the airport and the target catchment (i.e. local area or the broader Sydney region); and
- Ownership models.

Existing examples of the different models for multiple airports serving overlapping catchments were identified and reviewed to gain insight into the potential outcomes.

2.5 Develop Scenarios for Redistribution

Four scenarios were developed to explore the potential for capture and redistribution of demand from Sydney (Kingsford-Smith) Airport to an additional major RPT facility, and the stimulation of additional demand due to reduced access costs. The scenarios explore the impacts that an additional major RPT facility would have on demand at Sydney (Kingsford-Smith) Airport. The four scenarios were applied to RAAF Base Richmond. Each scenario is based on an incremental level of capital investment, which influences the overall airport size and thus the volume of passengers it can accommodate.

2.6 Assess Impact on Demand

The impact on Sydney (Kingsford-Smith) Airport and the broader Sydney region was assessed for each of the scenarios developed. The impact on Sydney (Kingsford-Smith) Airport and the Sydney region depended on:

- Target markets for each airport as identified in each scenario (e.g. if an alternative airport focused on domestic, what was the potential for Sydney (Kingsford-Smith) Airport to maximise international services);
- Scale of services at each of the airports included in the scenario; and
- Level of competition between airports (e.g. what were the ramifications for Sydney (Kingsford-Smith) Airport due to additional capacity within the Sydney region).

2.7 Investigate Implications for Airlines and Aviation Service Providers

The scale and level of competition an additional major RPT airport presents to Sydney (Kingsford-Smith) Airport will determine the potential implications for airlines and supporting aviation service providers. The implications of the scenarios developed are discussed in five key areas:

- Level of direct competition in the market and the resulting impact on passenger volumes and yields;
- Segmentation of air passenger market between airlines;

- Opportunities to grow new markets and improve operations within the Sydney region;
- Duplication of assets and supporting services; and
- Risks to the commercial sustainability of operations from an additional major RPT facility.

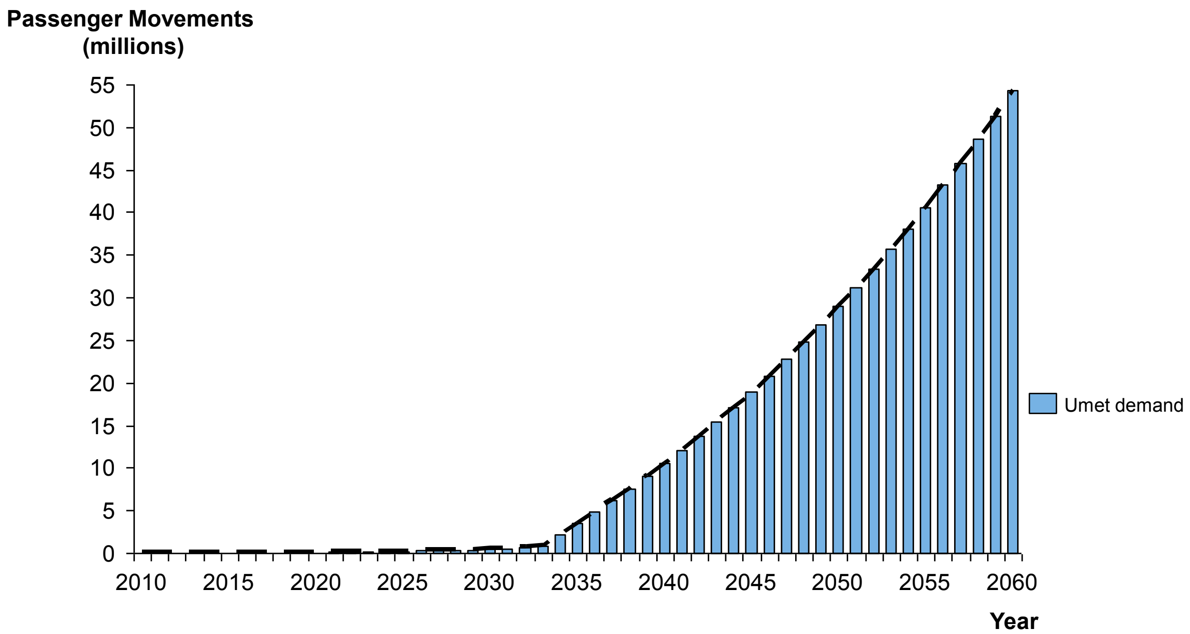
3. Baseline

This section explores the forecast level of unmet demand at Sydney (Kingsford-Smith) Airport to 2060 in order to gain an understanding of the additional capacity requirements to capture forecasted unmet demand. The demand forecast analysis undertaken in the "Forecast growth estimates for aviation activity in the Sydney region" report has been used as basis.

3.1 Extent and Nature of Unmet Demand at Sydney (Kingsford-Smith) Airport

Demand is forecast to exceed capacity at Sydney (Kingsford-Smith) Airport by 2033[1] under the current curfew (i.e. from 11pm to 5.59am) and assumed runway movement cap conditions (i.e. 80 movements per hour). The constrained passenger demand forecasts are based on constrained aircraft movement forecasts which assume that the up-gauging of aircraft using Sydney (Kingsford-Smith) Airport is faster than under unconstrained conditions. Capacity constraints at Sydney (Kingsford-Smith) Airport are expected to result in an estimated 54 million unmet passenger movements by 2060, approximately 1.5 times the volume of passenger movements through Sydney (Kingsford-Smith) Airport in 2010 as shown in Figure 2.

Figure 2: Unmet Demand at Sydney (Kingsford-Smith) Airport – Capacity Constrained



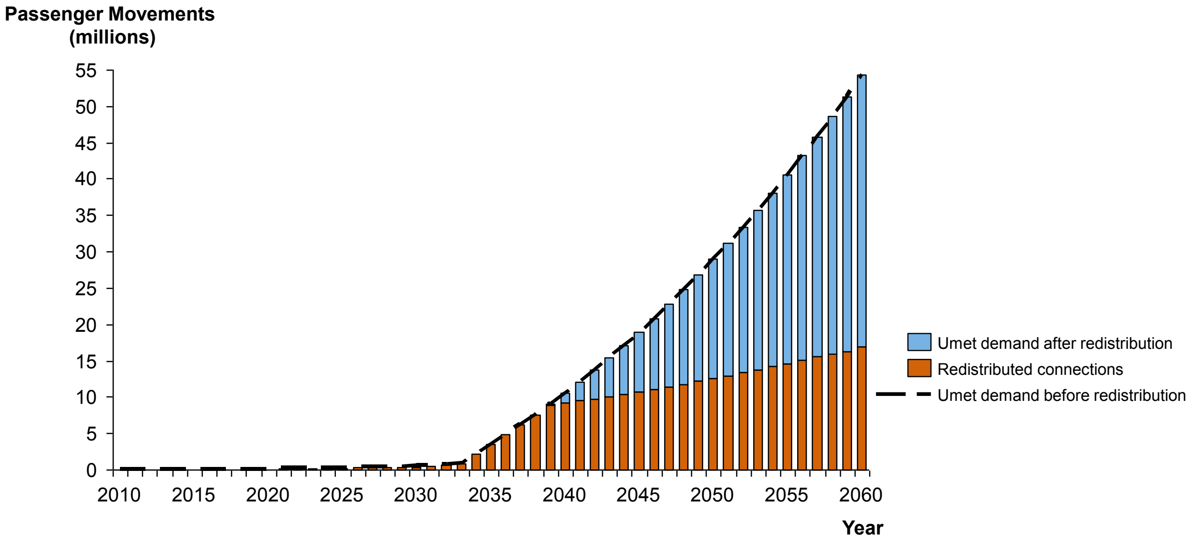
Source: Booz & Company, 2011

[1] Under Central case for demand growth and peak spreading.

3.2 Extent of Unmet Demand at Sydney (Kingsford-Smith) Airport with Increased Direct Services

Sensitivity analysis was undertaken of the potential to reduce demand by applying redistribution of connecting passengers to direct services bypassing hub airports. At the extreme, even if all such passengers (international, domestic and regional) were able to connect directly and bypass Sydney (Kingsford-Smith) Airport, then the forecast passenger demand that could be met would only be delayed by 7-8 years. Forecast unmet demand for Sydney (Kingsford-Smith) Airport would still cumulate to 36 million passenger movements annually, similar to the level of total passenger movements at Sydney (Kingsford-Smith) Airport in 2010. This is illustrated below in Figure 3.

Figure 3: Unmet Demand at Sydney (Kingsford-Smith) Airport with Redistribution of Connecting Passengers to Direct Services



Source: Booz & Company, 2011

3.3 Distribution of Demand

Demand for competing airports is driven by a set of factors which are important to the airlines and a second set of factors which are important to passengers. The proximity of an airport to demand generators (i.e. population centres, and demand attractors such as tourism facilities and businesses), will impact the volume of traffic an airport can capture in two ways:

- Substitution - passenger volumes gained or lost to a competing airport; and
- Suppression/stimulation – As air travel is discretionary on many occasions, passenger‟s will avoid travelling if the generalised journey cost exceeds the passenger‟s willingness to pay or more passengers will travel if the generalised journey cost is below a passenger‟s willingness to pay.

The final origins and destinations of airline passenger trips (e.g. home, place of employment etc) to and from the Sydney region provides an understanding of the impact of location on demand at Sydney (Kingsford-Smith) Airport and other airports within the Sydney region. The National Visitors Survey 2005-2009 (NVS) and the International Visitors Survey 2005-2008 (IVS) provide information on the air trip profiles of passengers travelling to and from Sydney. Table 1 shows the distribution of demand by region for Sydney (Kingsford-Smith) Airport.

Table 1: Distribution of Air Passenger Trips across the Sydney Region (2009)

SLA	International		Domestic	
	Inbound	Outbound	Inbound	Outbound
Baulkham Hills (A) - Central	0.4%	2.6%	0.7%	2.7%
Botany Bay (C)	1.0%	0.4%	1.5%	0.5%
Hornsby (A) - South	0.9%	3.4%	0.6%	2.3%
Hurstville (C)	0.9%	2.6%	0.2%	1.9%
Ku-ring-gai (A)	0.9%	4.8%	0.8%	4.3%
Manly (A)	2.0%	1.9%	1.2%	2.3%
Marrickville (A)	1.4%	1.8%	1.2%	4.6%
North Sydney (A)	1.7%	3.1%	1.1%	3.9%
Parramatta (C) – Inner	1.3%	1.2%	1.7%	1.2%
Pittwater (A)	0.3%	2.0%	0.4%	3.1%
Randwick (C)	3.0%	4.1%	2.2%	3.3%
Rockdale (C)	1.4%	1.6%	0.5%	0.7%
Ryde (C)	2.1%	2.5%	1.4%	1.8%
Sutherland Shire (A) - West	0.3%	3.2%	0.6%	2.9%
Sydney (C) - East	2.5%	1.3%	1.2%	1.4%
Sydney (C) - Inner	61.5%	1.8%	70.0%	2.1%
Warringah (A)	1.0%	4.4%	1.3%	4.7%
Waverley (A)	2.8%	2.3%	1.5%	3.0%
Willoughby (C)	1.4%	2.7%	0.6%	2.7%
Woollahra (A)	0.6%	2.6%	1.0%	1.6%
Other	12.7%	49.5%	10.2%	49.0%
Total	100.0%	100.0%	100.0%	100.0%

Source: Booz and Company analysis of Tourism Australia NVS (2009) and, IVS (2008) data[2] for International Inbound, and ABS population data

2 The most recent NVS and IVS data was used for the purpose of this analysis. Raw data was analysed at an SLA level to meet the needs of the modelling. This was taken as the best available data at the time of the analysis.

International and Domestic air passenger demand showed similar patterns in that inbound trips are primarily destined for Inner Sydney whereas outbound trips were distributed across the catchment, mainly in-line with population. Inner Sydney accounted for approximately 62 per cent of inbound International trips and 70 per cent of inbound Domestic trips.

4. Competition and Commercial Structures

4.1 Competitive Dynamics

Airport co-existence models range from highly "competitive" to purely "complementary". A brief description of this spectrum is provided below:

- **Competing:** a competing airport model would see two airports in direct commercial competition with each other.
- **Hybrid:** a hybrid airport model would see two airports in "semi" competition with each other for certain markets segments, while also complementing each other"s service offerings across a cross-section of market segment.
- **Complementary:** a complementary airport model would see two major RPT airports in the Sydney region with complementary service offerings. The market would be divided up between the two airports in a mutually exclusive manner.

The characteristics and impacts of each airport co-existence model are presented in Figure 4 below. Characteristics and impacts are explored in further detail within the following subsections.

Figure 4: Competitive Dynamics Framework

AIRPORT CO-EXISTENCE MODEL	COMPETING	HYBRID	COMPLEMENTARY
CHARACTERISTICS			
AIRLINE NETWORK SCHEDULE	**Full duplication** of services across both airports	Targeted **duplication of some** specific services	**Mutually exclusive** service offerings
MARKET SEGMENTS SERVED	**All** market segments serviced at both competing airports	**Some crossover** in market segments serviced at both airports	**Mutually exclusive** market segments serviced by each airport (e.g. domestic vs. international)
AIRLINE BASES	**Multiple airlines** based out of both airport sites	**Multiple airlines** *potentially* based out of both airport sites – **very limited** degree of airline **exclusivity** *likely*	**Multiple airlines** *potentially* based out of both airport sites – **some** degree of airline **exclusivity** *likely*
OWNERSHIP STRUCTURE	**Mutually exclusive** competing airport owners	**Mutually exclusive** competing airport owners (potential exists for individual ownership)	**One individual owner** of both complementary airports
IMPACTS			
SECONDARY IMPACT ON SURROUNDING AIRPORTS	**High impact** – competitive environment not necessarily geographically constrained, diversion from non-KSA possible	**Limited to medium impact** – impact dependent upon what segments competition exists within	**Limited** impact due to non competitive market dynamics
STIMULATION OF MARKET OR SECTOR GROWTH	**High degree** of stimulation of market growth – particularly for second airport "localities" where generalised costs fall markedly	**Some degree** of stimulation of market growth, impact dependent upon what segments competition exists within	**Limited degree** of stimulation of market growth
IMPACT ON AIRLINES & AIRFARES	**High impact** – strong competition drives down airport fees and subsequently airfares	**Some impact** – impact dependent upon what segments competition exists within	**Some impact** – alleviation of supply constrains should see some level of airfare decrease even with no competition existing

Source: Booz & Company, 2011

4.2 Characteristics of Airport Co-Existence Models

Airport co-existence model can be best explained and contrasted against the following characteristics:

- Market segments served;
- Airline bases; and
- Airline network schedule.

Each of these characteristics is discussed in further detail below.

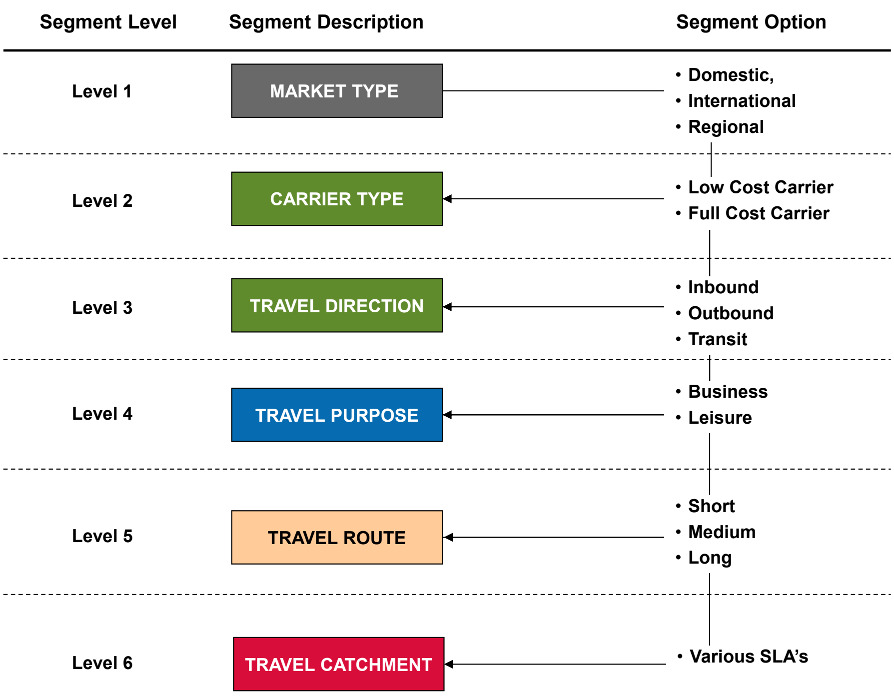
4.2.1 Market Segments Served

The first category of differentiation between airport co-existence models centres around an airport‟s overarching strategy and operating model. Depending on geographical location, segmented market characteristics and underlying commercial arrangements, airport operators will make a decision to target certain market segments over others. Different market segments may be appealing to different operators for a variety of reasons, but will ultimately be aligned to the operator‟s overarching corporate strategy.

Of additional importance is the emergence and proliferation of Low Cost Carriers (LCCs) in more recent decades. The potential competition between primary and secondary airports has become an increasingly important issue for domestic LCC operators all around the world, with LCC business models having drastically changed the market conditions experienced in the 21st century. LCCs essentially increase the efficiency and affordability of air travel, while inherently placing a strain on existing airport capacity.

A high level view of the air passenger market segments that an airport could potentially target are presented in Figure 5 below.

Figure 5: Micro segmentation Framework



Source: Booz & Company, 2011

Under a purely competitive co-existence model, airports will compete for airline and passenger traffic across all market segments. Under a hybrid model, airports will be operating under a “differentiated” corporate strategy, whereby select market segments will be chosen for “competition”, whist under a complementary airport model market segments will be divided up between airports in a mutually exclusive and ordered manner. To some extent, the market segments targeted under each scenario will not only be driven by the profit margins at stake, but also the alignment of certain higher order market segments to the characteristics of travellers within an airport‟s surrounding local catchment area.

4.2.2 Airline Bases

Airports, such as Sydney (Kingsford-Smith) Airport, drive much of their market positioning as hosts to one or more principal carriers in Australia. This symbiotic relationship between host carrier and airport is a central feature of the traditional „hub-spoke‟ business model. This is reinforced by Sydney (Kingsford-Smith) Airport‟s strong international presence and close geographical proximity to NSW‟s state capital of Sydney.

Metropolitan airports form a significant part of economic activity generated for its respective city. Airports seeking re-deployment of operators from Sydney (Kingsford-Smith) Airport to an additional major RPT facility will be mindful that any new airport must be capable of serving aircraft size which is sufficient to deliver economies of scale for the carrier. Additionally, in order to attract LCCs, the LCC business model must be complemented with adherence to low operational costs. Another aspect that may require attention encompasses the quick turnaround of aircraft. This means airport design considerations will be critical and need to be tailored to attract a target market (e.g. open apron configuration and taxiway).

Under a two airport model, airlines will have the choice of basing themselves exclusively out of one airport or a combination of the two airports. Ultimately, commercial factors and underlying infrastructure availability will dictate the decision around where to base an airline. However, it is highly unlikely that under the current capacity constrained operating environment, that major airlines will restrict themselves to a one singular port.

4.2.3 Airline Network and Schedule

The third category of differentiation between airport co-existence models centres around airline network schedule variability. The type and frequency of scheduled services at airports will correlate directly with an airports target markets.

In a competing airport environment, it is expected that there will be significant duplication of services across competing airports. Under a hybrid model, duplication will not be as widespread, but rather targeted based on the competing airports‟ chosen business operating models (and hence target market segments). Under a truly complementary airport model, services at complementary airports will by definition be mutually exclusive. Different airports will have mutually exclusive target markets, and hence services will be scheduled accordingly.

4.3 Impacts of Airport Co-Existence Models

Primary and secondary impacts of airport co-existence models centre around three main impact areas:

- Impact on surrounding airports;
- Stimulation of market or sector growth; and
- Impact on airlines and airfares.

Each of these impacts is discussed in further detail below.

4.3.1 Impact on Surrounding Airports

Different airport models will pose significantly different risks to surrounding airport market shares.

Under a model of two competing RPT airports, it is likely Sydney (Kingsford-Smith) Airport would lose market share across a wide cross section of market segments. However, market share losses may not necessarily be isolated to Sydney (Kingsford-Smith) Airport alone. Depending on the location of any airport, market share losses may also be experienced in existing airport locations such as Newcastle and Canberra. This is due to the fact that the geographical location of any new airport will significantly impact upon the relative generalised costs of air travel from a variety of NSW catchments and SLA"s. The magnitude of impacts on secondary airports will be heavily influenced by the ground "accessibility" of any new airport, including availability of transport infrastructure and public transport services.

Market share losses under a complementary airport setup, however, are likely to be less geographically concentrated and less pronounced. Under the complementary setup, shifts in entire market segments will be the resultant impact as services are simply transferred from one location to another. Government policy intervention would be required to realise this model for the Sydney region. The Scenario requires the development of Policies that mandate the respective roles of each airport. This would influence the services that would operate to and from each airport and could therefore strongly influence the level of passenger demand for each. It should be noted that such a scenario could not be achieved through market forces alone. Geographical location and generalised cost considerations play less of a part in a traveller"s decision making process, with the supply side availability dictating airport choice. Increased generalised costs are likely to result in an overall reduction in passenger movements as demand is suppressed.

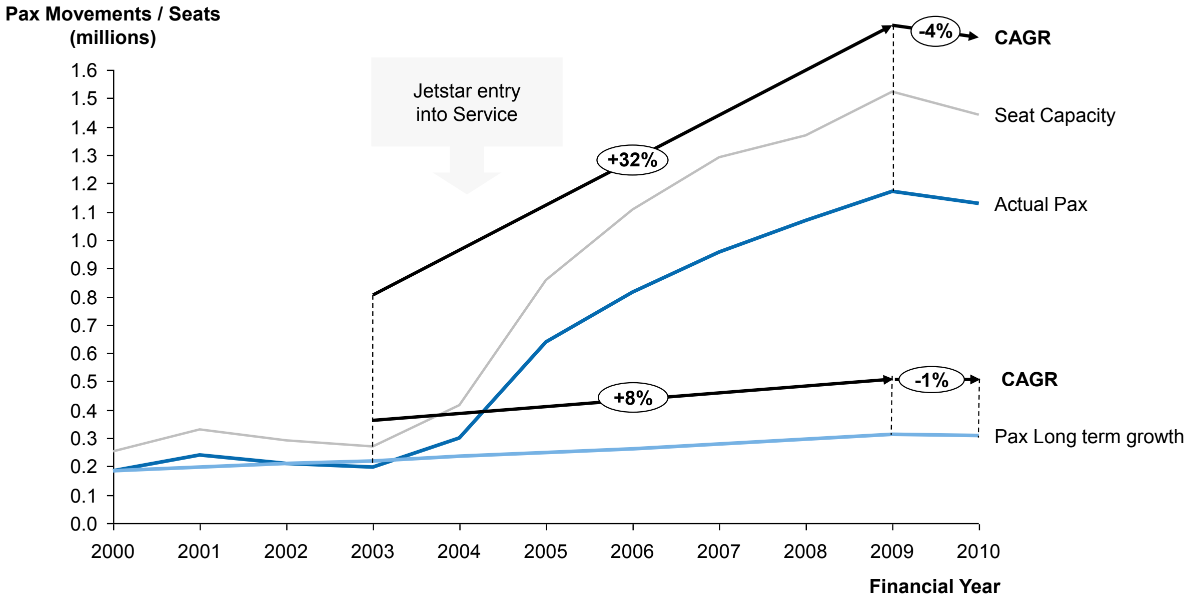
4.3.2 Stimulation of Market or Sector Growth

Development of an additional major RPT airport will not only result in market share implications within the captive air traveller market, but also has the potential to increase the size of the base market itself. Secondary airports may generate additional trips by facilitating access to air services for customers within the new airport catchment area who may not have otherwise undertaken these trips.

Stimulation of the base air traveller market is only likely to occur under a competing airport model. As previously discussed, the geographical location of any new airport will significantly impact upon the relative generalised costs of air travel from a variety of NSW catchments and SLAs. As generalised costs drop significantly for passengers living within closer proximity to a new airport, latent passenger markets are likely to emerge as a direct consequence. This will be particularly pronounced for leisure and shorter haul domestic market sub segments.

Historical growth at Newcastle Airport provides a clear case study for the stimulation of demand through introduction of new services. Exogenous growth at Newcastle would have seen passenger demand grow at 7 per cent per annum based on the level of service provided up until 2004. However the entrance of Jetstar and the response from Virgin Blue in the Newcastle market resulted in rapid growth in seat capacity. The market was subsequently stimulated by air fare sales and promotions resulting in an increase by 32 per cent per annum in passenger demand and seat capacity between 2033 and 2009, followed by a decrease of 4 per cent per annum due to the exit of Tiger Airways in 2010 which reduced capacity and slowed growth. A total CAGR of 27 per cent was registered from 2003 to 2010. Figure 6 shows the growth in passenger demand led by seat capacity at Newcastle Airport.

Figure 6: Stimulation of Passenger Demand (Newcastle Airport)



Source: BITRE reported passenger volumes and IATA published schedule data

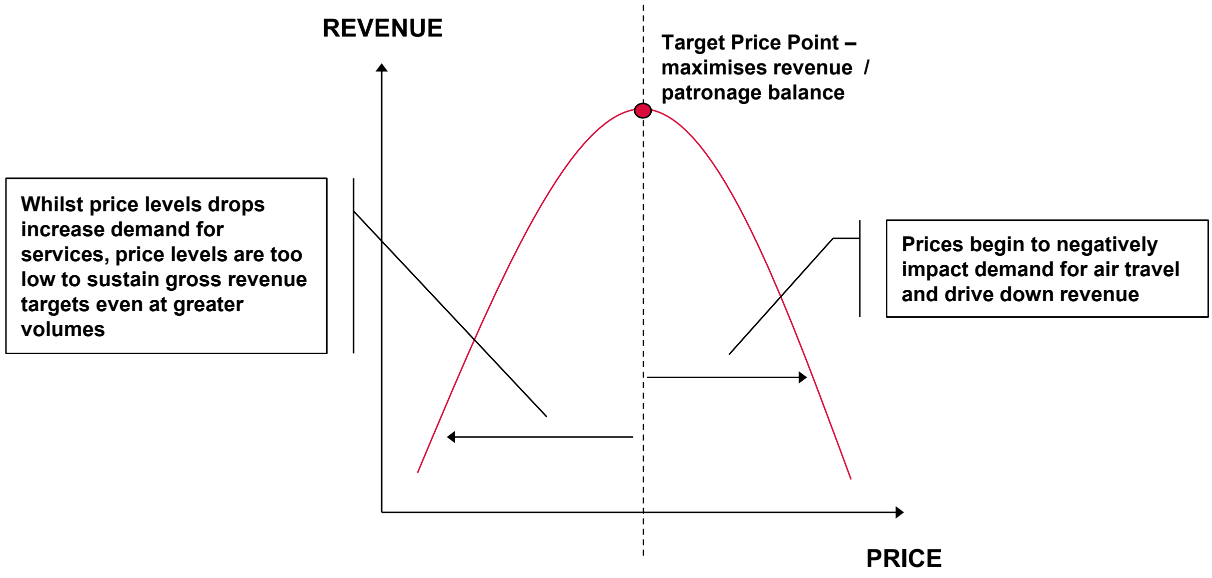
4.3.3 Impact on Airlines and Airfares

The development of an additional major RPT airport in the Sydney region could have the following benefits:

- Firstly, alleviation of capacity constraints will mean airlines are able to offer greater breadth and depth of routes and services. This benefit will hold true irrespective of the airport co-existence model in place, and also ensures that an additional RPT airport is likely to be viable irrespective of whether it is a complimentary or competing airport in nature.
- Secondly, introduction of competition into the Sydney market is likely to result in lower airport access charges and hence lower airfares for customers. This would be most pronounced within the domestic travel sub-market, where airport fees and charges make up a more significant portion of an airlines cost to serve. By definition, the benefits of competition can only be reaped under an airport co-existence model which is based more around a competing rather than complementary airport setup.

As previously discussed, the development of a competing RPT airport has the potential to stimulate latent traveller submarkets and increase the size of the captive market. This is likely to be even more pronounced in the face of reduced airfares. However, airlines and airport operators will still face the challenge of ensuring any price benefits have the desired effect of maximizing not only patronage, but also sector revenues. A trade-off, as illustrated within Figure 7 below, exists in this regard.

Figure 7: Price vs. Patronage vs. Revenue Trade-Off (Illustrative)



Source: Booz & Company, 2011

As described above, it is anticipated that there would be reductions in airfares resulting from competition between the two airports. For the purposes of this analysis, however, the demand forecasts do not take into account market stimulation resulting from these airfare reductions. This is consistent with the assumption that there is no demand suppression resulting from increases in airfares resulting from KSA‟s capacity constraints in the baseline demand forecasts.

4.4 Assessment Framework of Proposed Airport Site and Co-existence Models

The appropriateness of a particular airport co-existence model will vary by airport site. This variance is in accordance with the characteristics by which an additional RPT facility is constrained.

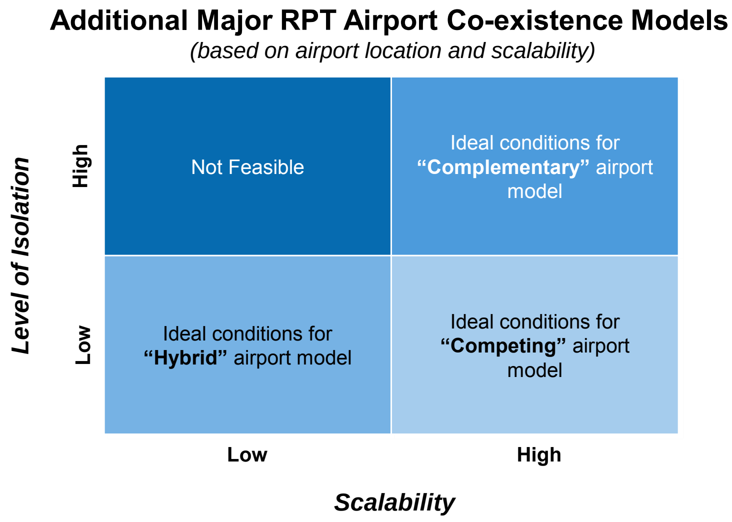
The key constraint governing the appropriateness of a particular co-existence model for a specific scenario is an airport‟s physical location. More specifically, the "level of isolation" which exists as a direct result of an airport‟s geography and surrounding environment plays a central role within this determination. "Level of Isolation" is defined across three sub-categories:

1. **Population / Density of Catchment:** this sub-category refers to an airport‟s "level of isolation" from its base market
2. **Proximity to Central Business District (CBD):** this sub-category refers to an airports "level of isolation" from key activity and tourism centres; and
3. **Accessibility:** this sub-category refers to an airports "level of isolation" from key enabling infrastructure, such as roads and public transport

Also governing the appropriateness of a particular co-existence model for a specific scenario is the additional RPT facility‟s scalability. "Scalability" refers to the level to which an airport can fluidly accommodate growth in air passenger markets, and respond to changes in base market characteristics. When assessing scalability, the availability of growth enabling resources (i.e. land) is critical.

A future RPT airport operator needs to be mindful of the applicability of specific co-existence business models against the backdrop of prevalent contextual limitations. Figure 8 presents a co-existence model applicability framework to assess the best co-existence models by balancing off “scalability” and “level of isolation” considerations.

Figure 8: Additional Major RPT Airport Co-existence Models (based on location and scalability)



Source: Booz & Company, 2011

4.5 Examples of Multiple Airports

The number of airports serving a city is not closely related to the population size of a city. A number of metropolitan cities around the world were analysed to determine how each city caters for air travel demand and the consequent relationship between the number of airports available and the population size. Figure 9 shows that a clear relationship between the population size of a city and the number of airports serving the city is not apparent.

Figure 9: Number of Airports versus Population

Source: Booz & Company analysis of UN and ATI data

The number of airports serving a city will be influenced by a number of factors other than population, including:

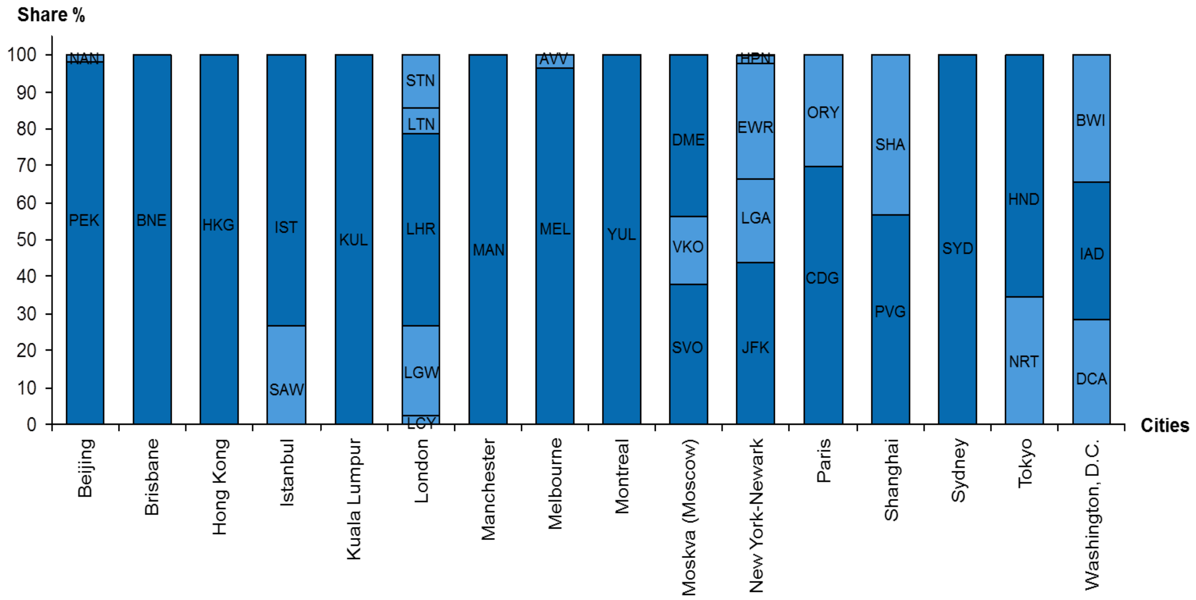
- Geographic concentration of population;
- Surface access;
- Ownership structures;
- Competitive landscape;
- Government policy; and
- Capacity constraints at individual airports.

Three of the cities with the largest population, among those analysed, are located in East Asia (i.e. Tokyo, Beijing, Shanghai). Tokyo, which has a population of 37 million people, is served by two main airports, namely Narita International Airport for international markets and Haneda Airport (until recently) for domestic markets. Shanghai is similar in its division between international and domestic airports and Beijing has the majority of passenger traffic concentrated on a single airport.

The range of population sizes served by two airports ranges from Melbourne with a population of 4 million to Tokyo with a population of 37 million. On the vertical scale, London, Moscow, Istanbul and Paris New York City, which as of 2010 had over 19 million inhabitants, is served by 5 airports.

Where a city is serviced by multiple airports, there is typically one dominant or primary airport within the catchment. Airports categorised as primary airports have a larger traffic than secondary airports, as shown in Figure 10.

Figure 10: Primary and Secondary Airports Share of Air Traffic Demand



Source: Booz & Company analysis of ATI data

Notes: Due to the absence of more recent data, 2008 air traffic data was used for Beijing Nanyuan Airport (source: CAA),

4.6 Observations of Multiple Airports

The need for secondary airports is driven by one or more of a number of factors:

- Capacity constraints;
- LCCs seeking lower cost access to destinations; and
- Catchments becoming large enough to warrant two airports based on the generalised cost of ground access and/or pressure from surround development.

In many cases the key driver for an additional facility is the emergence of capacity constraints at the primary airport. As an airport reaches capacity, enormous strain is posed not only on the airport itself but mostly on the airlines which become incapable of operating efficiently and expanding their network to cater for additional demand. As demand grows, the number of „sought after" slots will decrease and the operators will be looking for an alternative to develop their network and meet demand.

The growth in LCCs drove the conversion of many existing airfields into secondary RPT facilities. LCCs operations focus on providing point-to-point services satisfying the basic requirements of passenger journeys. Flexible time slots and quick turnaround of aircraft which can be facilitated by an open apron configuration and taxiway are required. Therefore, given the capacity constraints which often affect the primary airports, secondary airports are seen as a viable option to make front to this issue.

Secondary airports may generate additional trips by facilitating access to air services for customers within the new airport catchment area who may not have otherwise undertaken these trips. Good surface access is another determining factor for the success of secondary airports.

Network carriers or Full Service Carriers (FSC) are more likely to continue operating out of primary airports. Primary airports support the hub-and-spoke network model which allows for high frequency and interconnectivity between flights to provide a comprehensive network of origins and destinations, FSCs invest more into terminal facilities (e.g. gate lounges and airline clubs) to provide passengers with a higher standard of service and comfort.

Urban growth will drive the development of alternative aviation facilities, When urban areas expand geographically, ground access to existing airports will be degraded, creating an opportunity for an additional facility to serve part of the catchment. Residential development round existing airports will place pressure on governments to relocate all or some of the aviation activity to reduce the impacts of aircraft noise on residential areas.

For multiple airports to co-exist in the same catchment, the market needs to be large enough to sustain more than one airport. The primary airport needs to have sufficient capacity constraints to allow the secondary airport to grow or clear segmentation between markets served from each airport is required. An artificial or ambiguous split of services or market segments is likely to lead to the failure of one of the airports. Less successful cities often make the mistake to create two primary airports. Ineffective "multi-hub cities" have in effect focused on local traffic and failed to attract a proportionate share of connecting passengers.

The location and accessibility of the secondary airports are also key factors to their success. A passenger‟s choice of an airport is influenced by several factors such as travel distance and convenience in accessing the airport, available airline brands, schedule frequency and connectivity (for transfer passengers). Airlines‟ choice of which airport to use are driven by considerations of safety, security, yields, airport charges, interline connectivity and alliance partnership preferences.

The first challenge for secondary airports in openly competitive markets is to attract airline services. The second challenge is that of retaining airline services or, at a minimum, to avoid major losses if the airlines withdraw for any reason.

A number of lessons can be learnt from prior attempts by other cities to create split hubs. Today, there are multi-airport cities such as Chicago, Dallas and Houston which were able to create effective hubs and cities such as Washington, New York, London and Paris which run ineffective hub structures[3]:

- Aviation markets were decisively split in Paris when the majority of international services were moved to Charles de Gaulle Airport (58 million passengers) in 1966. Paris Orly (25 million passengers) remained and grew to be the second busiest airport in France with a focus on domestic and continental Europe markets;

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[3] Neufville, R. de (nd), "The Future of Secondary Airports: Nodes of a Parallel Air Transport Network?", English version of article prepared for the journal **Cahiers Scientifiques du Transport**

- Splitting the aviation market in Montreal failed to sustain a new airport at Mirabel. The Canadian national government forced intercontinental carriers to use Mirabel airport, while leaving Dorval airport to cater for domestic carriers only. International flights were banned from Dorval between 1975 and 1997. This policy deprived the intercontinental carriers of the possibility of easy onward domestic connections and gave them the incentive to relocate flights to Toronto. International operations quickly fell away after the ban was lifted in 1997 and by 2000, the underutilisation of Mirabel airport drove the decision to relocate all services back to Dorval airport.

- In Washington, D.C., Dulles did not develop into the international connecting hub it was planned to be. It was built with the intent to supplant Washington Reagan, but it catered to only about 3 million annual passengers (as compared to approx. 14 million passengers annually at Baltimore and Reagan) for its first two decades.

- London Stansted airport was built with the intent to be a major traffic reliever to the traffic pressures on London Heathrow. Traffic averaged to approximately 5 million annual passengers for most of its first decade. Its traffic has however grown to 18.6 million passengers in 2010 due to the growth of low cost airlines, especially Ryanair. It is still largely underutilised. Traffic at Heathrow has grown to 66 million over the same period and is over three times greater than London Stansted.

5. Assessment of RAAF Base Richmond as an Additional RPT Facility

This section analyses the potential of RAAF Base Richmond as an additional major RPT airport in the region, against a number of factors, including location, population catchment and scalability and draws comparisons with Sydney (Kingsford-Smith) Airport.

5.1 Overview of RAAF Base Richmond

RAAF Base Richmond is located 65 kilometers from the CBD, between the towns of Windsor and Richmond. It has a single runway, running east-west through the site. In general, the aerodrome at Richmond is currently not available to civil operators, with the exception of certain weekend and public holiday activities and for flying training purposes[4]. Key attributes of the aerodrome at Richmond from a demand perspective are summarized in Table 2 below.

Table 2: RAAF Base Richmond Overview

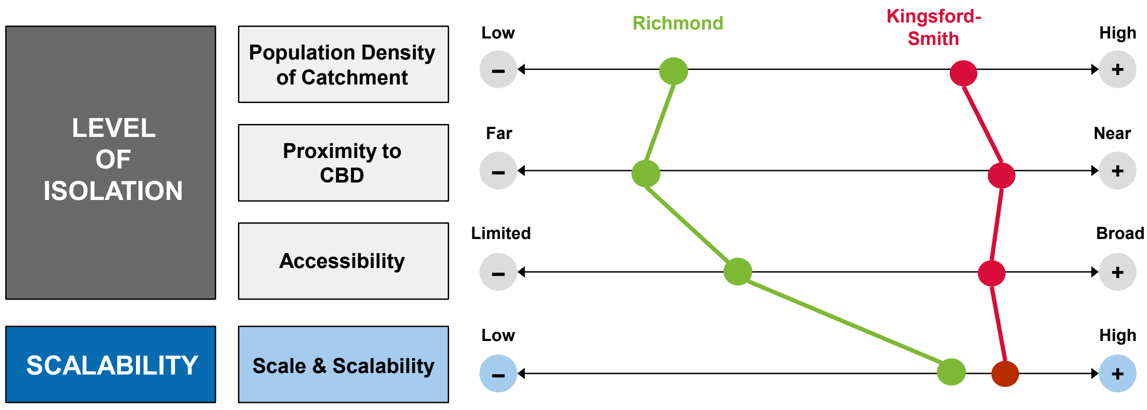
Aerodrome	Distance/Time from	
	CBD	Edge of Sydney GMA
RAAF Base Richmond	65km / 65min	18km / 26 min

Source: Worley Parsons, ABS Population Statistics, Google Maps, Booz & Company analysis of GIS data

5.2 Assessment[5] of Alternative Airport Site

A summary of the qualitative assessment undertaken for RAAF Base Richmond against Sydney (Kingsford-Smith) Airport is presented within Figure 11 below. Sydney (Kingsford-Smith) Airport rates well on "level of isolation" and "scalability" factors. The latter is attributable to its capacity in the short to medium term to accommodate 1.5 times the current passenger volume (i.e. approx. 35.7 million in 2010). However, it is estimated that capacity will be depleted in the medium to long term. This is one of the main drivers of the potential need for an additional RPT airport.

Figure 11: Airport Assessment Framework



Source: Booz & Company, 2011

[4] Worley Parsons, 2010
[5] The scale used in the assessments undertaken in this section is purely illustrative

An explanation of the above assessment criterion, as well as a more detailed assessment of each proposed airport site, is presented within the subsections below.

5.2.1.1 Level of Isolation

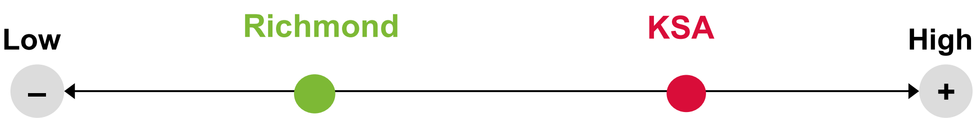
Population Density of Catchment

Positioning an airport close to higher density areas will be attractive from a demand perspective for three main reasons:

- **Reducing generalised costs for a greater volume of travellers**: the physical location of any new airport will significantly impact the relative generalised costs of air travel across SLAs within its geographical proximity.
- **Greater potential for stimulation of latent demand**: secondary airports can generate additional trips though inherently facilitating access to air services for customers within neighbouring SLA"s who may not have otherwise undertaken these trips.
- **The existence of a natural market** against which an airport may be able to position its services: the characteristics of the surrounding market can help shape an airport"s overarching strategy, allowing them to improve their competitive positioning through more targeted offerings.

A comparison of population densities in locations surrounding the aerodrome at Richmond (versus. those exhibited by Sydney (Kingsford-Smith) Airport) is presented in Figure 12 below.

Figure 12: Population Density of Catchment Comparison



RICHMOND	KSA
▪ Within 25km radius – 613,235 inhabitants ▪ Within 50km radius – 2,921,684 inhabitants	▪ Within 25km radius – 2,553,649 inhabitants ▪ Within 50km radius – 3,629,123 inhabitants

Source: Booz & Company analysis of GIS data, 2011

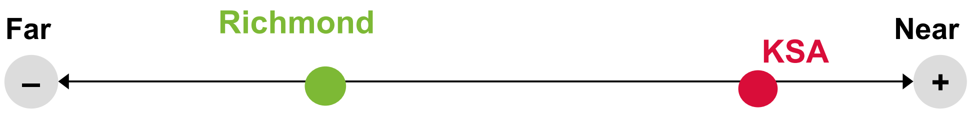
Proximity to CBD

The proximity of an airport to Sydney"s central business district (CBD) influences its attractiveness to the air traveller market. This effect will be pronounced across both business and leisure sub markets, with Sydney"s CBD serving as a hub for both tourism and business activity. By way of importance, Sydney"s CBD as a destination point currently accounts for approximately two-thirds of overnight and inbound passenger trips annually through Sydney (Kingsford-Smith) Airport[6]. Sydney"s CBD also ranks as a key travel origination point, with over one-third of outbound trips originating from within a 10km radius of the CBD.

[6] TRA, NVS & IVS (2009)

A comparison of the proximity of the aerodrome at Richmond to the Sydney CBD (vs. those exhibited by Sydney (Kingsford-Smith) Airport) is presented in Figure 13 below.

Figure 13: Proximity to CBD Comparison



RICHMOND	KSA
▪ Distance of **65kms** to Sydney CBD ▪ Approximately **65 mins** to Sydney CBD by road	▪ Domestic Terminal **11.7 km** south of Sydney CBD, International Terminal **14.3 km** south of CBD ▪ Approximately **20min** by road to Sydney CBD

Source: Worley Parsons (2010), Google Maps

Accessibility

Airport accessibility (through road, public transport and active transport means) is a significant contributor to an airport‟s attractiveness to the air traveller market. This is particularly the case in a “competing” airport environment, where accessibility may serve as a choice differentiator on a segment by segment basis. The importance placed on accessibility is due to two key reasons:

1. **Cost:** the more easily accessible an airport is, the less costly it is to access. This is generally as a result of time savings, which in turn bring down overall generalised travel costs, increasing the airports appeal. The importance of generalised cost in passenger decision making varies by customer segment (e.g. business vs. leisure and long vs. short haul)
2. **Breadth of Choice:** wider breadth of accessibility options (e.g. public transport, motorways, bus lanes) broadens the appeal of an airport to a greater cross section of market segments, which may inherently prefer a certain ground access mode over another.

A comparison of the accessibility assessment for RAAF Base Richmond and Sydney (Kingsford-Smith) Airport is presented in Figure 14 below.

Figure 14: Accessibility Comparison

RICHMOND	KSA
▪ Regionally isolated ▪ Closest motorway access is M7 Westlink -19.8kms/29 minutes away from airport precinct ▪ Train station currently exists in the suburb of Richmond – however access to current airport site by public transport difficult	▪ Located in close vicinity to Sydney Ports – high traffic congestion ▪ 2.0 kms/ 8 mins to South Western Motorway (M5) and Eastern Distributor ▪ Direct rail at Domestic and International Terminals to Sydney CBD and SW Sydney

Source: Worley Parsons (2010), Booz & Company (2011)

5.2.1.2 Scalability Potential

The availability of abundant undeveloped land in close proximity to an airport‟s site helps mitigate scalability risk. Latent scalability potential enables an airport to respond to two periodically recurring phenomena:

- **Changes in technology:** as aircraft technology evolves, changes to airport configurations and base infrastructure (e.g. wider runways to handle A380s) are likely to be required. Enough free land in close proximity to the airport site needs to exist to facilitate any future changes that may be required to accommodate airlines‟ continually evolving technological innovations
- **Growth in passenger volumes:** as passenger volumes grow into the future, land needs to be available to allow for any necessary airport or infrastructure expansions (e.g. reconfiguration or construction of new runways and terminals) to mitigate against the risk of capacity constraints re-emerging

A comparison of the scalability potential of RAAF Base Richmond against Sydney (Kingsford-Smith) Airport is presented in Figure 15 overleaf. As previously mentioned, it should be noted that the scalability comparison illustrated below only takes into account the short to medium term, during which Sydney (Kingsford-Smith) Airport is anticipated to have the capacity to cater for approximately 55 million additional passengers.

Figure 15: Scalability Comparison

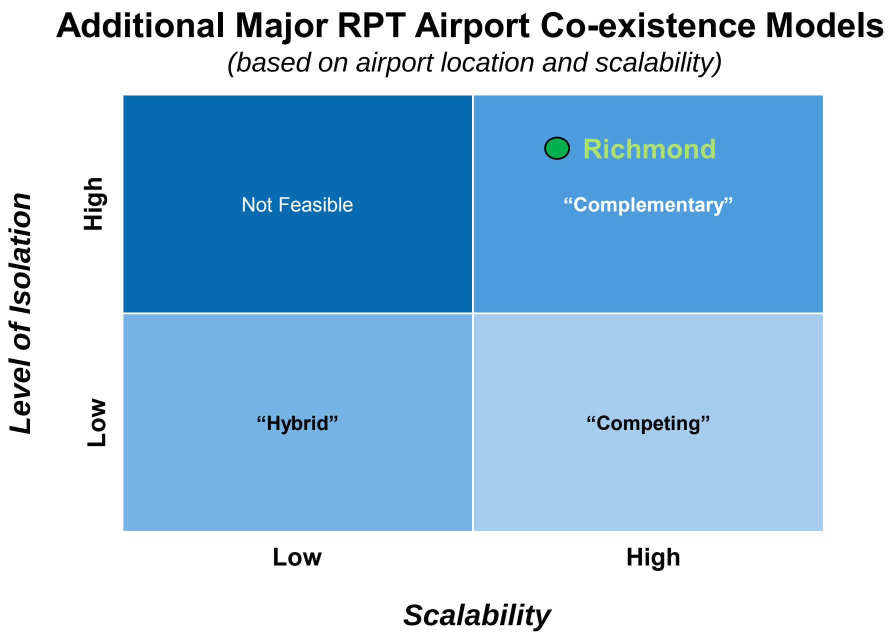
RICHMOND	KSA
▪ Site Area: **228 ha** ▪ Significant amount of free land available within Richmond precinct – low density area (population wise)	▪ Site Area: **907ha** ▪ Capacity currently available to handle ~90 million passengers, almost three time as much as current volumes

Source: Worley Parsons (2010), Booz & Company (2011)

5.2.2 Assessment of Co-existence Model Suitability

Having undertaken the above analysis, the aerodrome at Richmond can be categorized under the co-existence model framework presented in Figure 16 below. The analysis shows that the "level of isolation" and "scalability" characteristics exhibited by RAAF Base Richmond best suit a complementary co-existence operating model. The aerodrome at Richmond would have a competitive disadvantage compared to Sydney (Kingsford-Smith) Airport due to its high level of isolation, which means that it is unlikely to directly compete with a large portion of the market share of passengers in unconstrained conditions.

Figure 16: Suitability of Aerodrome Sites to Co-existence Models (under a two aerodromes environment)



Source: Booz & Company, 2011

The analysis above indicates that RAAF Base Richmond is more suited to serving as a complementary facility to Sydney (Kingsford-Smith) Airport, rather than providing direct competition. As a consequence, the ground access model that is described in subsequent chapters of this report factors in the lower level of attractiveness to passengers of the aerodrome at Richmond that results from its relative isolation compared to Sydney

(Kingsford-Smith) Airport. The aerodrome at Richmond scores highly, however, in the assessment of scalability and it is therefore rendered an appropriate alternative for assessment against the three operating scale scenarios in this report.

For the purpose of this analysis, it was assumed that ground access to an additional RPT facility at Richmond would be enhanced to match the scale of the airport development. For example, road and public transport connections would be of a higher quality for a 20 million passenger facility compared to a 2 million passenger facility. Should this be the case, there is potential for the aerodrome at Richmond to shift downwards into the “suitable for competing” quadrant of the matrix in Figure 16 above.

6. Scenarios for Redistribution of Services

This section presents an overview of the scenarios developed to explore the redistribution of unmet passenger demand from Sydney (Kingsford-Smith) Airport to a facility at RAAF Base Richmond. Each of the scenarios is then explored in detail, in terms of the likely markets served and the passenger profiles expected to use the facilities in each case. The assumptions underpinning these scenarios were informed by existing examples of different scales of operations at Australian airports.

6.1 Scenario Overview

Four scenarios for an additional RPT facility at RAAF Base Richmond were developed for evaluation. Each of the scenarios assumes a different level of capacity and that upgrades are made to provide sufficient capacity to meet demand. The scenarios also assume that ground access is enhanced to provide sufficient levels of service to each of the airports.

The four scenarios represent different levels of capacity at RAAF Base Richmond. A summary of the four alternative scenarios is presented in Table 3.

Table 3: Scenarios for Redistribution of Services

Scenario		Airport Capacity (passengers p.a.)	Level of Capital Investment
Number	Description		
Scenario 1	Low Capacity	2 million	Low
Scenario 2	Medium Capacity	5 million	Medium
Scenario 3	High Capacity Tier 1	20 million	High
Scenario 4	High Capacity Tier 2	30 million	High

Source: Booz & Company, 2011

The level of duplication of airline networks across the two airports is incremental between the four cases and is influenced by the defined capacity of the aerodrome at Richmond airport. In Scenario 1, there will be a low level of competition in niche markets, whilst in Scenario 4, there will be competition over a broad range of market segments. In general, however, it is expected that the smaller markets would go to one airport or the other but not to both. The four scenarios model the stimulation of additional trips from the local catchment that result from reductions in the generalised cost of the end to end air trip with the development of a new facility at RAAF Base Richmond.

The capacity constraints defined in each of the four scenarios influence the service offering that is sustainable in each particular case. That is, the depth and breadth of the network in each scenario is influenced by the airport capacity. With increasing airport capacity, the depth and breadth of the network is similarly increased. Scenario 1 would have limited domestic services whereas Scenario 4 would serve all of the broad markets except for long haul international hubs and regional markets. The depth and breadth of airline service offering will influence the attractiveness of the airport to passengers in the Sydney region.

The level of capacity for each scenario provides an indicative size of airport. It is assumed that upgrades would be made at the airport to provide capacity for additional growth in demand.

6.2 Scenario 1 – Low Capacity

Scenario 1 involves using RAAF Base Richmond‟s existing runway facilities with minimal capital upgrades. It was estimated that this would provide a total annual capacity for two million passengers[7], in a competitive situation with Sydney (Kingsford-Smith) Airport. In this scenario, it was assumed that the aerodrome at Richmond would service only the domestic short-haul market, as based on the analysis of routes served at Avalon Airport in Victoria[8], whose scale of operations would be similar in size to that proposed under scenario 1. Short-haul flights are to include locations on the east coast such as the Gold Coast (OOL), Brisbane (BNE), Melbourne (MEL), Canberra (CBR), and Adelaide (ADL). The scenario assumes that these markets would be served by a single operator out of RAAF Base Richmond. Table 4 presents a summary of the key attributes of Scenario 1.

Table 4: Scenario 1 Overview

Attribute	Description
Annual Capacity (pax p.a.)	2 million
Capital Investment	Minimal
Runways	1
Markets Served	Short haul domestic (high volume routes)

Source: Booz & Company, 2011

6.3 Scenario 2 – Medium Capacity

The second scenario represents the situation whereby RAAF Base Richmond provides capacity for five million passengers per annum. The markets served from the additional RPT facility at the aerodrome at Richmond would focus on Domestic Australia:

- Short haul domestic (up to 2.5 hours);
- Medium haul domestic (2.4 to 4 hours) including North Queensland and Central Australia, but excluding Western Australia; and
- Short haul international, primarily Trans-Tasman services.

Scenario 2 supports operations from two primary carriers and the provision of additional services by other carriers. An airport operating with a network of comparable breadth and depth is Gold Coast (OOL).

In this scenario, the existing runway facility will be utilised to its maximum capacity. The capital investment requirement for Scenario 2 primarily represents the costs to upgrade RAAF Base Richmond with passenger facilities. A summary of the second scenario is presented in Table 5.

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7 Booz & Company estimates, 2011

8 IATA published schedules for Avalon 2003 to 2010

Table 5: Scenario 2 Overview

Attribute	Description
Annual Capacity (pax p.a.)	5 million
Capital Investment	Medium
Runways	1
Markets Served	Short haul domestic Medium haul domestic Short haul international

Source: Booz & Company, 2011

6.4 Scenario 3 – High Capacity Tier 1

Scenario 3 involves the provision of a fully developed airport alternative. In this situation, the aerodrome at Richmond has sufficient capacity to support 20 million passengers annually. The markets served from RAAF Base Richmond would include:

- All domestic markets;
- Short haul international; and
- Medium-haul international secondary markets in South-East Asia, China and India.

This scenario supports two main airlines and a range of additional airlines representing smaller market shares. Capital investment would be required at the aerodrome at Richmond to develop a second runway, running perpendicular to the existing runway, and facilities to accommodate 20 million passengers per annum. A summary of the key attributes of Scenario 3 are presented in Table 6.

Table 6: Scenario 3 Overview

Attribute	Description
Annual Capacity (pax p.a.)	20 million
Capital Investment	High
Runways	2
Markets Served	All domestic flights Short haul international Limited number of medium haul international

Source: Booz & Company, 2011

6.5 Scenario 4 – High Capacity Tier 2

Scenario Four similarly involves the provision of a fully developed airport alternative with capacity for 30 million passengers annually. The markets served from RAAF Base Richmond would include:

- All domestic markets;
- Short haul international; and

- Medium-haul international focused on point to point traffic for South-East Asia, China and India.

This scenario supports two main airlines and a range of additional airlines representing smaller market shares. As with Scenario 3, the capital investment into the aerodrome at Richmond would require the development of a second runway, running perpendicular to the existing runway, and facilities to accommodate 30 million passengers per annum. A summary of the key attributes of Scenario 4 are presented in Table 7.

Table 7: Scenario 4 Overview

Attribute	Description
Annual Capacity (pax p.a.)	30 million
Capital Investment	High
Runways	2
Markets Served	All Domestic Flights Short Haul International Medium Haul International

Source: Booz & Company, 2011

7. Impact on Air Travel Demand in the Sydney Region

This section describes the approach adopted to determine mode share within the domestic and international markets for each of the scenarios. The resulting impact on passenger demand distribution under each of the four scenarios is then presented. Each of the scenarios is tested in the unconstrained situation to determine the market share for Sydney (Kingsford-Smith) Airport and the alternative airport. Under a complementary scenario it was assumed that passengers were only redistributed to the additional major RPT facility once capacity at Sydney (Kingsford-Smith) Airport was exceeded in 2033. Under a competing scenario the market was divided between the two airports based on the generalised cost for passenger using each of the airports.

The four scenarios analysed are expected to stimulate additional demand due to a reduction the generalised cost of the end-to-end air trip. The level of induced demand is expected to increase between scenarios one and four as the cases provide incrementally higher levels of network breadth and depth.

7.1 Factors for of Market Share

The process for determining market share for each market segment (domestic and international) was based on the relative generalised cost to access the two competing airports from the CBD- that is, the ratio of generalised access costs for Richmond and Sydney (Kingsford-Smith) aerodromes. Analyses of similar relationships between competing pairs of airports globally informed the development of the model to predict relative mode share. For example, relative mode share between airport pairs such as Kuala Lumpur International Airport (KUL) and Sultan Abdul Aziz Shah Airport (formerly Subang airport, SZB); and Haneda Airport (HND) and Narita (NRT) were examined. The benchmarking analysis was used to determine the influence of generalised costs of secondary airports to their subsequent market share.

A range of additional relationships between the referenced airport pairs were examined to determine the relative impact of airport service offering on mode share. These include the relative range of destination and service frequencies at the competing airports. Accordingly, these factors represent the differences between the four airport scenarios evaluated in this paper.

Table 8 presents a summary of comparisons between competing airport pairs across all markets. As described above, a range of factors were examined to determine the influence of generalised costs and service offering on the relative market share of competing airport pairs.

Table 8: Market Share Comparison (All Markets)

Competing Airport Pair		Market Share of A1	Access to CBD (A1/A2)*	Destinations Served (A1/A2)	Number of Services (A1/A2)	Service Frequencies (A1/A2)
Airport 1 Primary (A1)	Airport 2 Secondary (A2)					
Kuala Lumpur	Sultan Abdul Aziz Shah	92%	2.3	1.7	4.5	2.7
Melbourne	Avalon	97%	0.4	15.0	40.3	2.7
Haneda	Narita	96%	0.4	5.3	15.4	2.9
Istanbul	Istanbul Sabiha	68%	0.4	1.6	2.1	1.4

**Access to CBD = the generalised cost of ground access to Airport 1 (A1) / generalised cost of ground access to Airport 1 (A2)*
Source: Air Transport Intelligence, IATA published schedule data Booz & Company analysis, 2011

A similar comparison was undertaken, which considered common markets only between the two airports. The results of this comparison are presented in Table 9 below.

Table 9: Market Share Comparison (Common Markets)

Competing Airport Pair		Market Share of A1	Access to CBD (A1/A2)	Number of Services (A1/A2)	Service Frequencies (A1/A2)
Airport 1 Primary (A1)	Airport 2 Secondary (A2)				
Kuala Lumpur	Sultan Abdul Aziz Shah	84%	2.3	17.3	17.3
Melbourne	Avalon	94%	0.4	2.2	2.2
Haneda	Narita	95%	0.4	8.2	8.2
Istanbul	Istanbul Sabiha	66%	0.4	1.9	2.0

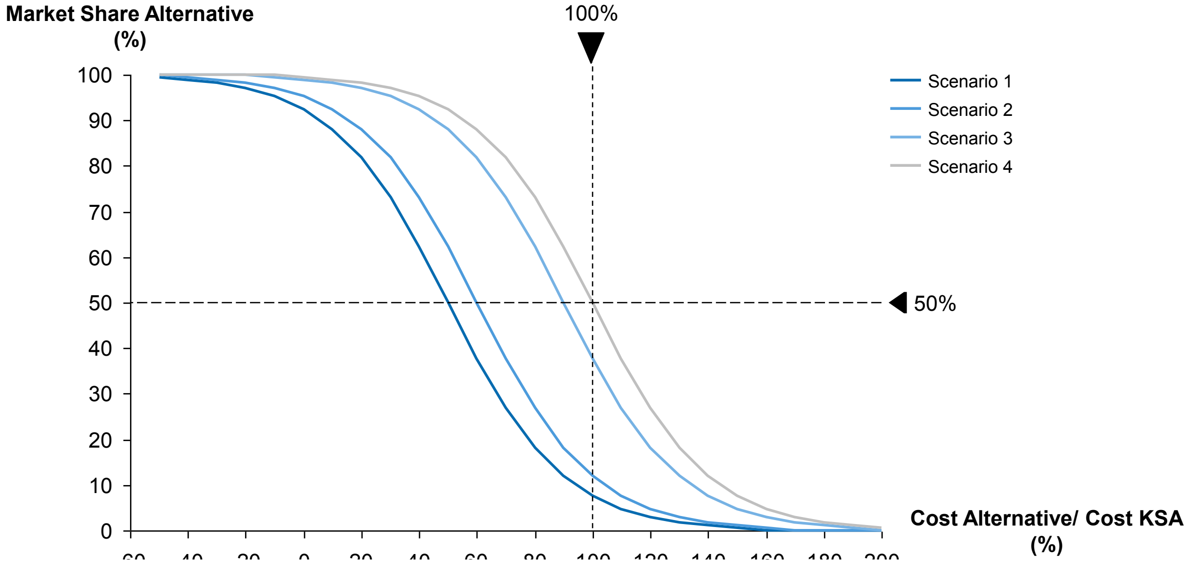
Source: Air Transport Intelligence, IATA published schedule data, Booz & Company analysis, 2011

The results of these analyses indicate that there is a negative relationship between secondary airport access costs and market share. As the ground access costs of the secondary airport increase, its relative market share decreases. A trend was also observed relating to the relative service offering between the primary and secondary airports. The greater the proportion of markets served by the secondary airport and the greater the service frequencies, the higher the market share of that airport.

The functions developed to assess the relationship between generalised costs of the alternative, and its subsequent market share in each of the scenarios, reflect the analysis above The function was calibrated based on the empirical evidence found for airports operating as the "tail end" of the curve (i.e. the secondary airport has a low market share in the markets where the two airports compete).

Figure 17 presents the function describing relative domestic market share for each of the scenarios. When the relative generalised costs for the end to end journey are equal between two competing airports and service offering is comparable between the two airports, as in Scenario 4, the model predicts that the alternative airport will capture 50 per cent of the primary airport"s domestic market share. Whereas for Scenario 1 the same generalised cost for both airports results in only a 7 per cent market share for the additional RPT facility due to the restricted airline service offering within the broader domestic market.

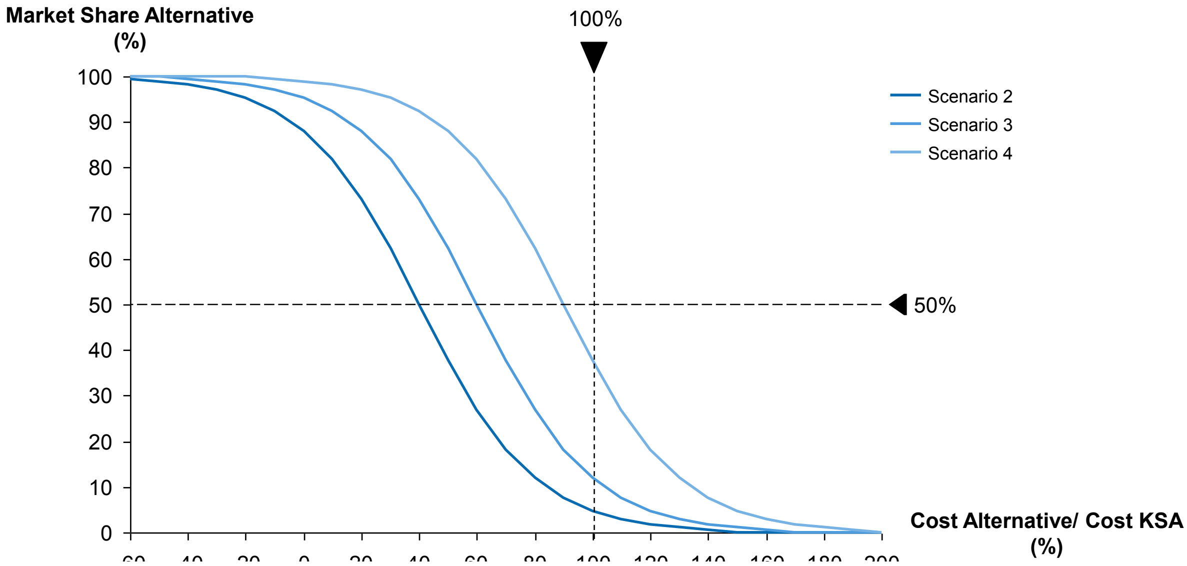
Figure 17: Demand Function for Forecasting Domestic Market Share



Source: Booz & Company, 2011

In the international case, the model illustrates that ground access costs to the alternative airport must be more competitive to attract the same market share as the domestic case. That is, the ground access costs of the alternative must represent 70 per cent of the primary"s to attract half of the market share. This reflects the fact that the breadth and depth of the international service offering of RAAF Base Richmond that is described in Scenario 3 is significantly lower than that for Sydney (Kingsford- Smith) Airport. Similarly, in Scenario 2, the lower breadth and depth of the international network requires even greater generalized access cost savings to attract 50 per cent of the market share. This is illustrated in Figure 18 below. Scenario 1 is not represented in the below figure as in that scenario the aerodrome at Richmond would service domestic routes only in this case.

Figure 18: Demand Function for Forecasting Market Share



Source: Booz & Company, 2011

7.2 Forecast Demand

The demand forecasts were developed from the perspective of redistributing unmet demand from Sydney (Kingsford-Smith) Airport to an additional RPT facility in the Sydney Basin under complementary conditions. Therefore only unmet demand was redistributed to the additional RPT facility under the four scenarios developed. Demand has been identified in five categories:

1. Passenger movements which would naturally redistribute to RAAF Base Richmond due to it being more attractive from a generalised cost perspective;

2. Passengers movements which would be redistributed to RAAF Base Richmond due to capacity not being available at Sydney (Kingsford-Smith) Airport;

3. Passenger trips which remain at Sydney (Kingsford-Smith) Airport;

4. Suppressed passenger trips due to insufficient capacity at both Richmond and Sydney (Kingsford-Smith) aerodromes; and

5. Stimulated passenger trips due to an overall reduction in the generalised cost of travelling by air.

Section 7.4 investigates the difference between complementary and competitive conditions for the four scenarios developed.

7.3 Complementary Capacity Scenarios

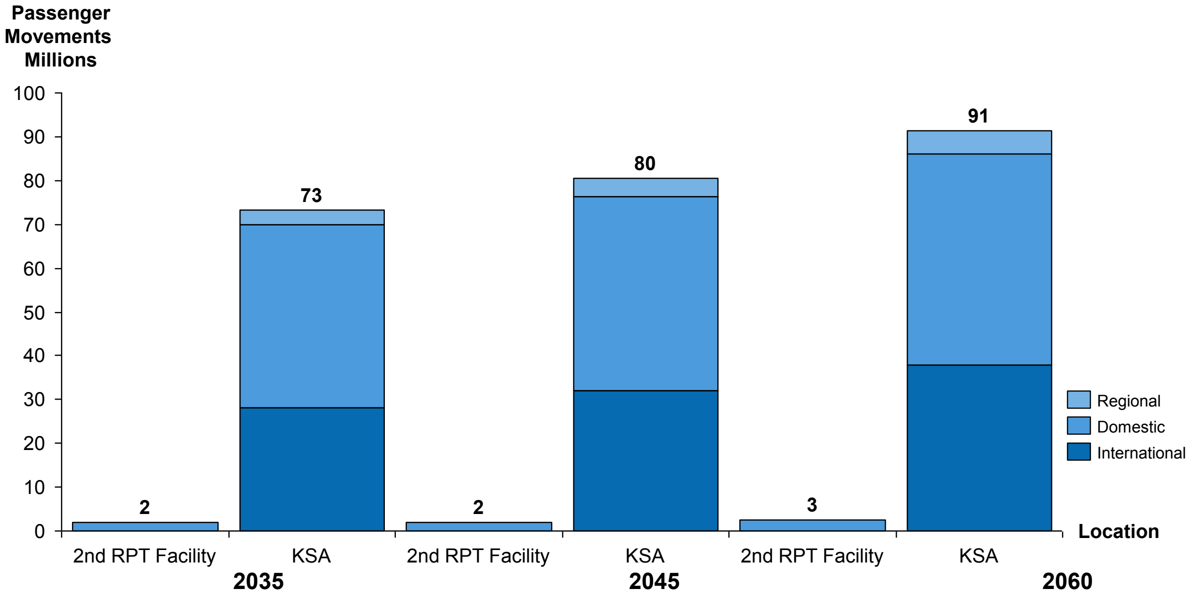
The four scenarios for the development of an additional RPT facility at RAAF Base Richmond were first run under complementary conditions. Under complementary conditions, capacity would be brought on line as unmet demand from Sydney (Kingsford-Smith) Airport warrants it. The initial capacity of the additional RPT facility provides an indication of the scale of the facility and has not been assumed to be a discrete ultimate capacity i.e. the analysis assumes that incremental capacity at an additional RPT facility would be provide to accommodate growth but no step changes in capacity would be made.

7.3.1 Scenario 1 – Low Capacity

The results for Scenario 1 indicate that a total of approximately 2.5 million domestic passengers will be diverted to the aerodrome at Richmond by 2060. This represents approximately 5 per cent of the forecast domestic passenger demand between Sydney (Kingsford-Smith) Airport and Richmond aerodromes and 3 per cent of total passenger demand across all market segments. It was assumed that all international and regional passenger volumes would remain at Sydney (Kingsford-Smith) Airport under this scenario. Under this scenario it is assumed that airlines would target larger domestic markets where the airline could sustainably capture part of the market as opposed to moving individual regional (intrastate) markets away from Sydney (Kingsford-Smith) Airport.

Figure 19 shows the composition of passenger traffic at each of the aerodromes under Scenario 1.

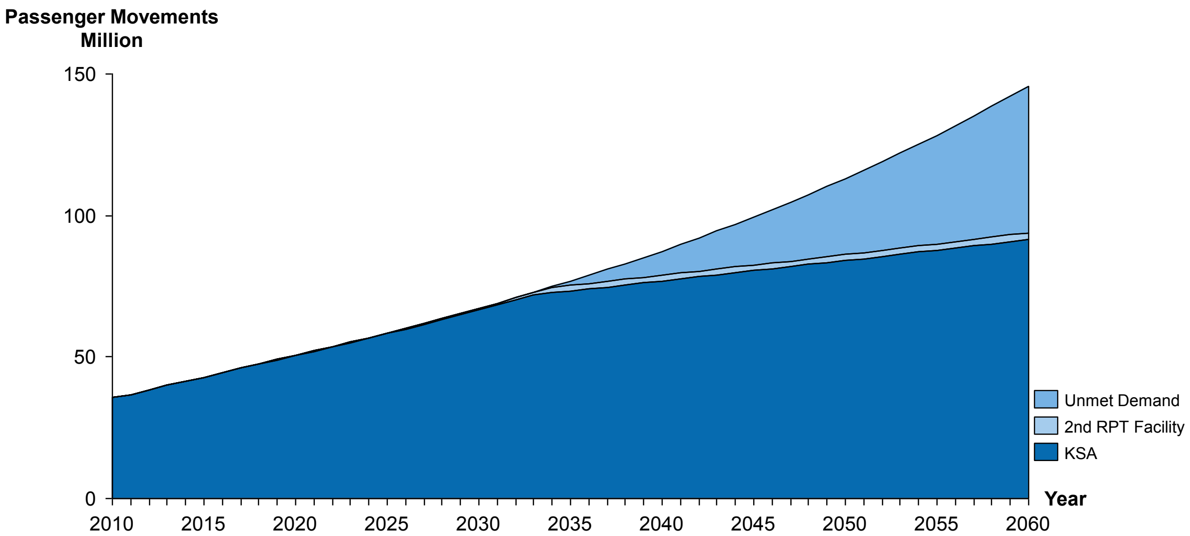
Figure 19: Composition of Passenger Volumes – Scenario 1



Note: The chart only shows met demand at Sydney (Kingsford-Smith) Airport and at an additional major RPT facility.
Source: Booz & Company Demand Forecasts and Patronage Model, 2011

The growth in passenger demand for an additional RPT facility at RAAF Base Richmond between 2010 and 2060 is illustrated in Figure 20. Under this scenario, only a small amount of unmet demand from Sydney (Kingsford-Smith) is captured by an additional RPT facility. Figure 20 illustrates the passenger demand split by airport for the period between 2010 and 2060.

Figure 20: Passenger Demand - Scenario 1



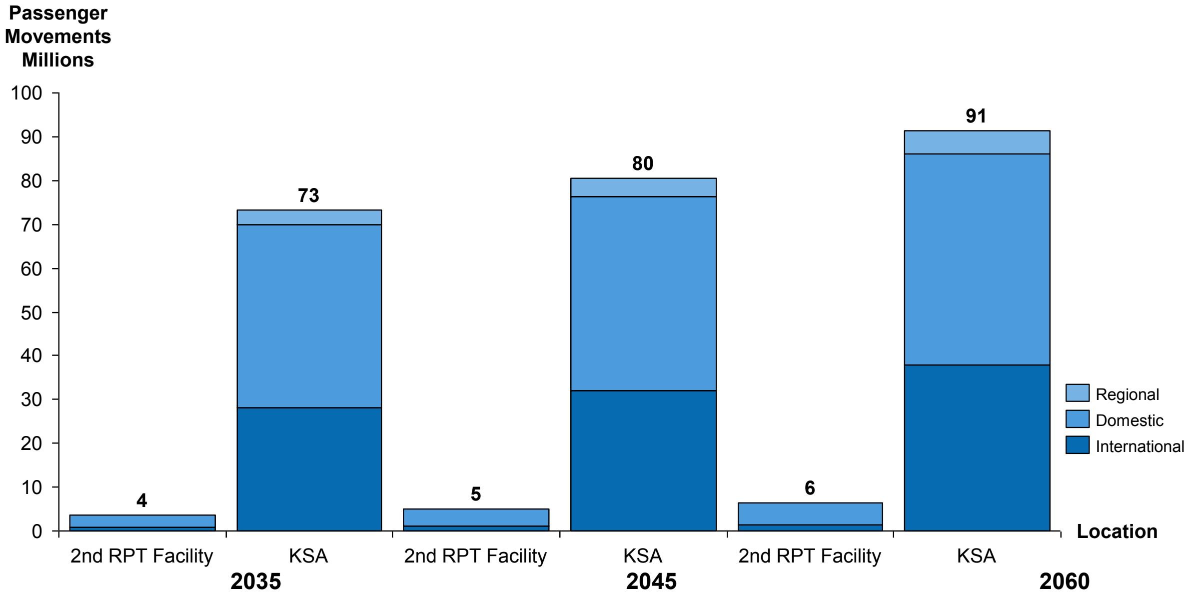
Source: Booz & Company Demand Forecasts and Patronage Model, 2011

7.3.2 Scenario Two – Medium Capacity

The results for Scenario 2 indicate that a total of approximately 6 million domestic and short haul international passengers would be redistributed to the aerodrome at Richmond by 2060. This represents 9.2 per cent of the forecast domestic passenger demand between Sydney

(Kingsford-Smith) Airport and Richmond aerodromes, 3.7 per cent of international passenger demand and 6.5 per cent of total passenger demand at the two airports. Figure 21 shows the composition of passenger traffic across the two airports under Scenario 2.

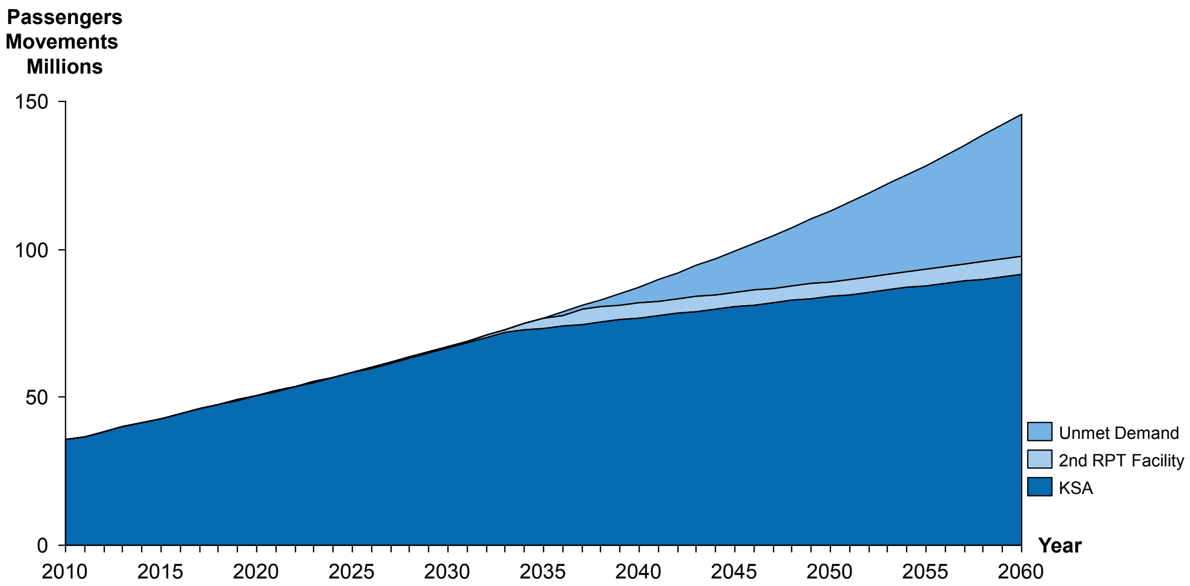
Figure 21: Composition of Passenger Volumes - Scenario 2



Note: The chart only shows met demand at Sydney (Kingsford-Smith) Airport and at an additional major RPT facility.
Source: Booz & Company Demand Forecasts and Patronage Model, 2011

Sydney (Kingsford-Smith) Airport remains the largest airport in Scenario 2; the aerodrome at Richmond represents the third-largest aerodrome in the Sydney Region up until 2027, only preceded by Canberra Airport which is estimated to register the second highest volume of passenger traffic. Figure 22 illustrates the passenger demand split by airport for the period between 2010 and 2060.

Figure 22: Passenger Demand - Scenario 2



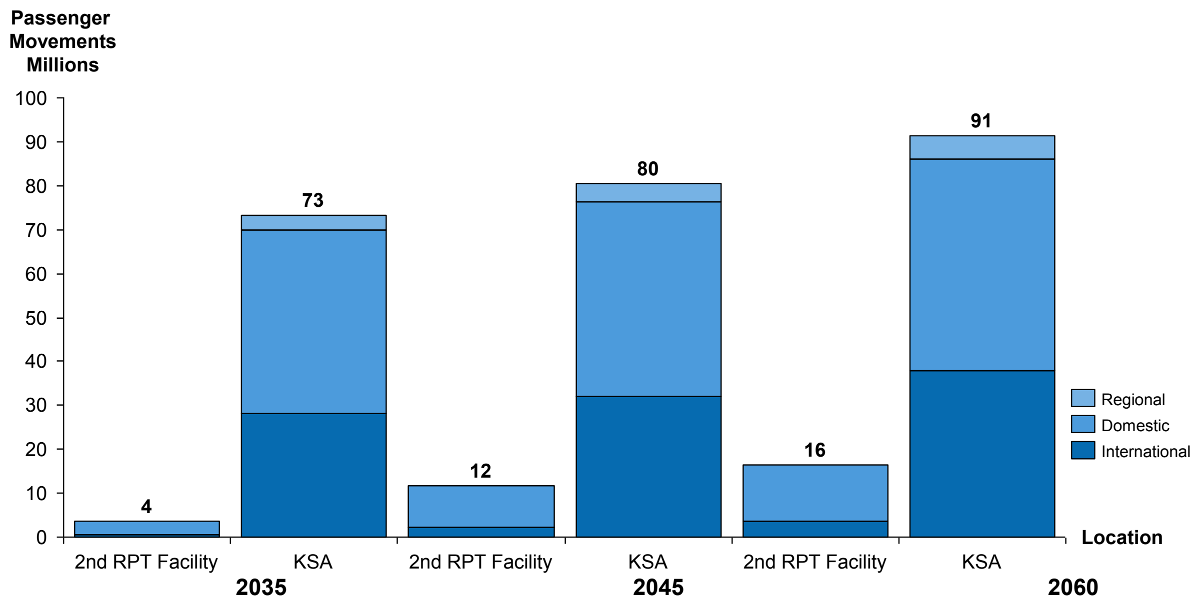
Source: Booz & Company Demand Forecasts and Patronage Model, 2011

7.3.3 Scenario 3 – High Capacity

The results for Scenario 3 indicate that a total of approximately 16 million domestic and short haul international passengers will utilise the aerodrome at Richmond by 2060. In this scenario, the total capacity of the aerodrome at Richmond is 20 million passengers. This represents 21 per cent of the forecast domestic passenger demand between Sydney (Kingsford-Smith) Airport and Richmond aerodromes and 8.5 per cent of the total international passenger demand at the two airports. Overall, a total of 15 per cent of the combined forecast passenger demand would use an additional RPT facility at RAAF Base Richmond.

Figure 23 shows the composition of passenger traffic at each of the airports for each of the airports under Scenario 3.

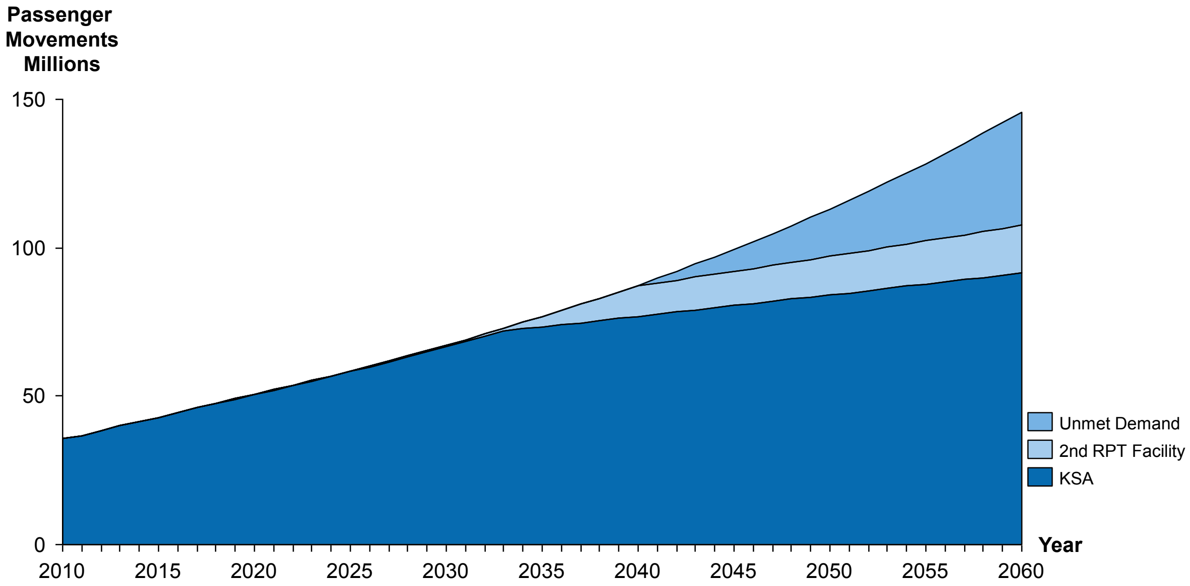
Figure 23 - Composition of Passenger Volumes - Scenario 3



Note: The chart only shows met demand at Sydney (Kingsford-Smith) Airport and at an additional major RPT facility.
Source: Booz & Company Demand Forecasts and Patronage Model, 2011

The growth in passenger demand at aerodrome at Richmond between 2010 and 2060 is illustrated in and Figure 24.

Figure 24 - Passenger Demand - Scenario 3



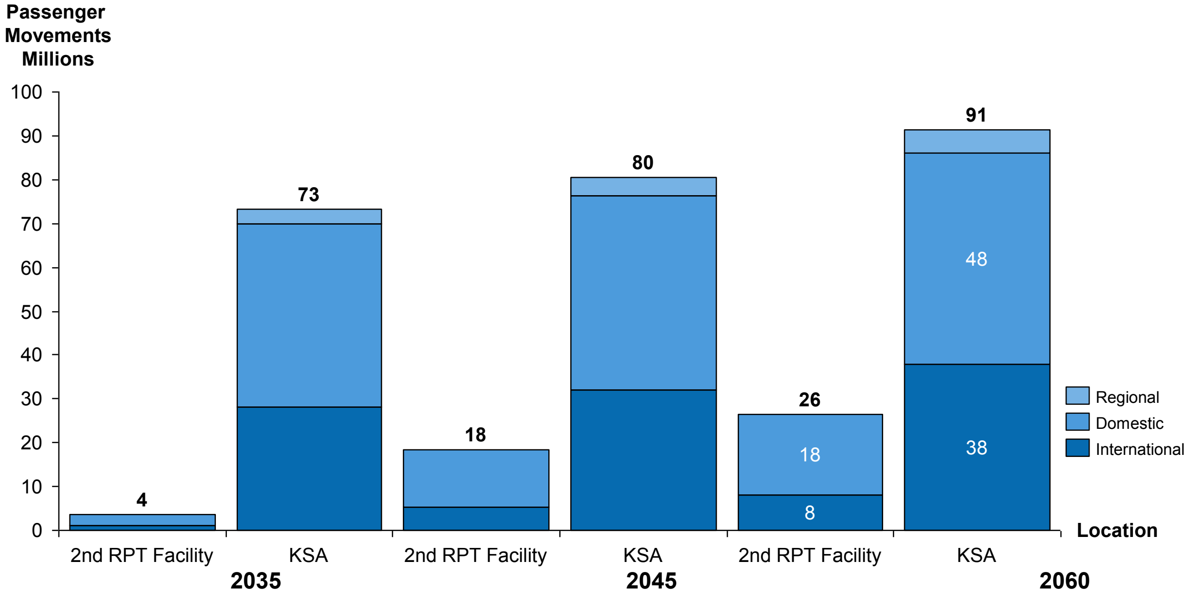
Note: The chart only shows met demand at Sydney (Kingsford-Smith) Airport and at an additional major RPT facility.
Source: Booz & Company Demand Forecasts and Patronage Model, 2011

7.3.4 Scenario Four – High Capacity Tier 2

The results for Scenario 4 indicate that a total of approximately 26 million domestic and short haul international passengers will utilise the additional RPT facility at RAAF Base Richmond by 2060 compared to an ultimate capacity of 30 million passengers per annum. This represents 27.4 per cent of the forecast domestic passenger demand between Sydney (Kingsford-Smith) Airport and Richmond aerodromes and 17.7 per cent of the total international passenger demand at the two airports. Overall, a total of 21.4 per cent of the combined forecast passenger demand utilise the additional RPT facility at the aerodrome at Richmond.

Figure 25 shows the composition of passenger traffic at each of the airports for each of the airports under Scenario 4.

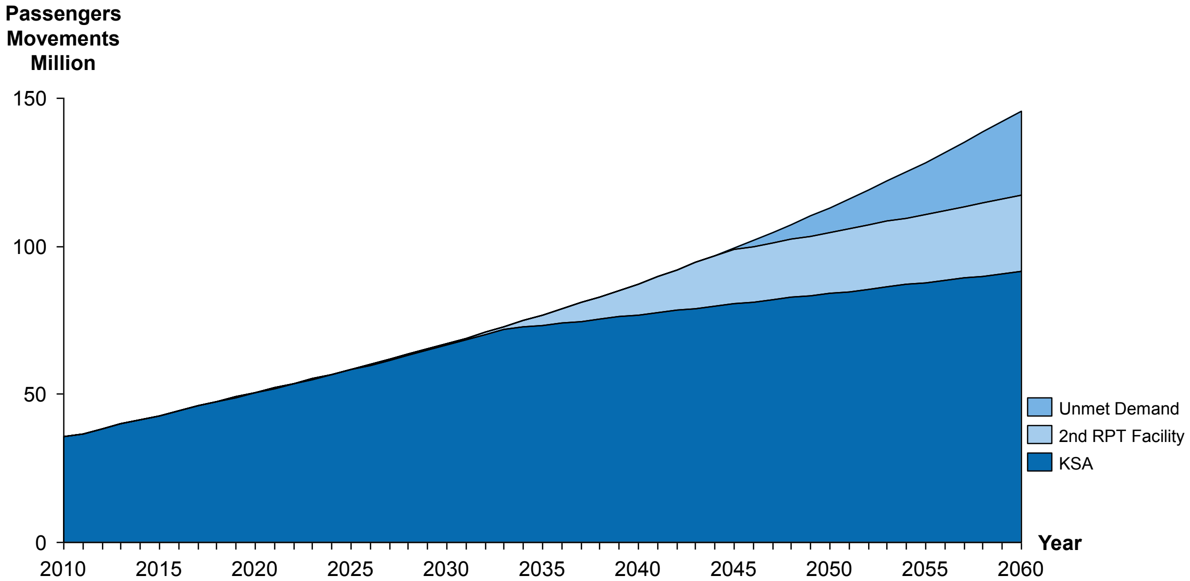
Figure 25: Composition of Passenger Volumes – Scenario 4



Note: The chart only shows met demand at Sydney (Kingsford-Smith) Airport and at an additional major RPT facility.
Source: Booz & Company Demand Forecasts and Patronage Model, 2011

The growth in passenger demand at the aerodrome at Richmond between 2010 and 2060 is illustrated in Figure 26. The extent of unmet demand under Scenario 4 has visibly reduced with only 19 per cent of total demand remaining not catered for.

Figure 26: Passenger Demand - Scenario 4

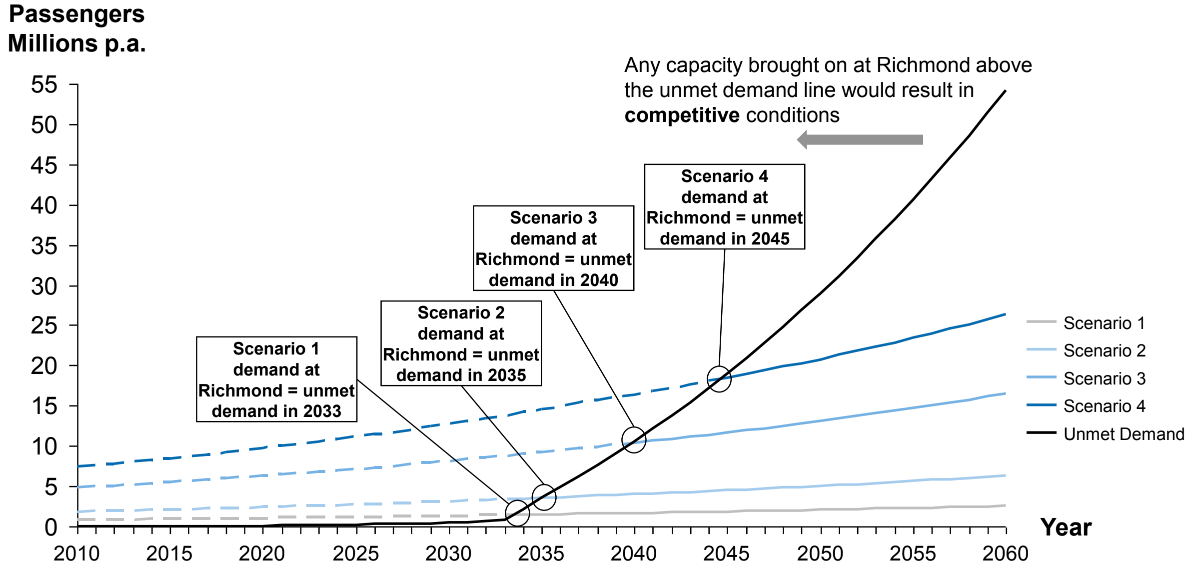


Source: Booz & Company Demand Forecasts and Patronage Model, 2011

7.4 Competitive versus Complementary Airports

The amount of competition between Sydney (Kingsford-Smith) Airport and an additional RPT facility at RAAF Base Richmond depends on the timing of the introduction of additional capacity. Whenever surplus capacity is introduced to the market, competition will increase, hence introducing more capacity than what is needed to accommodate unmet demand at Sydney (Kingsford-Smith) Airport will result some level of competition. Figure 27 shows the year at which an additional RPT facility at RAAF Base Richmond becomes purely complementary to Sydney- (Kingsford-Smith) Airport under each of the four development scenarios.

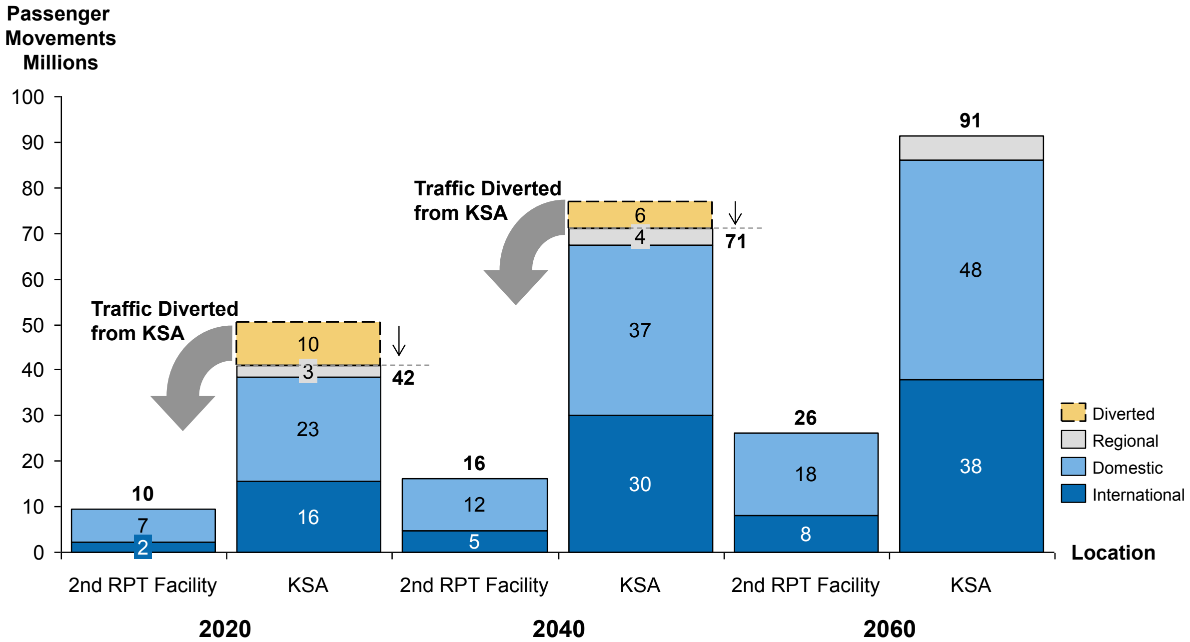
Figure 27: Competitive and Complementary Scenarios



Source: Booz & Company Demand Forecasts and Patronage Model, 2011

Figure 28 shows the amount of passenger traffic diverted away from Sydney (Kingsford-Smith) Airport under a competitive Scenario 4. The analysis indicates that passenger demand at Sydney (Kingsford-Smith) Airport would be 10 million passengers less than the constrained central forecast in 2040 if an additional RPT facility of the scale and standard as described for Scenario 4 is established at RAAF Base Richmond. Scenarios 1 to 3 would have less impact on passenger demand at Sydney (Kingsford-Smith) Airport. No passenger demand is diverted from Sydney (Kingsford-Smith) Airport in 2060 as unconstrained demand is greater than the sum of demand captured by both airports.

Figure 28: Diversion of Passenger Volumes Under Competitive Scenario 4

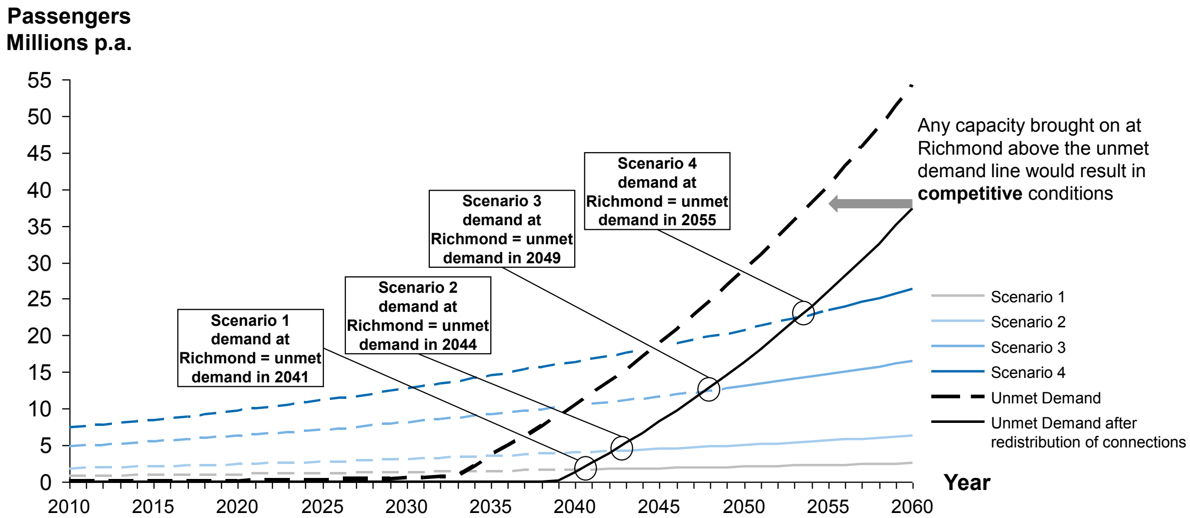


Source: Booz & Company Demand Forecasts and Patronage Model, 2011

7.5 Sensitivity

Redistribution of passengers connecting over Sydney (Kingsford-Smith) Airport to direct services delays the year at which an additional RPT facility at RAAF Base Richmond would be able to operate in a purely complementary manner. The analysis presented in Section 7.3 assumes that connecting traffic is only redistributed to direct services after Sydney region demand is distributed between the two aerodromes, Sydney (Kingsford-Smith) Airport and the additional RPT facility at RAAF Base Richmond. Redistributing connecting passenger movements reduces the amount of unmet demand.. Figure 29 shows the delay of eight years in Sydney (Kingsford-Smith) and an additional RPT facility co-existing under complementary conditions.

Figure 29: Competitive and Complementary Scenarios with Connections Redistributed



8. Limitations

The patronage modeling underpinning the scenario outcomes contained in this report were based on the best available data at the time of the analysis.

The report presents four development scenarios at the aerodrome at Richmond, based on capacity limitations provided by the Department of Infrastructure and Transport in the form of annual passenger volumes. The scenarios were modeled under unconstrained conditions for the two airports and assumed capacity constraints due to policy settings at Sydney (Kingsford-Smith) Airport. The analysis was based on a set of hypothetical conditions for competitive and complementary scenarios based on professional judgment and do not reflect the position of the owners and managers of Sydney (Kingsford-Smith) Airport.

The catchment analysis assumes an even distribution of socioeconomic characteristics across the Sydney region. Therefore the demand responses to the defined scenarios do not take demographic factors into account. For example, the difference in income levels between inner Sydney suburbs and those in the outer west. These factors should be considered in reviewing the forecast demand responses to the alternative scenarios as they are likely to influence the market catchment of each airport.

The demand functions which drive the market share of the two airports under each of the scenarios were based on theoretical analysis informed by the limited number of real examples of airport co-existence in the same catchment. The curves for Scenario 1 was calibrated based on real examples of multiple competing airports within the same catchment, where the additional RPT facility has a much more limited service offering than the primary airport. Scenario 4 assumes that both airports are equally attractive in markets where they compete. The other two scenarios are graduations between the two extremes.

RPT Aviation Operations RAAF Base Richmond North South Runway Scenarios

C9

WorleyParsons
resources & energy

North South Runway Scenarios

Civil RPT Aviation Operations

RAAF Base Richmond

Disclaimer

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CONTENTS

1 INTRODUCTION

1.1 Scope of this Study

As one input to the Sydney Region Aviation Capacity Study, the Department of Infrastructure and Transport (the Department) required an assessment of the likely costs to enable Regular Passenger Transport (RPT) aviation services to operate from RAAF Base Richmond .

The range of RPT operations envisaged by the Department which might operate to/from Richmond range from simple, startup, low cost carrier (LCC) domestic services to international services, implying runway lengths of the order of 2600m to 4000m. The primary issue with continuing to use only the existing 10/28 runway direction is the increased level of aircraft noise on the residents of Richmond and Windsor. A north-south alignment seeks to direct the aircraft noise away from these areas and over the floodplain to the north.

The work follows on from the assessment made of airport infrastructure in the Sydney Region[1] which collected data on 12 airports including Richmond and the draft working paper 'Civil RPT Operations RAAF Base Richmond', which considered use of the existing 10/28 runway for civil operations.

In particular, the scope of the work was to consider:

- The costs to aviation assets and supporting infrastructure associated with the concept of constructing a new runway on a north – south alignment at the existing RAAF Base Richmond;
- Costs to land transport to support air traffic;
- Other factors which arise in establishing a civil aviation operation at RAAF Base Richmond; and
- The scale of investment which would be required to permit RPT operations.

In this study, a notionally north-south runway alignment is considered which would effectively be a cross runway to the existing 10/28 runway used by RAAF.

Some of the reasons why the Department considered that a north-south runway at Richmond might be an attractive proposition and should be investigated include that:

- the existing 10/28 (east/west) runway was operationally constrained;
- RPT activity at the airport could have a reduced environmental impact by operating on a north-south runway;
- airborne conflict with existing Sydney (Kingsford-Smith) Airport traffic patterns may be more easily addressed thus enhancing safety over RPT operation on the 10/28 runway;
- the need for aircraft to cross an active runway when taxiing to/from terminals could be avoided (unless, as preferred by RAAF, a full southern taxiway to runway 10/28 was implemented);

[1] *"Airport Infrastructure in the Sydney Region" WorleyParsons / AMPC for the Department of Infrastructure and Transport .*

- that an additional runway could significantly boost capacity and travel options for the Sydney Region; and
- overall, the addition of a north-south runway would enhance safety, efficiency and environmental performance if RPT operations were to be introduced at Richmond.

1.2 General Planning Objectives for Secondary Scale Airports

Commercial success and sustainability of LCC's is generally predicated on their use of secondary airports at which they incur low operating costs as a result of:

- Secondary airports being less busy, leading to fewer delays;
- Taxiing times and surface movement delays are generally shorter;
- Aircraft can use free moving (power in/power out) operations if apron size permits;[2]
- There are generally lower airport user costs and charges as a result of lower investment in infrastructure;
- There is reduced direct competition with established traditional airlines;
- Ground access may be less congested; and
- Reduced car parking costs possible.

In developing options for Richmond, these considerations should be taken into account to the extent possible.

Avalon and Newcastle have demonstrated that LCC passenger services at secondary airports in relative close proximity their major capitals are sustainable. Avalon with its distance to the Melbourne CBD of 55 km and road travel time of 47 minutes is not significantly different to Richmond's distance of 65 km and 1 hour and 5 minute road travel time to the Sydney CBD. Newcastle on the other hand is developing a specific regional market focussed mainly on interstate city pairs.

1.3 General Qualifications

The following general qualifications apply to the concepts for airports described herein and should be noted when this report is reviewed:

Forecasts or Demand thresholds – prepared only to provide a framework to guide development of possible conceptual layouts and are not intended as a formal forecast for the future use of Richmond Airport;

Review of the OLS – is based on a desktop study of 1:25,000 topographic maps, and does not address obstacles other than terrain such as trees, power lines, towers, masts etc. A detailed survey would be required should any concept be developed to the next stage;

PANS-OPS - have not been addressed and a detailed survey would be required should any concept be developed to the next stage;

---

[2] However, as noted later, constraints at Richmond mean power in - push out have been adopted to maximise space available on the apron.

Explosives – the specific safety templates applicable to the type and quantity of explosives stored or being handled require separate assessment by Defence. The clearances shown in the report are indicative only and to show that the overall issue has been recognised;

RAAF requirements –one for one replacement of affected RAAF facilities has been assumed. RAAF will need to determine its requirements in greater detail; RAAF feedback as received for earlier work on usage of the existing runway has been interpreted in the context of a north-south runway but requires further RAAF input to validate this;

Airspace interaction – potential airspace conflicts near Hornsby (refer Figure 3.9) have been identified. It is assumed that the conflicts with the existing airspace arrangements are manageable, but this requires separate review and assessment by Defence, CASA OAR and Airservices Australia;

Publicly available data from ERSA has been relied upon;

Specific site issues such as any environmental, heritage or contaminated sites and the like have not been specifically addressed in detail in the report although, to the extent possible, concepts have responded to those constraints that were known;

Flood management **-** it is assumed that the area of the site for any north-south runaway and the proposed earthworks at Rickaby's Creek can be demonstrated to be manageable in regard to flood management. More detailed work would be required to further consider this issue, if the decision is made to advance the concept to a next stage;

Cost estimates are high level budget figures intended only to indicate the overall order of costs and should not be used for any other purpose. The costs have been prepared without site survey, geotechnical data and detailed planning such as airport master grading or design of pavements or services for the quantification of volumes. The quantities and rates are indicative and are based on available information at the time of writing the report, and will be subject to change over time;

Publically available unit rate sources such as Rawlinson were used as applicable or as part of developing rates; and

Industry rates were also used (note some information is based on commercial in confidence information).

1.4 Strategic Context of Richmond

1.4.1 In its Defence Role

RAAF Base Richmond is located approximately 48 km north-west of the Sydney CBD and is accessed from Percival Street off Richmond Road. The towns of Windsor and Richmond lie to the immediate east and west of the airport respectively. It is the RAAF's only operational air base in the Sydney Basin and is an integral part of an established logistics chain for the transportation of Defence personnel and materiel.

Currently, the only flying squadron is 37SQN operating the C-130H/J Hercules. These aircraft provide a vital air mobility capability for the Australian Defence Force (ADF). RAAF Base Richmond is also home to Headquarters Air Lift Group, which is responsible for the ADF air mobility aircraft. The base also accommodates a further number of support units, including the Air Mobility Control Centre which is the central tasking agency for airlift operations across the ADF. Other transport assets of the RAAF such as the C-17, BBJ, Challenger and forthcoming KC-30A multi role tanker transport (MRTT) use the base, as required, as do other ADF elements (including fast jets). The base also supports air drop and parachute training as well as itinerant foreign military aircraft operations and the USAF.

Statistics provided by the Department of Defence show there were 5,318 military aircraft movements in 2009. There were 7,513 civil transits of Richmond airspace and the base is used during the bushfire season for fire fighting helicopter operations. Helicopter transits between Holsworthy and Richmond are also undertaken.

The base is commonly used for:

- Transit of explosive ordnance from Defence Establishment Orchard Hills;
- A point of exit for air medical evacuation (AME), disaster relief and combat forces;
- A point of delivery for repatriation for wounded or deceased personnel; and
- A divert for fighter aircraft from Williamtown.

Industry is an important part of the RAAF Base Richmond community. Amongst the private industry partners at the base are Australian Aerospace and Qantas Defence Services, which both provide aircraft maintenance services for Defence, as well as contracted partners Serco, Sodexo, Defence Maintenance Management, Childcare Centre, Frontline (Australian Commercial Catering), Lockheed Martin, Standard Aero and Jacobs Australia.

Civil operations are not undertaken on a regular basis, although the following activities occur:

- RAAF Richmond Gliding Club which operates on weekends and public holidays;
- Aeroclub flying on weekends; and
- Use of the Instrument Landing System (ILS) for flying training purposes.

Figure 1.1 depicts the main elements and layout of the airport.

Source: Base Image Google Earth Pro 2010 (Image Date January 2007)
Figure 1.1 – Airport Layout

1.4.2 In the Sydney Metropolitan Region

In terms of its physical location, Richmond is at the north-western extremity of metropolitan Sydney and accordingly at the north-western edge of one of the fastest growing regions in the metropolitan area.

Figure 1.2 shows its location in the context of the current metropolitan planning strategy for Sydney.

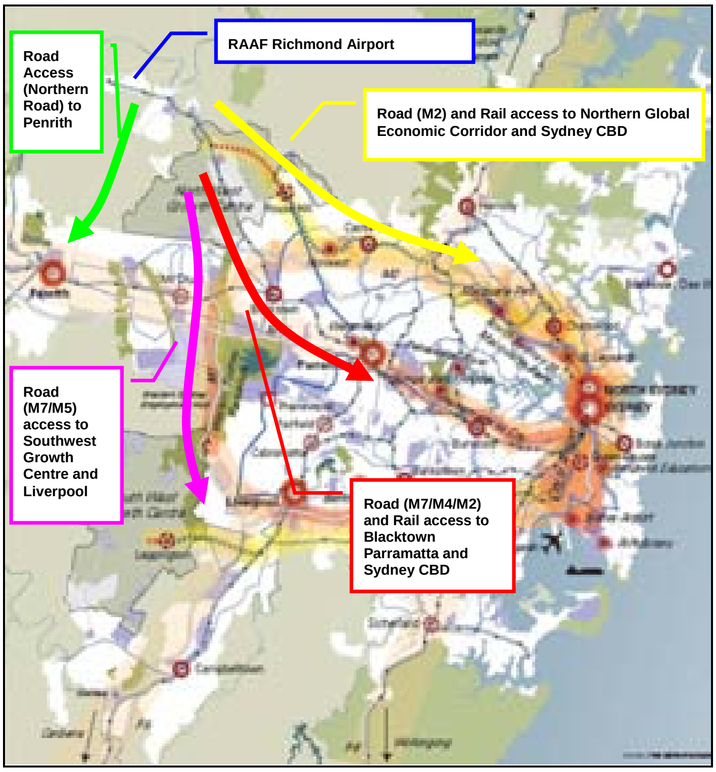


Figure 1.2 Strategic Context of Richmond Airport

Base Map Source: Metropolitan Strategy

This figure shows that Richmond is accessible to many of the major centres of growth in population and economic activity in the western parts of Sydney - in most instances via over Freeway standard roads.

Additionally, Richmond is directly accessible by road from urban centres such as the Blue Mountains townships, Penrith, as well as Lithgow, Bathurst and Orange beyond the Blue Mountains. Bathurst and Orange are currently served by Regional Express (REX) services direct to Sydney (KSA) Airport.

A further key context issue for Richmond Airport is its close proximity to the Richmond rail line. This line is currently undergoing considerable capacity upgrades and, according to 'The NSW Metropolitan Transport Plan, February 2010' will form a part of the proposed Western Express operational sector. This would allow direct rail services from Richmond to the major growth centres of Blacktown, Parramatta, Burwood and the major CBD stations of Central, Town Hall and Wynyard. Connecting rail services can be made to Penrith, Liverpool, and Campbelltown.

Additionally, should the North-West rail link project be completed and connected to the Richmond line as has been proposed, then there will be direct rail service to the designated growth centres of Rouse Hill, Castle Hill and the major employment centres of Norwest, Macquarie Park, Chatswood, and North Sydney .

A rail connection with Sydney (Kingsford-Smith) Airport could be made at Central, by interchanging from the Richmond Line service to the Airport Line service and vice versa.

1.5 Consultation with RAAF and Defence

On 9 September 2010, a presentation of the concepts for development of a civil precinct using the existing 10/28 runway at Richmond was given to representatives of the Department of Defence, representatives of senior RAAF officers and RAAF Richmond based officers. While these discussions were specifically in respect of civil usage of the existing runway, the comments received from Defence remain germane to consideration of the north-south runway development.

The key issues identified by RAAF and Defence in respect of civil usage of Richmond are as follows (with interpretation as appropriate to address a north-south runway):

- RAAF must be able to continue all current activities which occur at Richmond in a secure manner, being:
  - Unimpeded C-130 operations;
  - Movement of Explosive Ordnance;
  - Fighter aircraft diversion;
  - Allied air transport support;
- The Ordnance loading area (OLA) would have to be relocated from its current position and cannot be located further to the north of its existing position (as it is then within 800m of the civil housing development to northwest of the Base. In any event, the OLA could not to be located in that manner because there would be a direct clash with the north-south runway development and operations;
- A location in Rickaby's Creek area for the OLA appears feasible, but expensive to construct (due to the extent of earthworks required and extended taxiways);

- If taxiway Zulu is reconstructed in a position north of its current position in order to increase separation from the runway, there appears to still be adequate apron parking space for RAAF requirement. If additional space was required, it would be preferred in the Rickaby's Creek drop zone;
- Of all the scenarios for operating a civil capability at Richmond, RAAF expressed a preference for an arrangement which provided the maximum separation of civilian activities from those of the Defence and RAAF (in similar manner to Williamtown), as well as locating the OLA in the preferred location – i.e. placement of all civil activities on the opposite side of runway 10/28;
- Defence noted that it did not consider scenarios which adopted the precondition of RAAF having vacated the site – this was interpreted as indicating RAAF's intention to remain at Richmond for the foreseeable future;
- Defence suggested that in the first instance the requirement for a 300m wide strip on runway 10/28 could be accommodated by managing the parking of aircraft on the RAAF apron and by ATC management of aircraft usage of the existing Taxiway Zulu. If possible then, this could enable reconstruction of Taxi way Zulu to be deferred and/or staged;
- In the event of civil operations occurring at Richmond, RAAF expressed the view that GA light aircraft traffic would not be compatible with C130 operations, but some forms of Business jet activities could be possible.

The following Figure 1.3 summarises these constraints.

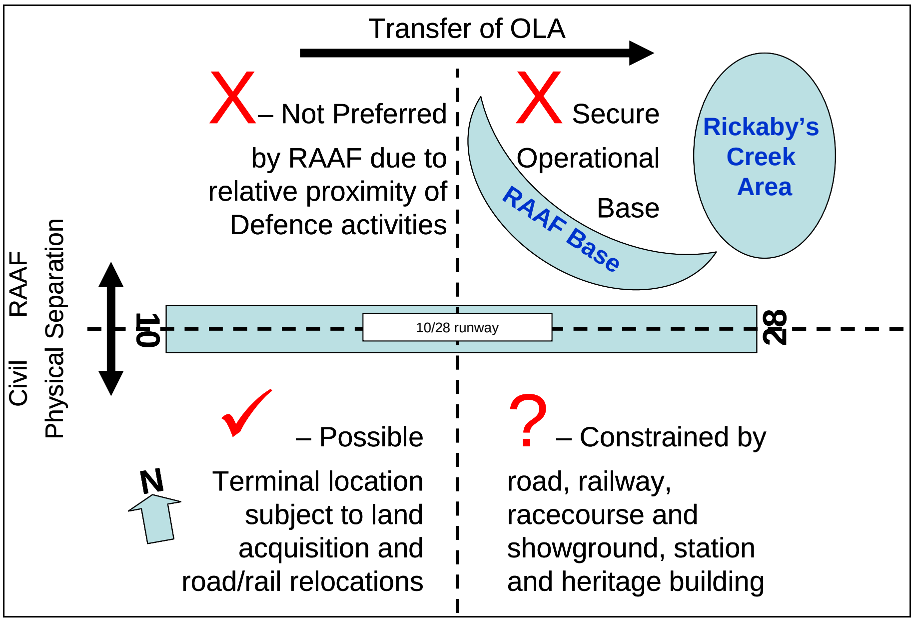


Figure 1.3 Basic constraints at RAAF Richmond

1.6 Basic assumptions and constraints on a North-South Runway.

The following Figure 1.4 indicates some of the planning key issues in siting and orienting a notionally north-south runway, either partially or wholly on the RAAF Richmond Airbase, and provides a discussion on each of the key issues.

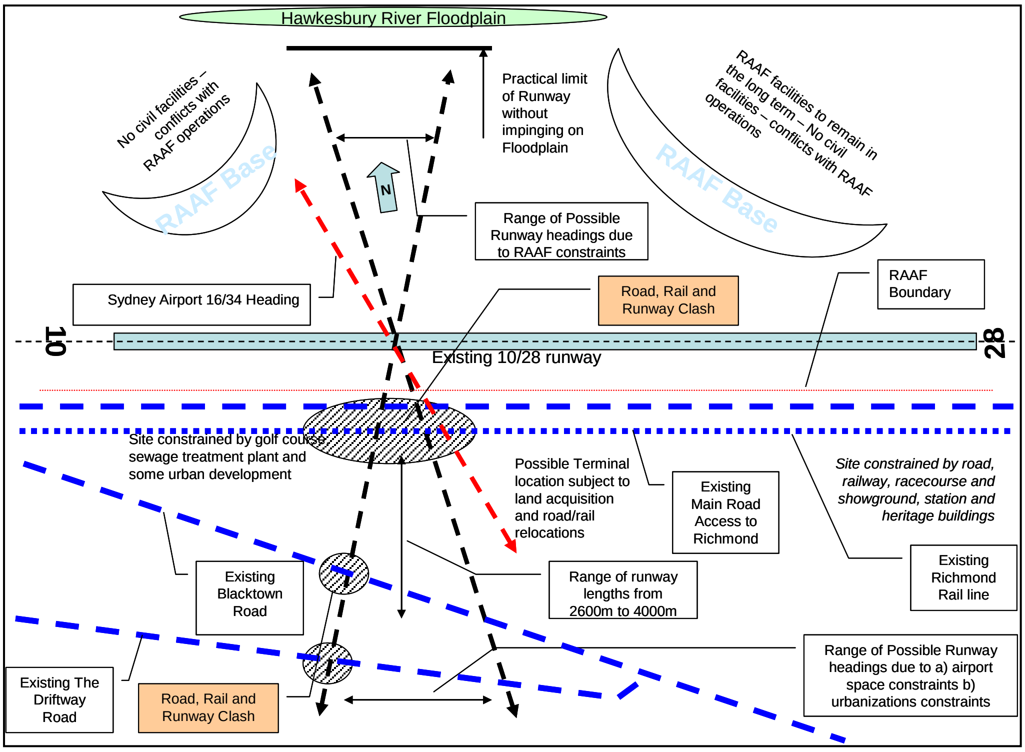


Figure 1.4 Runway Location Planning Issues

1.6.1 Runway Orientation

The runway has been selected on an orientation of 01/19 on the basis of the following key reasons:

- An orientation that is close or as close as possible to being parallel to Sydney (Kingsford-Smith) Airport's 16/34 runway;
- An orientation that would avoid, or reduce as far as practical, over flight of existing urban areas within 9-10 kms of the ends of the runway;
- A limitation on any further clockwise rotation of the runway, due to high terrain at the south-west corner of the obstacle limitation surface (OLS) and the possible movement of noise contours onto existing Richmond urban areas;
- A limitation on any further clockwise/anticlockwise rotation due noise (N70 exposures) starting to impact on the northern parts of Penrith, plus the village of Freeman's Reach;
- A limitation on any further anticlockwise rotation to any great extent a) due increasing likelihood of conflicting with Orchard Hills explosives storage restricted area and b) so as to avoid impacting/restricting the existing RAAF BASE Richmond (note assumed inclusion of parallel taxiways and navigational aids).

In addition to these reasons, there are limited orientations which can be fitted into the land space at the northern end of the RAAF base, while still maintaining the required clearances. A runway orientation of 01/19 is quite possibly the only one which is able to address all of these constraints to a reasonable degree of acceptability.

Further information showing these constraints is provided in the proposed development concepts (attached).

1.6.2 Runway Position

At the northern end of the RAAF base, beyond Percival St, the ground drops away steeply to the floodplain of the Hawkesbury River. To extend the runway beyond the RAAF's current northern boundary would require formation of either an earthen embankment or structural platform. It would need to be up to 9 metres in height and at least 500m wide in order to accommodate the graded runway strip, navigational aids (critical areas), parallel taxiways, perimeter road, RESA and alike. While an extension of this form is possible in an engineering sense, it would need to be considered in terms of posing a constriction on the movement of flood waters through the Hawkesbury River floodplain. For the purposes of this study only it has not been considered further, although it could be if there are other major issues at the southern end of any runway which warrant it.

Other possible constraints on runway location are:

- Clearances to any RAAF installations and operational areas for security purposes;
- To the south, the presence of Blacktown Road and The Driftway Road which is a flood evacuation route from Richmond.
- Infrastructure, such as Richmond Sewage Treatment Plant;
- Public amenities such as the Hawkesbury Showground and Racecourse and Richmond Golf Club; and
- Educational facilities at University of Western Sydney's Hawkesbury Campus.

A runway of at least 2600m, and a northern limit of any runway within the existing RAAF boundary would require an extension to the south, at the very least across Hawkesbury Valley Way and the railway.

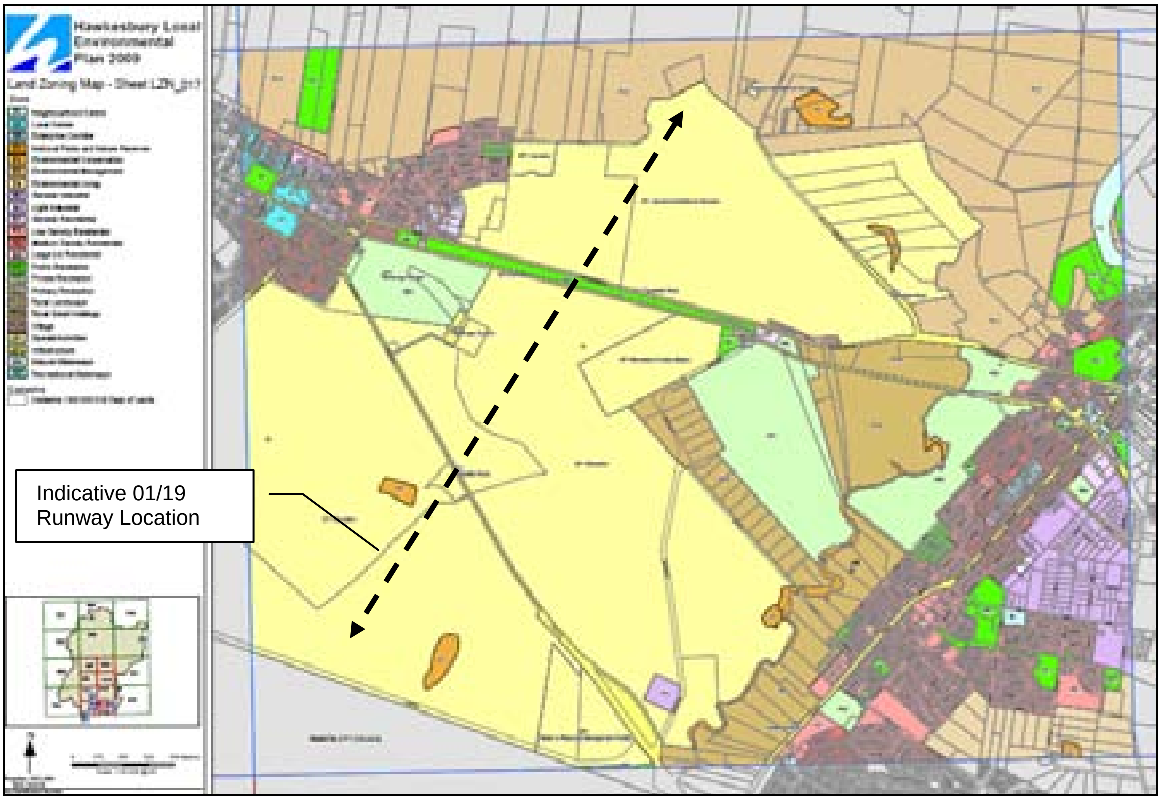
1.6.3 Existing Transportation

The key transportation links which would be affected by a north-south runway are:

- Hawkesbury Valley Way – which is the main route linking the townships of Richmond and Windsor – and which connects to the major arterial of Windsor Road, leading back to the Northwest growth sector of Sydney; and to Kurrajong Road / Bells Line of Road which is the alternate crossing of the Blue Mountains;
- The Richmond rail line which runs parallel to and immediately south of Hawkesbury Valley Way and terminates in Richmond – there are two stations which, while not directly affected, are possibly affected by any change in the alignment of the railway line – East Richmond to the west and Clarendon to east. The Richmond Line provides direct rail access to Blacktown, Parramatta and the Sydney CBD, and connections to other parts of the metropolitan railway network, including the Airport Rail Link at Central Station;
- Blacktown Road, which is the second major route providing connectivity of Richmond to the Sydney metropolitan area, and is the most direct connection to the M2/M7 motorway system;
- The Driftway Road, which lies further to the south from Blacktown Road and is part of the of the designated flood evacuation route system for Richmond.

1.6.4 Land Uses

The 2009 LEP for the locality around RAAF Richmond is shown in Figure 1.5.



Source: Hawkesbury Shire Local Environmental Plan 2009

Figure 1.5 Land Uses around RAAF Richmond

The land on which a 01/19 runway and airport infrastructure would be principally located (and which does not lie within the existing RAAF Base), comprises all of part of, depending upon the runway length adopted the following land uses:

- The road reserve for Hawkesbury Valley Way (SP2 Classified Road);
- Ham Common Bicentenary Park (RE1 Public Recreation);
- The railway reserve (SP2 Railways);
- The Clarendon paddocks of the University of Western Sydney (SP1 Education);
- Blacktown Road reserve (SP2 Classified Road);
- The Blacktown Paddocks of the University of Western Sydney (SP1 Education); and
- The Driftway reserve (SP1 Education).

Other land uses which would not necessarily be directly physically affected by airport development, but which may be affected as a result of an adjustment of infrastructure include:

- Near Clarendon station - parcels of land zoned:
    - 1) RE1 Public Recreation;

   - 2) SP2 Electricity Generating Works;
   - 3) IN2 General Industrial;
   - 4) R2 Low Density Residential; and
   - 5) RU4 Rural Small holdings;
- Hawkesbury Show Ground (SP1 - Recreation Facility Major);
- Clarendon Race Course (RE2 – Private recreation);
- Lands along Race Course road and Rickaby's road (RU4 Rural Small holdings);
- Within the Blacktown Paddocks are two small areas zoned E2 Environmental Conservation;
- Richmond golf Course (RE2 – Private recreation); and
- The Richmond Sewage Treatment works (SP2 Sewerage System).

As indicated in Figure 1.5 the significant majority of land affected by a 01/19 runway is that which forms part of the University of Western Sydney agricultural lands.

2 AIRPORT DEVELOPMENT SCENARIOS

2.1 RPT passenger

A set of basic development scenarios have been developed to examine how difference levels of service could be accommodated at Richmond by a new runway on a notionally north-south alignment. Different lengths of runways are needed to enable differing types of air service to be operated, according to the type of aircraft required and the takeoff and landing runway lengths needed for that aircraft type to operate. The following service options have been considered:

- Essentially domestic reliever capacity similar to the operating scenario suggested in the earlier Worley Parsons/AMPC report on usage of the existing runway, commencing with a basics startup operation – e.g. services operated by a Code C aircraft such as B737/A320 for interstate (LCC) type operations, with typical routes being to the Gold Coast and Melbourne;
- Limited international plus domestic and regional traffic operated by aircraft such as Code E (e.g. the A330 and B787 for international), Code C which encapsulates the full range of medium narrow body jet aircraft (e.g. the B737 and A320 series), and the Code D DHC8-400 for regional traffic (with typical international routes including South East Asian ports such as Singapore, Hong Kong); and
- Full international, domestic and regional traffic (e.g. services operated by aircraft up to and including the Code F A380), to operate on long haul international operations, as well as full domestic and regional traffic with international routes extending to ports such as Los Angeles.

The key infrastructure to support those service forms is the runway length and configuration. The runway lengths needed to be chosen to enable the above three broad types of operating scenarios.

Accordingly, four basic runway operating lengths options have been identified as follows:

- Option A1 - Domestic Reliever - 2,600m (part on - RAAF Base);
- Option A2 - Domestic Reliever - 2,600m (fully off - RAAF base);
- Option B - Domestic Reliever - 2,800m (part on - RAAF base) Note: The operational differences between a 2,600m and 2,800m long runway are not of such significance as would suggest notionally different traffic types;
- Option C - Limited international - 3,000m (part on - RAAF base);
- Option D - Full international - 4,000m (part on - RAAF base);

Associated with each of these would be differing standards of landside facilities according to passenger demand and throughput.

2.2 Freight

The potential for Richmond to handle air freight traffic has been raised in the past in the context of enhanced civil operations. LCC passenger operations as outlined above would probably involve relatively low belly freight volumes of time critical items. The potential for dedicated freight operations is considered less likely, other than niche-type services capable of operating from the options with the shorter runway lengths (2,600m). Runway length would be a limiting factor in being able to facilitate dedicated international freight aircraft. These aircraft are generally heavy wide bodied Code 4D/E aircraft such as B747 and MD11, requiring significant runway lengths, such as would be available with Option D (4,000m long runway). In any event, the numbers of these aircraft operating through Sydney (Kingsford-Smith) Airport is relatively small, in comparison to passenger aircraft. As noted in Sydney Airport Corporation Limited's current Master Plan, over 80% of freight is carried in holds of passenger aircraft. For the purpose of the development concepts presented below, provision has been made for a small dedicated freight operation in Options A1, A2, B and C and a larger facility for Option D.

2.3 General aviation and other related activities

Additionally, the Brief requests that consideration be given in the development of concepts for general aviation. This could be considered to include small scale civil aircraft maintenance activities. It is relevant to note, however, that no civil general aviation currently takes place at RAAF Richmond. Discussion of this issue with RAAF indicated that they would not accept usage of the airport by private owners, flying schools and the like, but might consider larger executive jet charters and heavy maintenance on larger aircraft (which for example that cannot be undertaken at Bankstown).

2.4 RAAF Operations

As noted earlier, it is assumed that the RAAF operations will continue at RAAF Base Richmond on the northern side of the existing runway. To the maximum extent, the civil development will be planned to minimise any impact on the existing military operations.

Based on the findings from the *"Draft Working Paper Civil RPT Operations RAAF Base Richmond"* report and Defence's comments thereon, it is assumed that it will be possible to relocate the OLA to the land zoned "Special Uses 1 Aerodrome – Defence Services" north of Percival St and within the flood plain area of Rickaby's Creek and to develop the area in the north west quadrant of the base for the runway component of civil facilities. This is basically along the line of an existing grassed landing area which had, in the past, been used by Caribou aircraft.

2.5 Notional Passenger Throughputs

The development concepts presented in this report indicate the level of infrastructure required to support civil operations, catering initially for approximately 5 million passengers per annum in a start-up mode and with the capability to expand over time (to the levels of patronage indicated below as used for noise studies). For the purpose only of assessing infrastructure demand requirements and preparing indicative Australian Noise Exposure Concepts (ANEC), it is necessary to identify air traffic passenger demand levels, fleet mix and aircraft movements for each of the above options. The following has been assumed:

- Options A1, A2 and B - 20 million passengers per annum;
- Option C - 25 million passengers per annum; and
- Option D - 30 million passengers per annum.

Chapter 5 details the air traffic forecasts underpinning this passenger throughput assumption.

2.6 Design Aircraft

2.6.1 Primary Design Aircraft

For Options A1, A2 and B the primary design aircraft adopted for this study is Code C which encapsulates the full range of medium narrow body jet aircraft such as the B737 and A320 series, as well as the smaller EMB-190. The B737 and A320 series can have passenger capacities of up to about 210, while the EMB - 190 has seating up to 104. The major critical dimensional characteristics are:

- Wing span 36m (based on B737 series with winglets);
- Length 44.5m (based on A321); and
- Fin height 12.6m (based on B737 series).

Figure 2.1 - B737 and A320 Aircraft

Figure 2.2- Embraer 190 Aircraft

For Option C the primary design aircraft adopted for this study is the Code E, such as the A330 and B787 for international; Code C which encapsulates the full range of medium narrow body jet aircraft such as the B737 and A320 series; and the Code D DHC8-400 for regional traffic. The A330 series can have passenger capacities of up to about 300 whereas the DHC8-400 has seating up to 75. The major critical dimensional characteristics for the A330/B787 are:

Figure 2.3 – Boeing B787 Aircraft

Source: http://787flighttest.com/

The major critical dimensional characteristics are:

- Wing span - 65m (noting the A330 and B787 series are both slightly smaller at just over 60m);
- Length - 63.6 (based on A330-300); and
- Fin height - 17.4m (based on A330-200).

For Option D, the primary design aircraft adopted for this study is Code F (such as the A380), as well as the smaller types above. The major critical dimensional characteristics are:

- Wing span - 79.75m;
- Length - 72.73m; and
- Fin height - 24.09m.

Figure 2.4 A380 Aircraft

2.6.2 Airport Planning Standards and Requirements

The Civil Aviation Safety Authority's (CASA) "*Manual of Standards Part 139 – Aerodromes"* (MOS) prescribes the physical geometric standards applicable to civil aerodrome operations. Relevant standards applicable to the design aircraft are shown in **Table 3.1**.

Table 3.1 – Geometric Standards

Element	Code F	Code E	Code C
Runway centreline to taxiway centreline (precision approach)	190m	182.5m[3]	168m[4]
Taxiway centreline to taxiway centreline	97.5m	80m	44m
Taxiway centreline to object	57.5m	47.5m	26m
Parking position taxi lane to object	50.5m	42.5m	24.5m
Apron wingtip clearance	7.5m	7.5m	4.5m

Source: CASA 2004.

2.6.3 Apron Geometric Setout

For the purpose of the development concepts presented below, a power-in/push-out configuration has been assumed which minimises the length of apron required. This does add to an airline's operating costs but is used at airports such as Gold Coast which is largely serviced by LCC's.

2.7 Indicative Runway Layouts

Figures 2.5 to 2.9 show indicative runway layouts for each of the options.

Of these, A2 is possibly the least favoured because:

- The intention is to permit the eventual expansion of the runway option from 2,600m up to 4,000m length. The other options are more suitable in allowing extension of the runway at the southern end rather than affecting both runway ends;
- Starting the runway at the northern end of RAAF base Richmond also minimizes noise on residential areas to the south west; and
- The runway and movement area still need to be physically connected to the existing airport taxiway system (which still involves severance of the existing road and railway line).

[3] Note 1: based on a 300m wide runway strip.

[4] Ibid.

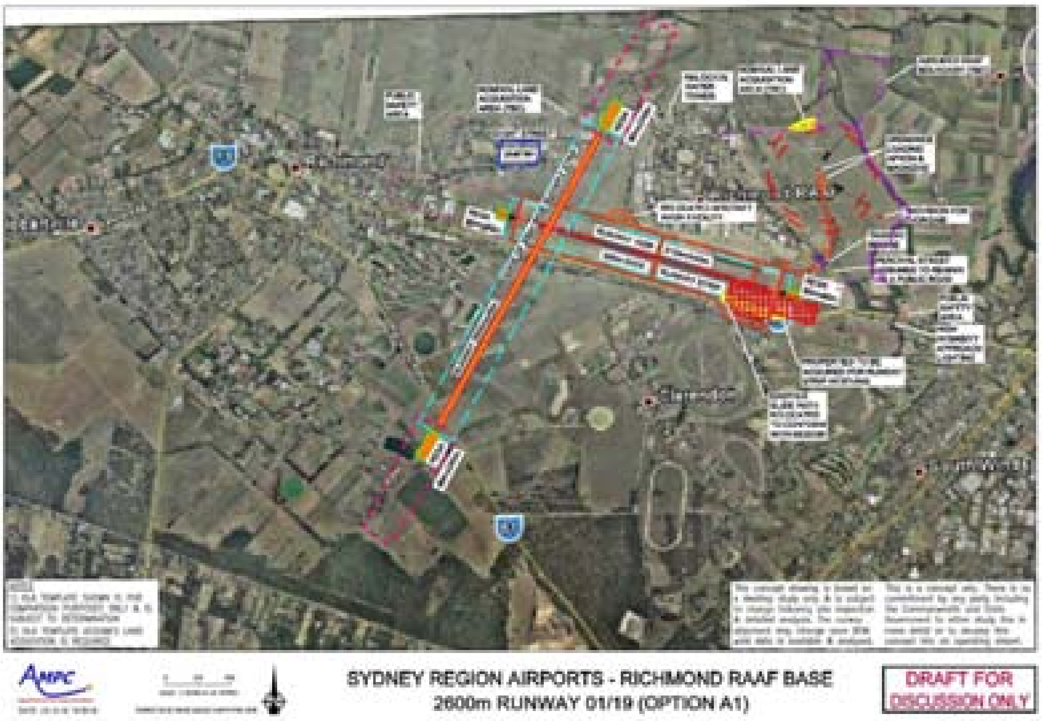


Figure 2.5 Option A1 2,600m (part on-Base)

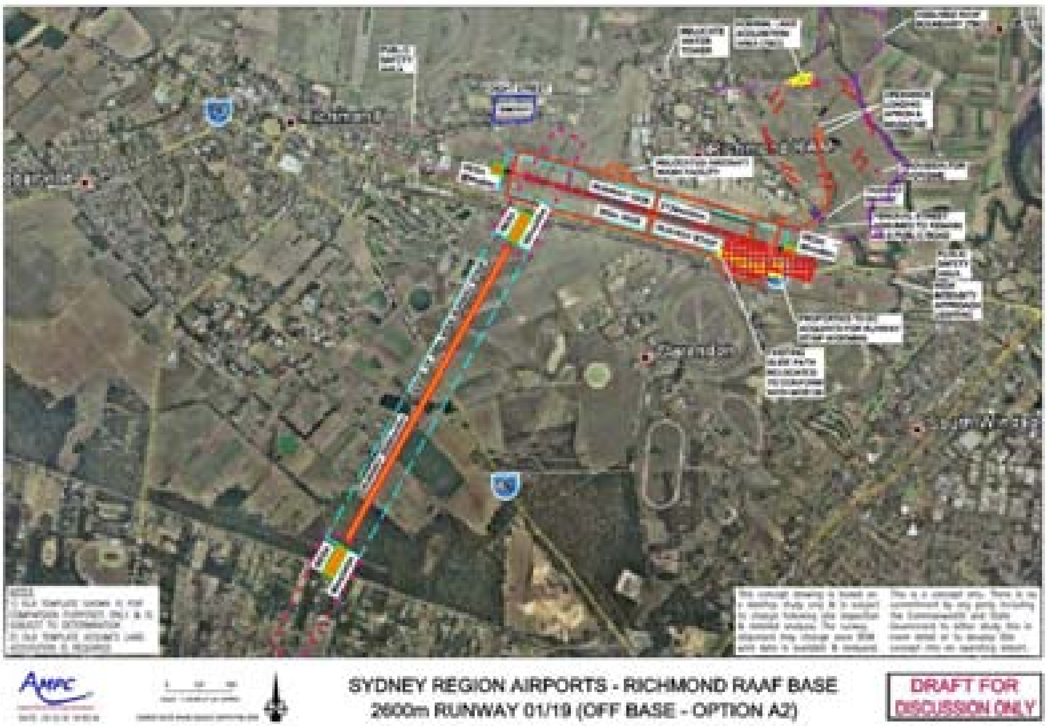


Figure 2.6 Option A2 2,600m (off-Base)

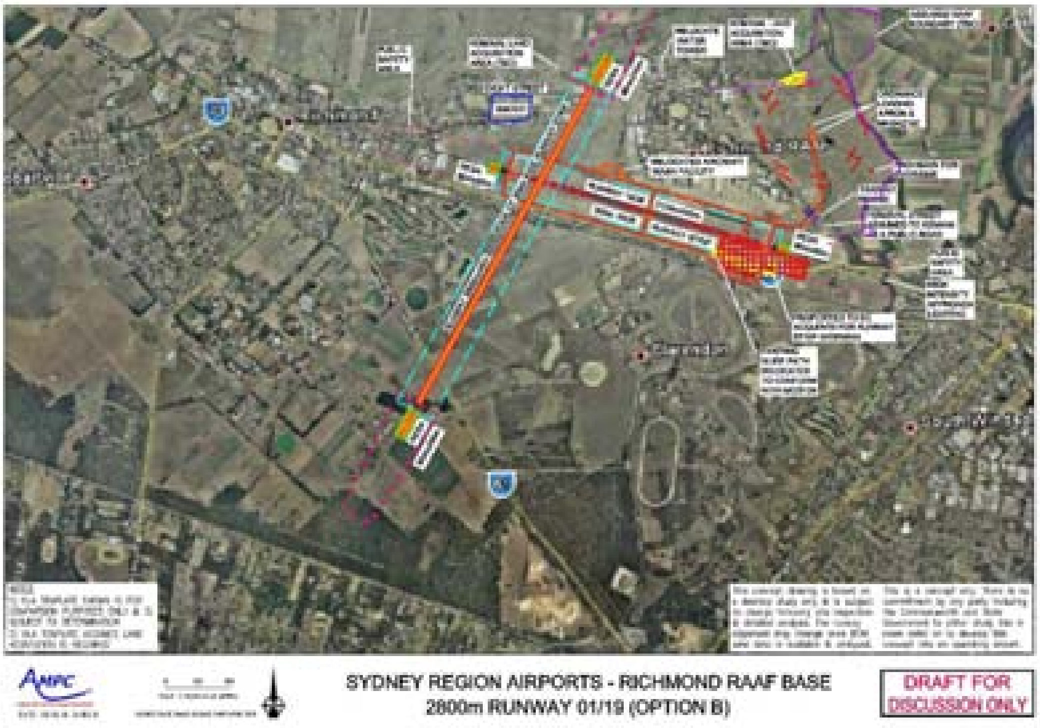


Figure 2.7 Option B 2,800m (part on-Base)

Figure 2.8 Option C 3,000m (part on-Base)

Figure 2.9 Option D 4,000m (part on-Base)

3 AIRPORT CONFIGURATION ISSUES AT RICHMOND

3.1 Runway Capacity

The upgraded airport is likely to be operated as a single runway 01/19 (with the existing 10/28 runway only being used in periods of high cross winds) to minimise noise impacts on the residents at Richmond and Windsor, in a similar manner to the east-west runway at Sydney (Kingsford-Smith) Airport. The single runway configuration with full length parallel taxiway would be capable of supporting up to 40 movements per hour, based on a relatively homogenous fleet mix of jet aircraft in visual weather conditions.

3.2 Existing Runway Capability

While it is anticipated that with a north-south runway, the majority of operations will be on the new 01/19 Runway, provision may need to be made for occasional use of the existing 10/28 runway. This has a 154m wide runway strip but RPT operations would ideally require provision of a 300m wide strip. Provision has also been made for full length parallel taxiways on both sides of the 10/28 runway to provide for separation between civil and military operations (see Figure 3.1).

Figure 3.1 Possible Widening of Runway Strip to 300m

The need for these modifications needs to first be established.

3.3 Taxiway Capability

Runway 10/28 is currently served by a full length parallel taxiway on the northern side. It is 15 m wide generally and ignoring shoulder requirements would meet Code C civil standards. The taxiway centreline to runway centreline distance is 122 m, which meets Code E Instrument Non-Precision requirements (based on a 150m wide runway strip).

With the exception of Taxiway B (which is limited to aircraft up to 20,000kg), taxiway pavements are rated as the same as the runway.

As indicated above, a worthwhile objective for ultimate design aircraft operations is to achieve the full 300m wide runway strip width requirement for instrument precision approaches. **Figure 4.1** also depicts the object clearance implications of relocating the taxiway to provide this Code E capability.

As can be seen from **Figure 4.1**, compliance with Code E civil object clearance requirements impacts on part of the RAAF eastern apron, a situation which already partly exists in relation to the location of Taxiways Z1 and Z2. The development scenarios presented below seek to address this with a replacement apron (if it is required) located elsewhere on the base.

For the new 01/19 runway, dual parallel taxiways are proposed on the eastern side of the runway.

3.4 Obstacle Limitation Surfaces Review

OLS's protect the immediate airspace in the vicinity of the airport for visual operations and are based on specifications laid down in the MOS for the applicable runway classification. The OLS comprise a series of imaginary planar surfaces in the air surrounding an airport, which desirably should be kept free from penetration by obstacles, so as to ensure the safety of aircraft operations on approach to, departure from, and general activity around airports.

A preliminary check has been made of the most critical element of the OLS for runway 01/19. This concerns the Instrument Precision approach surface, which is also used to determine the threshold location in relation to obstacle clearance requirements. The dimensions of the approach surface are:

- 300m wide inner edge located 60m beyond the threshold;
- divergence of 15% on each side;
- a first section length of 3000m at a slope of 2%;
- a second section length of 3,600m at a slope of 2.5%; and
- a horizontal section length of 8,400m.

This template has been applied over the standard 1:25,000 topographical mapping available for the area, as shown in Figures 3.2 and 3.3. It should be noted this assessment only looks at terrain clearance based on the vertical accuracy of +/- 5m applicable to the contours shown on the base mapping. It does not address any natural or man-made obstacles which may be present in the relevant airspace.

There are no terrain obstacles within the approach and take off climb surfaces.

This assessment has not considered all the other elements of the OLS, such as the inner and outer horizontal surfaces and conical surface. It also has not considered the transitional surfaces, which are part of the approach surfaces and relate to obstacles adjacent to the runway strip (other than noting that the existing elevated water tanks in RAAF Base Richmond will infringe the OLS and will require relocation). It is also noted that there are towers on the RAAF Transmitter Site to the south of the airport. The heights of these towers will need to be checked against the OLS. A comprehensive obstacle survey is required of all relevant OLS, to confirm or otherwise the conclusions of this preliminary assessment.

The obstacle assessment has not specifically considered any issues arising from the Procedures for Air Navigation Services and Operations (PANS-OPS) surfaces which protect the immediate airspace in the vicinity of the airport for instrument operations and are based on specifications laid down by CASA's '*Manual of Standards Part 173 – Standards Applicable to Instrument Flight Procedure Design*' (MOS 173).

The PANS-OPS surfaces differ to the OLS in that they protect aircraft conducting operations under Instrument Flight Rules (IFR), and as such cannot be infringed under any circumstances as aircraft relying on them may be flying in Instrument Meteorological Conditions (IMC). However, like the OLS, they comprise a series of airspace reference surfaces. PANS-OPS surfaces generally (although not always) sit at an equivalent or higher level in the airspace than the OLS and are therefore normally protected by virtue of the lower OLS.

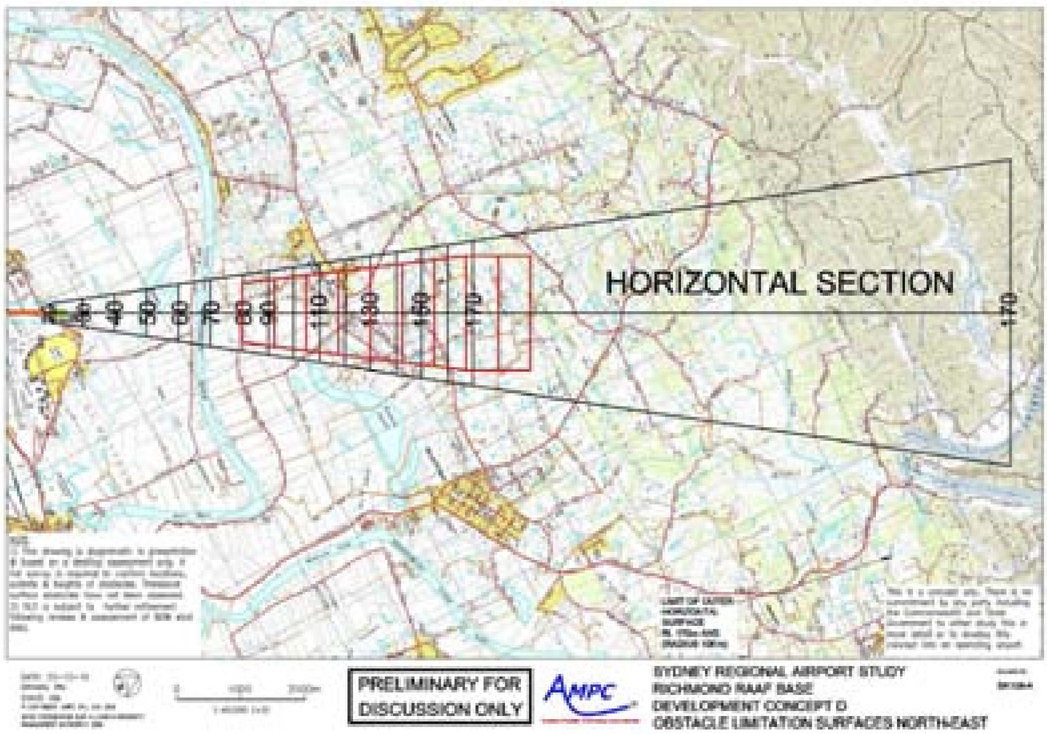


Figure 3.2 Northern OLS Option D Runway 01/19

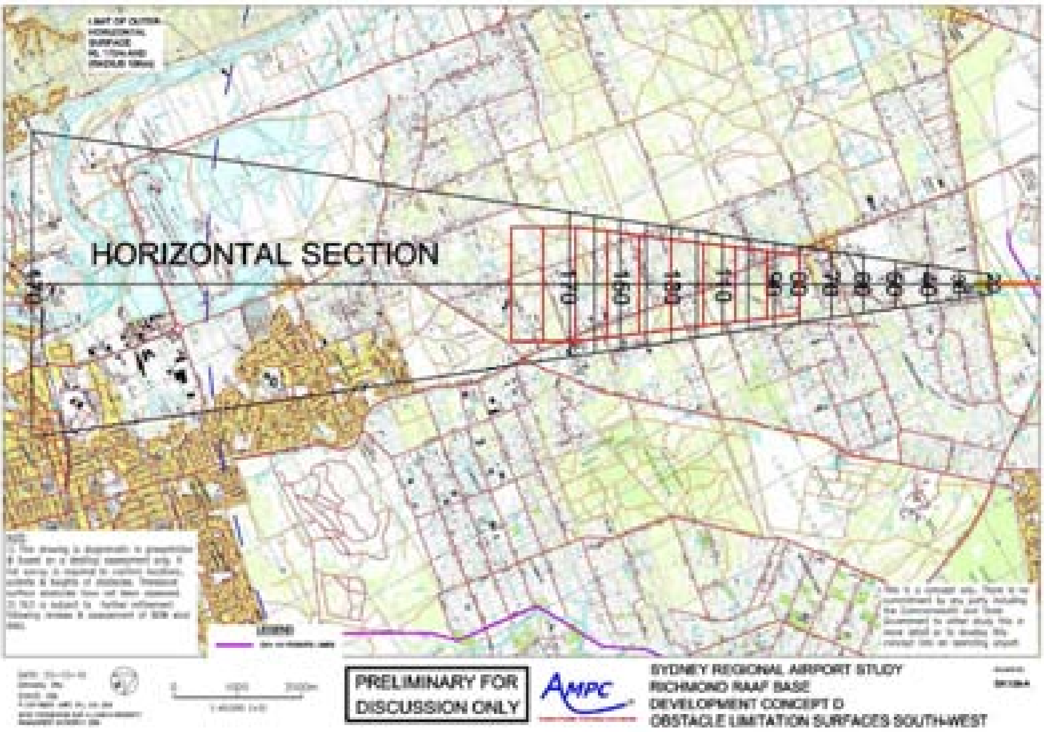


Figure 3.3 Southern OLS Option D Runway 01/19

3.5 Fog Events

3.5.1 Bureau of Meteorology Analysis

Issues in relation to fog events at Richmond have previously been mentioned in the public arena as a potential reason that enhanced civil operations could be operationally impractical, and perhaps commercially unviable. The Bureau of Meteorology (BoM) through the Department of Defence provided some statistical information and further data was obtained by WorleyParsons/AMPC. This data was analysed to assist in obtaining a better understanding of the issue. Fog is technically defined as visibility below 1000m so any fog is, strictly speaking, below the ILS criteria.

BoM has advised that observations at Richmond extend from 1928 to the present, so there is a substantial record available. Two observation sites have been used. Visual observations of fog have been recorded from 1941 to 1994 at the first site and from 1995 to 1999 at a second site nearby. After 1999, automatic visibility and cloud height sensors replaced manual observations. Fog occurrence was not recorded, but could be largely deduced from sustained visibility reductions. Using the long record of observations of fog at Richmond monthly records of fog occurrence were documented for both the 1941-1994 period and the 1995-1999 period as shown in Figures 3.4 and 3.5.

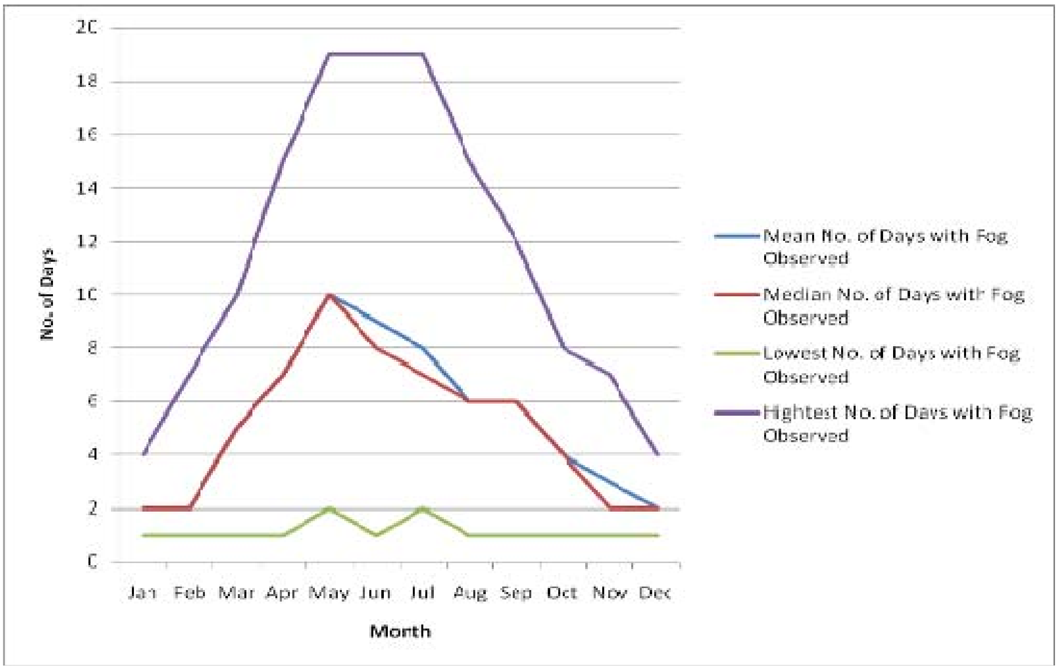


Figure 3.4 – Monthly Fog Occurrence (1941-1994)

Source: BoM 2010

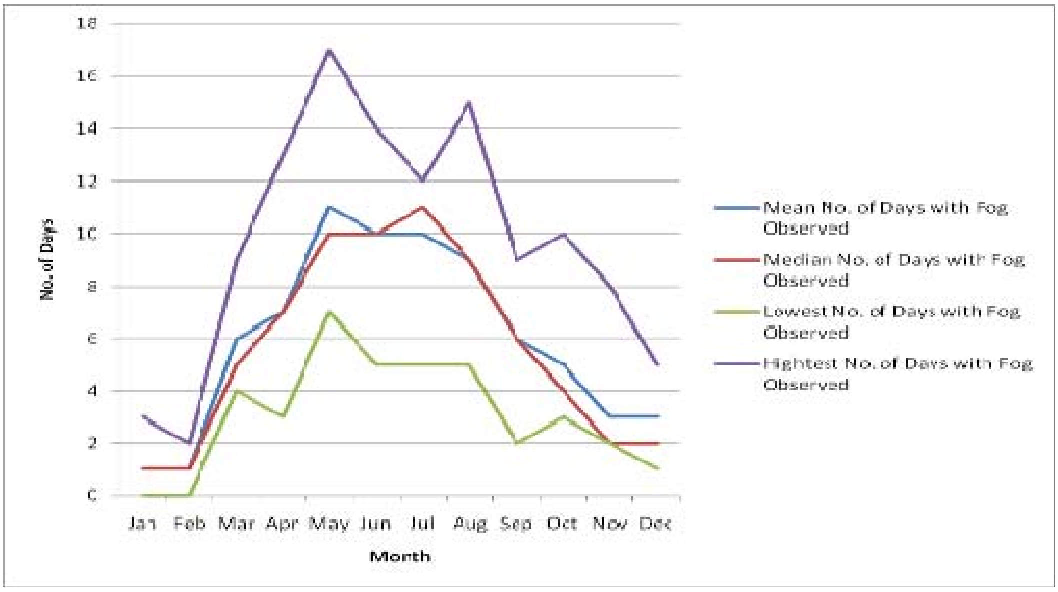


Figure 3.5 – Monthly Fog Occurrence (1995-1999)

Source: BoM 2010

From these records it can be seen that Richmond averages 70 fogs a year, varying from 40 to 100. The months of May to August are the worst with approximately one in three days affected. The 1941-1994 record is little different from the 1995-1999 record.

While these records do not say how extensive the fog was, it could be assumed that whether the fog was widespread or not, fog would have impacted severely on air movements and planning. Also, it could be argued that given some bias towards conservative forecasting, the frequency of disruptive fog forecasts would be higher than the actual fog frequency.

3.5.2 WorleyParsons/AMPC Analysis

WorleyParsons/AMPC also undertook some additional analysis of Richmond and some other airport's data for comparison purposes, as discussed below.

The complete databases of observations were obtained from BoM for Richmond, Bankstown, Canberra, Camden and RAAF Base Williamtown. These records were mainly half hourly observations recorded by automatic weather stations (AWS), although the earliest records in the databases were often manual recordings at greater than half hourly intervals. Only the half hourly records (dating from when all half hourly records were available) were utilised to provide a common basis for this analysis. The record periods used were:

- Richmond – 1994 to present;
- Bankstown – 1993 to present;
- Canberra – 1988 to present;
- Camden – 1998 to present; and
- Williamtown – 1997 to present.

Two sets of airport usability criteria were employed:

- For each airport the main runway direction was compared with the half hourly wind velocity to determine usability due crosswind limits; and
- The cloud base and visibility were compared with 'average' ILS minima to determine whether the airport would be closed due weather conditions or not.

Only the main runway at each airport was considered for usability against the wind velocity. Those runways were:

- Richmond – 10/28;
- Bankstown – 11/29;
- Canberra – 17/35;
- Camden – 06/24; and
- Williamtown – 12/30.

Runway selection criteria of 15 knots crosswind and 5 knots downwind were used for all airports in this assessment, to provide consistency in the results. The ILS minima used for all airports (whether or not they are equipped with an ILS) was a cloud base of 300 ft Above Ground Level (AGL) and a visibility of 800m. It was assumed that there would need to be more than scattered cloud below the ILS minima to render the airport unusable. For the analysis of both runway usability and occurrences of weather conditions below the ILS minima, the recordings between the hours of 6am to 7pm (day time) were used to represent the reasonable operating hours of the airports.

The following lists both the average percentage and time per year (assuming half hourly observation intervals for the day time period) that no runway would meet the specified wind criteria:

- Richmond – 0.65% or 32.0 hours[5];

[5] This would be likely to change, possibly to zero, with the introduction of a 01/19 runway.

- Bankstown – 0.69% or 34.0 hours;
- Canberra – 0.39% or 19.2 hours;
- Camden – 0.75% or 37.0 hours; and
- Williamtown – 2.18% or 107.4 hours.

The following lists both the average percentage and time per year (assuming half hourly observation intervals for the day time period) that airport weather would be below the specified cloud base and /or visibility criteria:

- Richmond – 0.96% or 47.3 hours[6];
- Bankstown – 0.17% or 8.4 hours;
- Canberra – 0.37% or 18.2 hours;
- Camden – 0.65% or 32.0 hours; and
- Williamtown – 0.51% or 25.1 hours.

These data are also shown graphically in Figure 3.6.

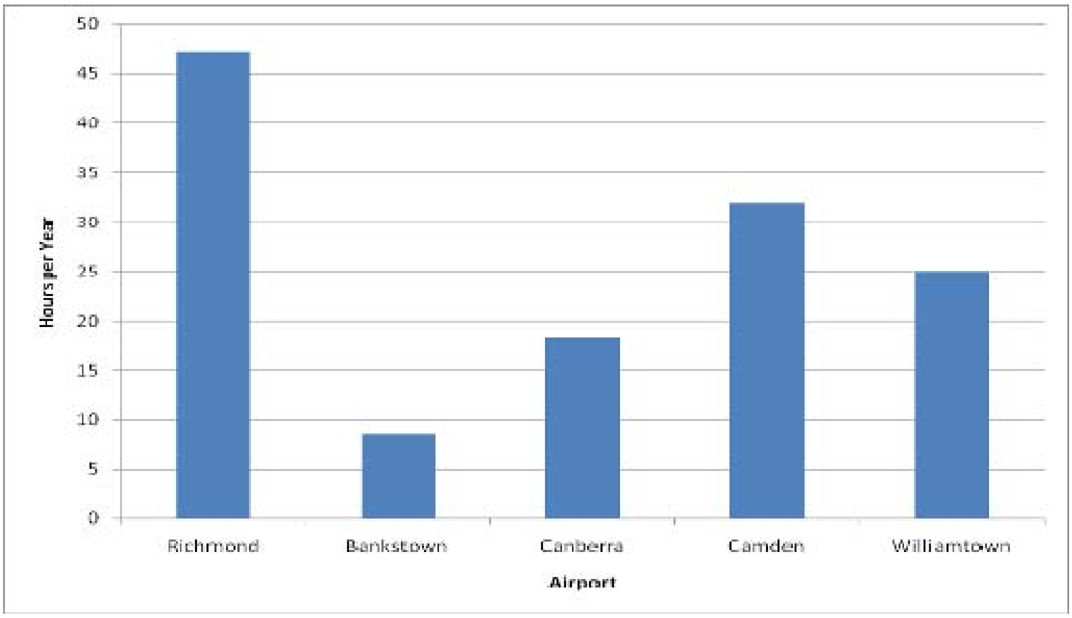


Figure 3.6 –Average Time per Year Less than Specified Cloud Base and/or Visibility Criteria

Source: Dataset BoM 2010

Figure 3.6 suggests that civil operations at Richmond would be more impacted by the occurrence of specified cloud base and/or visibility criteria compared to those at other airports assessed.

Table 3.2 presents for each half hourly observation (over 24 hours) the percentage of time that the airports would have weather conditions below the specified criteria.

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6 This would also be likely to change with the introduction of a 01/19 runway.

Table 3.2 – Half Hourly Observation Comparison over 24 Hours

Observation Time	Richmond (Percentage of Time)	Bankstown (Percentage of Time)	Canberra (Percentage of Time)	Camden (Percentage of Time)	Williamtown (Percentage of Time)
00:00	2.11	0.70	0.21	2.06	1.31
00:30	2.37	0.74	0.31	4.29	1.54
01:00	3.09	0.71	0.39	3.41	1.84
01:30	3.87	0.90	0.57	6.01	1.99
02:00	4.84	1.03	0.63	4.84	2.03
02:30	5.43	0.98	0.87	8.31	2.32
03:00	6.15	1.13	0.77	5.44	2.42
03:30	6.50	1.29	1.07	9.65	2.87
04:00	7.01	1.43	1.25	5.97	3.15
04:30	7.86	1.37	1.43	10.26	3.19
05:00	8.11	1.54	1.58	7.06	3.44
05:30	9.06	1.55	1.88	10.58	3.69
06:00	9.19	1.55	1.96	6.71	3.41
06:30	8.66	1.35	2.16	9.80	3.32
07:00	7.61	1.35	2.06	4.82	2.94
07:30	6.15	1.10	2.14	4.63	2.94
08:00	4.64	0.81	1.90	1.79	2.47
08:30	3.48	0.57	1.87	1.69	2.04
09:00	2.55	0.46	1.36	0.54	1.57
09:30	1.84	0.34	1.20	0.42	1.33
10:00	1.13	0.20	0.96	0.09	1.05
10:30	0.47	0.13	0.62	0.10	0.57
11:00	0.24	0.05	0.38	0.11	0.43
11:30	0.07	0.06	0.22	0.07	0.31
12:00	0.04	0.02	0.10	0.04	0.17
12:30	0.02	0.02	0.00	0.14	0.11
13:00	0.02	0.02	0.04	0.02	0.08
13:30	0.02	0.00	0.01	0.04	0.00
14:00	0.04	0.03	0.01	0.00	0.04
14:30	0.03	0.02	0.03	0.04	0.02
15:00	0.05	0.07	0.01	0.04	0.06
15:30	0.09	0.02	0.00	0.07	0.02
16:00	0.02	0.03	0.01	0.07	0.04
16:30	0.00	0.03	0.03	0.04	0.16
17:00	0.00	0.00	0.00	0.00	0.08
17:30	0.00	0.00	0.00	0.10	0.09
18:00	0.03	0.03	0.00	0.04	0.10
18:30	0.02	0.02	0.00	0.24	0.12
19:00	0.03	0.03	0.00	0.18	0.15
19:30	0.14	0.08	0.01	0.38	0.21
20:00	0.17	0.11	0.05	0.33	0.11
20:30	0.19	0.11	0.04	0.63	0.23
21:00	0.31	0.16	0.05	0.55	0.20
21:30	0.58	0.40	0.08	1.19	0.33

Observation Time	Richmond (Percentage of Time)	Bankstown (Percentage of Time)	Canberra (Percentage of Time)	Camden (Percentage of Time)	Williamtown (Percentage of Time)
22:00	0.44	0.37	0.10	0.80	0.50
22:30	0.73	0.21	0.15	1.58	0.67
23:00	1.26	0.40	0.21	1.64	0.70
23:30	1.49	0.48	0.28	2.67	0.91

Source: Dataset BoM 2010

These data are also presented graphically in Figure 3.7.

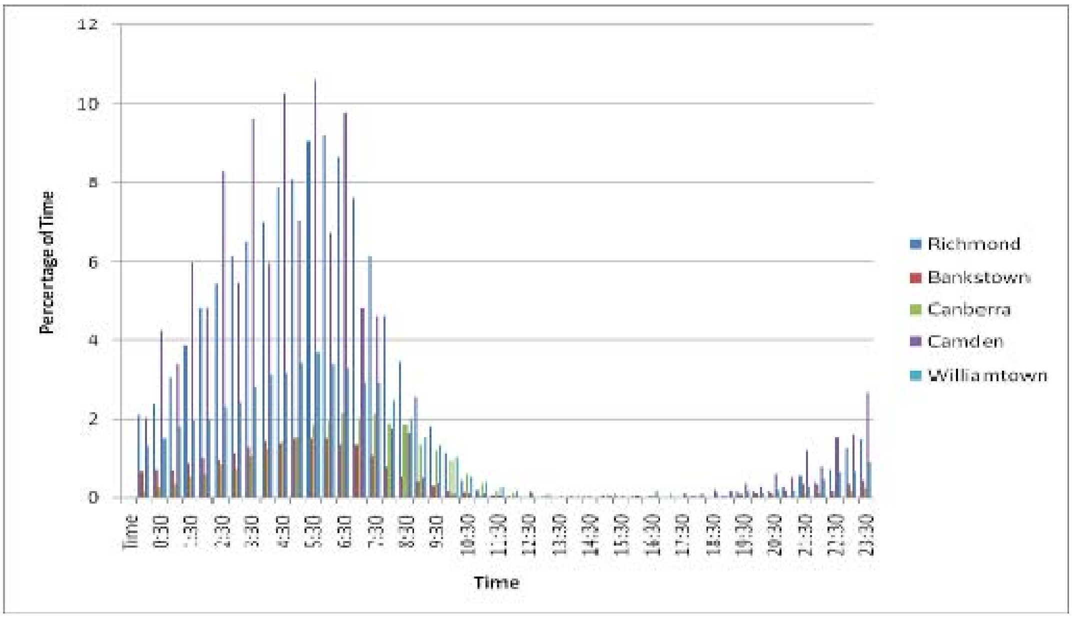

Figure 3.7 – Half Hourly Observation Comparison over 24 Hours

Source: Dataset BoM 2010

Figure 3.7 shows that the incidence of each airport having weather conditions below the assumed ILS minima are concentrated in the early to mid morning parts of the day (as would be expected when fog was the limiting factor). The Richmond 7am records for conditions below the ILS minima were examined in detail and the great majority of those records had both reduced visibility and a 'broken' or 'overcast' cloud base below the 300 minima, suggesting that the airport would be severely impacted by prevailing weather conditions on average 27 mornings of the year. This figure is less than the average of 70 events identified by BoM. This may be due to the different lengths and periods of data records assessed (1941-1995 – BoM) and (1994-present – WorleyParsons/AMPC).

It is important to note the limitations of this assessment. The AWS records cloud base directly above the station and that may not reflect the conditions on the approach to the runway. The AWS records visibility in a single direction and that may not reflect the conditions on the approach to the runway. The recordings are at half hourly intervals and are a snapshot of conditions at that time and may not reflect the overall trend of changes to the weather conditions. The cloud base is recorded up to three layers, with each layer being given an amount of either 'scattered', 'broken' or 'overcast'. The assumption that there needs to be 'more than scattered cloud below the ILS minima to close the airport' is untested. Finally, these data do not provide an actual indication of fog if it is present.

3.6 Technological Opportunities

There are a number of technological opportunities which could be employed to mitigate some of the weather related operational impacts, such as the incidence and duration of fog events, and noise impacts.

3.6.1 CAT II ILS

Until recently, all ILS in Australia have been CAT 1 systems. However, Melbourne Airport has recently commissioned a CAT IIIb system serving Runway 16. This also has the capability to provide CAT II and CAT IIIa approaches for suitably equipped aircraft and appropriately rated pilots. Canberra and Sydney (Kingsford-Smith) Airports are understood to be contemplating provision of CAT II systems. The primary benefit of these higher standard systems is to reduce the likelihood of diversions in poor weather (primarily fog). Compared to a CAT I system, CAT II provides for a decision height lower than 200 feet but not lower than 100 feet and a Runway Visual Range (RVR) not less than 350m.

Therefore, provision of a CAT II system for Runway 01/19 at Richmond could be a worthwhile enhancement. Provision of a 300m wide runway strip as discussed above is assumed to be required to fully utilise the CAT II potential. In addition to the system itself, additional supporting infrastructure required would include:

- Enhanced HIAL system;
- Touchdown zone lights;
- Runway centreline lights;
- Taxiway centreline lights that provide continuance guidance between the runway centreline and the apron; and
- Stop bars at each runway holding position serving the runway.

Secondary power would also be required (but may already be provided for RAAF operations). Transmission meters, which provide a more accurate means of assessing RVR than a human observer would be assumed to be required.

As aircraft making CAT II approaches would be utilising radar altimeters, an additional consideration is the terrain immediately preceding the threshold. The International Civil Aviation Organization (ICAO) notes it is desirable that slope changes be avoided or kept to a minimum, on a rectangular area at least 300m long before the threshold of a precision approach runway. The area should be symmetrical about the extended centre line, 120m wide. It is known that the terrain drops appreciably in the area to the north beyond the Runway 01 threshold, and therefore a survey would be required to determine if compliance with the ICAO guidance on ground level associated with the operation of the navaid is met or if this area would require earthworks to bring it into conformity with the guideline.[7]

[7] The same may apply for Runway 28 if to be used for civil operations.

3.6.2 Required Navigation Performance (RNP)

Required Navigation Performance (RNP) is a statement of the navigation performance necessary for operation within a defined airspace. It is part of a broader concept called "Performance-based Navigation". RNP is a method of implementing routes and flight paths that differs from previous methods in that not only does it have an associated performance specification that an aircraft must meet before the path can be flown, but it must also monitor the achieved performance and provide an alert in the event that this fails to meet the specification.

Airservices Australia has recently commissioned Naverus to develop RNP procedures for arrival and departure flight paths at up to 28 major airports around Australia over the next five years, as the initial stage in the wider use of this technology.

ICAO has recognised that approaches with some form of vertical guidance or approach vertical guidance should be the minimum approach design standard as this (vertical guidance) can add some eight times the safety to the straight-in approach. Australia is working towards this goal and one such advancement is the incorporation of vertical guidance on Global Navigation Satellite Systems (GNSS) approaches known as BARO-VNAV. The BARO-VNAV approach allows for suitably equipped and certified aircraft to conduct a GNSS approach with the addition of computer generated vertical guidance, similar to an ILS display. It is envisaged that a single approach plate will be produced depicting both the “standard” GNSS approach with its associated minima, and additional BARO-VNAV decision altitude (DA) information for the BARO-VNAV approach. PANS-OPS describe BARO-VNAV approaches as “… Instrument procedures in support of approach and landing operations with vertical guidance… They use obstacle assessment surfaces (OAS) similar to those for ILS but based on a specific lateral guidance system.” In this case, the guidance system referred to is the GNSS receiver. In the Federal Government’s Aviation White Paper released in December 2009, the commitment to APV utilising BARO-VNAV was reinforced, with the objective of having APV procedures available for 100% of instrument runways used by APV-capable aircraft in the 2014-19 timeframe.

The use of RNP with BARO-VNAV at Richmond should provide additional instrument approach capability complimenting the existing ILS, as well as potential flexibility in the definition of approach and departure tracks, as a means of mitigating noise impacts.

An example of a RNP instrument approach procedure is shown in Figure 3.8 for Runway 14 at Gold Coast Airport. As can be seen, the aircraft carries out a curved approach to Waypoint CG641 before intercepting the runway extended centreline at a distance of only 1.9 nautical miles (3.5km) from the threshold.

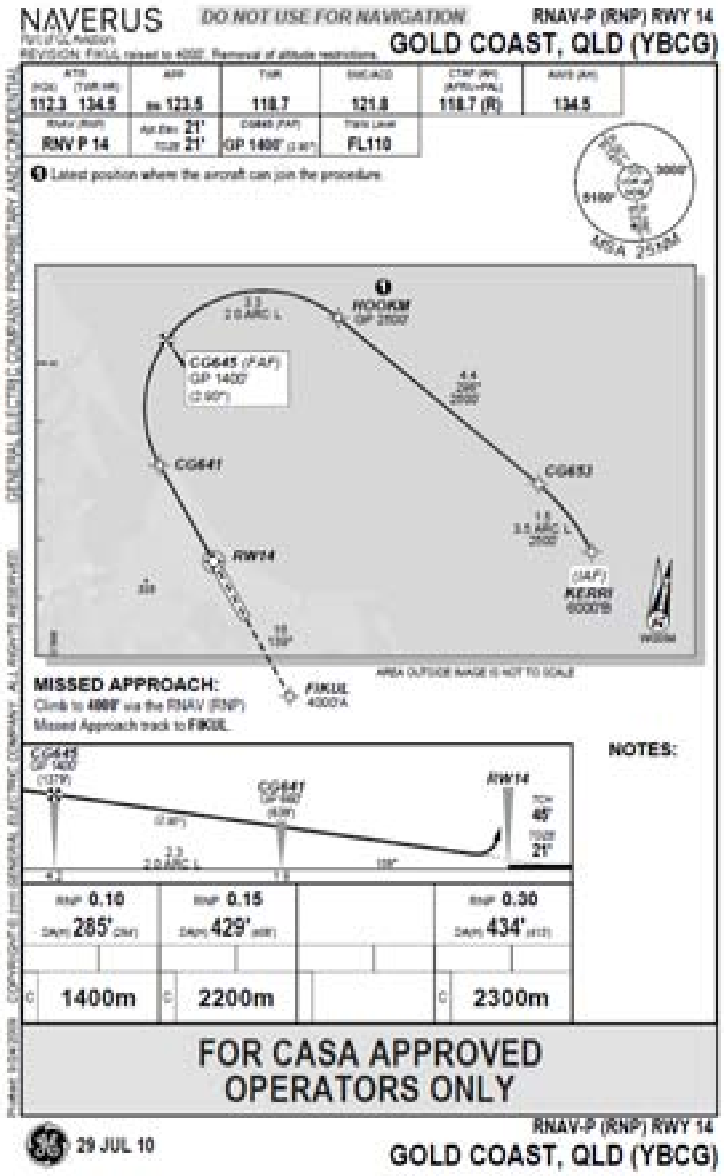

Figure 3.8 – RNP Instrument Approach Example

Source: Airservices Australia 2010

3.6.3 Very High Frequency Omni-Range and Distance Measuring Equipment (VOR/DME)

Depending on the timing of any future civil operations it may be prudent to allow for the installation of VOR/DME equipment to support instrument non-precision approaches, ahead of a more widespread removal of these and other ground-based navigation aids and their replacement by satellite based technology such as RNP and alike.

The development concepts presented below therefore show a nominal site for a future VOR/DME, if it is deemed to be required.

3.7 Airspace

As an existing airport, military Air Traffic Control (ATC) is applicable within the Richmond Control Zone (CTR) which is a trapezoidal shaped area extending approximately 16 nautical miles to the north-west and 20 nautical miles to the south-east. It extends from the surface to an altitude of 2,500 feet and is active during the tower's hours of operation which are 0800-2300 hours local. The tower may be vacated and the CTR deactivated during these hours when long breaks between scheduled movements occur. Figure 3.9 shows the current airspace arrangements in the vicinity of the airport.

Figure 3.9 Current Airspace Arrangements (Not to Scale)

Outside of tower operations hours, the airspace reverts to Class G and Common Traffic Area Frequency (CTAF) procedures apply. Overlying the CTR are Restricted Areas R468 and R493 which operate from an altitude of 2,500 feet and 4,500 feet respectively to 4,500 feet and Flight Level 280 respectively. Both restricted areas are activated by NOTAM and have conditional status of RA1.

The immediate vicinity airspace is also used to support airdrop operations into Rickaby's Creek Drop Zone, located east of the runway and the Londonderry Drop Zone, which is roughly south-west.

The existing CTR boundaries may be able to accommodate operations associated with a future runway in the 01/19 alignment of up to 4,000m length (Option D). It would be expected there would need to be new or modified control area (CTA) step design undertaken generally along the 01/19 alignment. These would be associated with the complex airspace arrangements within the Sydney Basin, including the existing CTA and Danger Areas associated with civil flying training, particularly D556B which operates to an altitude of 4,500 feet.

Restricted Areas R536A and 536B are located approximately 9.4nm to the south of the possible future 01 runway end/threshold (4,000m length Option D). The boundary of R536A/536B is a 1nm radius circle. As shown on Figure 3.10, the extended runway centreline would be approximately 3.6nm from the edge of the Restricted Area boundary. R536A and 536B are associated with explosives demolition at Orchard Hills and operate from the surface to an altitude of 1,500 feet and 4,500 feet respectively. R536A is active from daylight to sunset and R536B is active Monday to Friday 0900-1200 hours and 1300-1600 hours local. Both areas have a conditional status of RA3.

There may be other issues in relation to the airspace interaction between a new Runway 01/19 at Richmond and operations at Sydney (Kingsford-Smith) Airport. The design and management of any new procedures would therefore need to address these types of issues, with the objective of minimising any dependency requirements which might impact on the capacity potential at either airport. These and the other issues identified above would require more detailed analysis by Airservices Australia/Defence and/or the Office of Airspace Regulation (OAR).

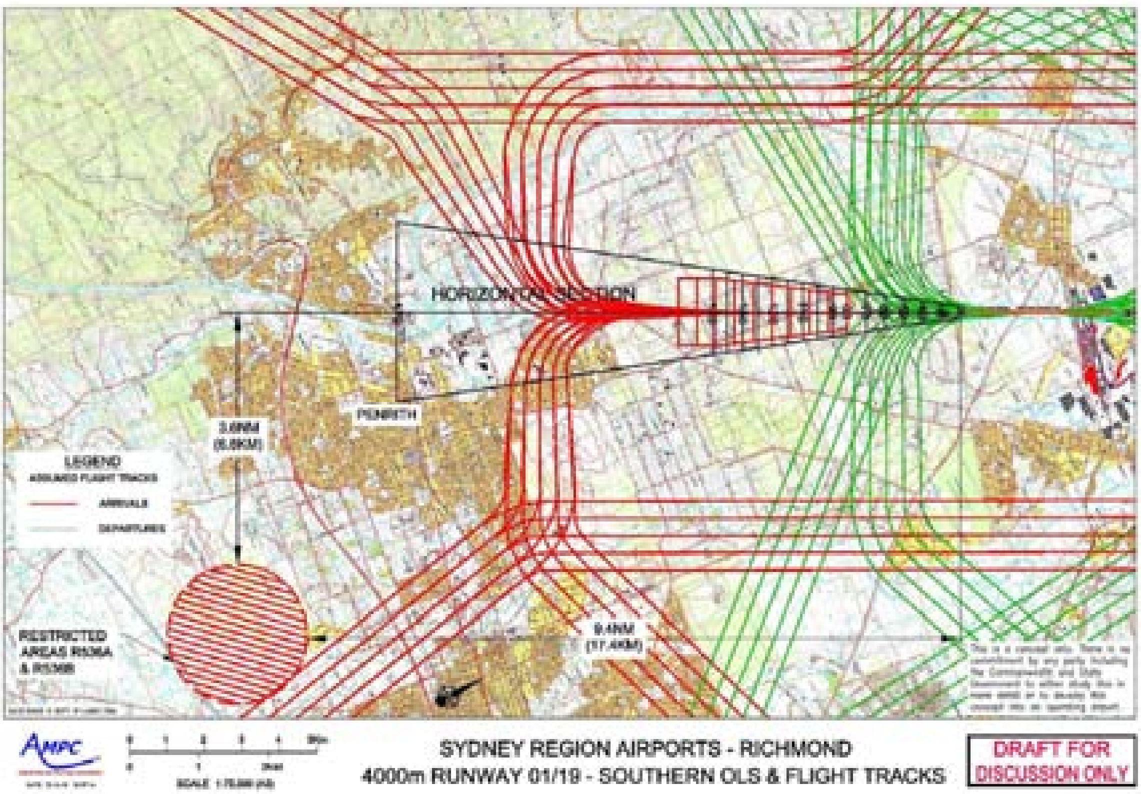

Figure 3.10 – Richmond Airport 4,000m Runway 01/19 Southern OLS and Flight Tracks

3.8 Public Safety

In the Aviation White Paper, the Federal Government indicated its intention to work with State, Territory, Local governments and industry stakeholders to undertake a detailed examination of the implications of public safety zones in the vicinity of airports. This policy initiative followed an earlier

Discussion Paper associated with the Green Paper, entitled '*Safeguards for airports and the communities around them 2009'* which were released with the aim of increasing public safety and protecting aviation infrastructure from inappropriate development around airports and under flight paths. The Discussion Paper noted that with the exception of Queensland, there are no guidelines or standards currently operating in Australia.

Within its *State Planning Policy 1/02* and associated guidelines, the Queensland Government has requirements for public safety areas (PSA) which are applicable at a number of Queensland aerodromes. The PSA are based on UK research undertaken in the late 1990's by NATS and on which UK public safety zone policy is currently based.

Although these PSA requirements only apply in Queensland, some airports in other jurisdictions nevertheless apply the Queensland PSA in the absence of the national policy. The Queensland policy seeks to avoid significant increases in people living, working or congregating in the PSA and the use or storage of hazardous materials. In the PSA, the risk of an accident is sufficient to justify restrictions on development within those areas. Increased risks to public safety can arise from development that involves the following:

- residential uses;
- the manufacture or bulk storage of inflammable, explosive or noxious materials;
- uses that attract large numbers of people (e.g. sports stadium, shopping centre, industrial uses involving large numbers of workers or customers); or
- Institutional uses (e.g. schools, hospitals).

Application of the Queensland PSA template in relation to Runway 01/19 would suggest that for some options land may need to be acquired at the southern end of the runway.

4 AIR TRAFFIC FORECASTS FOR CONCEPT DEVELOPMENT

4.1 Passenger and Aircraft Movement Demand Scenarios

For the purpose only of assessing infrastructure demand requirements, confirming appropriateness of the runway alignment chosen and preparing indicative Australian Noise Exposure Concepts (ANEC), it is necessary to identify air traffic passenger demand levels, fleet mix and aircraft movements for each of the above options. The following has been assumed:

- Options A1, A2 and B — 20 million passengers per annum;
- Option C — 25 million passengers per annum; and
- Option D — 30 million passengers per annum.

These air traffic passenger demand levels are not related to a particular point in time as would be the case in a conventional air traffic forecasting sense, the intention being simply to enable estimates of the types of facilities needed to support that demand and to indicate potential aircraft noise impacts. The three demand scenarios may, however, be capable of being part of a sequence of incremental development responding to runway and other infrastructure upgrading over time.

4.2 Aircraft Movements

For the purpose of deriving aircraft movement numbers for the various passenger demand levels, it is necessary to make a number of assumptions regarding the relative proportions of passenger categories, aircraft fleet mix, load factors, etc.

4.2.1 Options A1, A2 and B

A 180-seat aircraft configuration (Code C such as B737/A20) has been adopted and an 85% load factor assumed. Table 4.1 shows the annual and average daily aircraft movement numbers for 20 million passengers per annum.

Table 4.1 – Indicative Annual and Average Daily Aircraft Movements

Passenger Demand Level (Millions)	Seats (85% Load Factor) (Millions)	Annual Aircraft Movements	Code - Type	Average Movements per Day
20.0	23.53	130,719	C – B737/A320	358

4.2.2 Option C

The availability of a 3,000m runway would enable short to medium-haul international operations to be undertaken, as well as full domestic and regional traffic.

Assumptions as to relative proportions of passenger categories are as follows:

- International 14%[8] (Note 1);
- Domestic 77% (Note 2); and
- Regional 9%[9].

Seat configuration assumptions are as follows:

- International high capacity 300 seats (Code E such as A330); medium capacity 180 seats (Code C such as B737/A320);
- Domestic high capacity 300 seats (Code E such as A330); medium capacity 180 seats (Code C such as B737/A320); and
- Regional 74 seats (Code C/D such as DHC8-400) and 50 seats (Code C such as DHC8-300).

Fleet mix assumptions are as follows:

- International 90% of seats, high capacity 300 seats (Code E such as A330); and 10% of seats, medium capacity 180 seats (Code C such as B737/A320);
- Domestic 15% of seats, high capacity 300 seats (Code E such as A330); and 85% of seats, medium capacity 180 seats (Code C such as B737/A320); and
- Regional 15% of seats, 74 seats (Code C/D such as DHC8-400); and 85% of seats, 50 seats (Code C such as DHC8-300).

Table 4.2 shows the annual and average daily aircraft movement numbers for 25 million passengers per annum based on an 85% load factor across all flights.

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[8] based on Gold Coast Airport's proportion of international passengers in 2009/10 within its overall passenger mix.

[9] based on Sydney Airport's relative proportions of domestic and regional passengers in 2009/10 within its domestic/regional passenger mix.

Table 4.2 – Indicative Annual and Average Daily Aircraft Movements

Service Type	Passenger Demand Level (Millions)	Seats (85% Load Factor) (Millions)	Annual Aircraft Movements	Code - Type	Average Movements per Day
International	3.50	4.11	12,353 2,288	E - A330 C – B737/A320	34 6
Domestic	19.25	22.65	11,324 106,944	E –A330 C – B737/A320	31 293
Regional	2.25	2.65	5,366 45,000	C/D – DHC8-400 C – DHC8-300	15 123
Total	25.00	29.41	183,274		502

4.2.3 Option D

The availability of a 4,000m runway under this option would effectively enable the full range of passenger aircraft to operate, up to and including the Code F A380-800 (assuming a 60m wide runway). For this 30 million passenger option, the 2009/10 Sydney (Kingsford-Smith) Airport passenger mix has been adopted as a proxy as follows:

- International Passengers 32%;
- Domestic Passengers 62%; and
- Regional Passengers 6%.

Seat configuration assumptions are as follows:

- International ultra high capacity 450 seats (Code F A380-800); very high capacity 400 seats (Code E such as B777-300ER);high capacity 300 seats (Code E such as A330); medium capacity 180 seats (Code C such as B737/A320);
- Domestic high capacity 300 seats (Code E such as A330); medium capacity 180 seats (Code C such as B737/A320); and
- Regional 74 seats (Code C/D such as DHC8-400); 50 seats (Code C such as DHC8-300).

Fleet mix assumptions are as follows:

- International 5% of seats, ultra high capacity 450 seats (Code F A380-800); 35% of seats, very high capacity 400 seats (Code E such as B777-300ER); 50% of seats, high capacity 300 seats (Code E such as A330); and 10% of seats, medium capacity 180 seats (Code C such as B737/A320);

- Domestic 30% of seats, high capacity 300 seats (Code E such as A330); and 70% of seats, medium capacity 180 seats (Code C such as B737/A320); and
- Regional 50% of seats, 74 seats (Code C/D such as DHC8-400); and 50% of seats, 50 seats (Code C such as DHC8-300).

Table 4.3 shows the annual and average daily aircraft movement numbers for 30 million passengers per annum based on an 85% load factor across all flights.

Table 4.3 – Indicative Annual and Average Daily Aircraft Movements

Service Type	Passenger Demand Level (Millions)	Seats (85% Load Factor) (Millions)	Annual Aircraft Movements	Code - Type	Average Movements per Day
International	9.6	11.29	1,255 9,882 18,824 6,275	F – A380-800 E – B777-300ER E - A330 C – B737/A320	3 27 52 17
Domestic	18.6	21.88	21,882 85,098	E –A330 C – B737/A320	60 233
Regional	1.8	2.12	14,308 21,176	C/D – DHC8-400 C – DHC8-300	39 58
Total	30.0	35.29	178,701		490

4.3 Busy Hour Assessment

4.3.1 Options A1, A2 and B - Busy Hour Aircraft Movements

These options assume the airport's role as one of primarily providing domestic reliever capacity, most likely through LCC airlines operating a single aircraft type. Regional operations would also be possible but are unlikely to be commercially attractive to airlines, due to a relatively much smaller origin/destination market and the lack of the transfer capability afforded through a full service network airport such as Sydney[10]. Regional operations have therefore not been considered.

Gold Coast Airport probably provides the best current Australian example of an airport catering primarily to LCC operators with a significant number of passenger movements. A current Gold Coast Airport domestic schedule was therefore analysed to determine the relative proportions of domestic flights and their respective arrival and departure busy hours. It is assumed Options A1, A2 and B would operate similarly in terms of flight types and daily profiles, noting Gold Coast has a curfew and

[10] This assumption has not been tested, validated through market research of airport users or potential users, nor is it the result of discussions with operators. It is a professional judgment made solely for the purpose of this study.

the same operating hours as Sydney (Kingsford-Smith) Airport. Figure 4.1 shows a typical daily profile of domestic arrivals and departures (by percentage of movements).

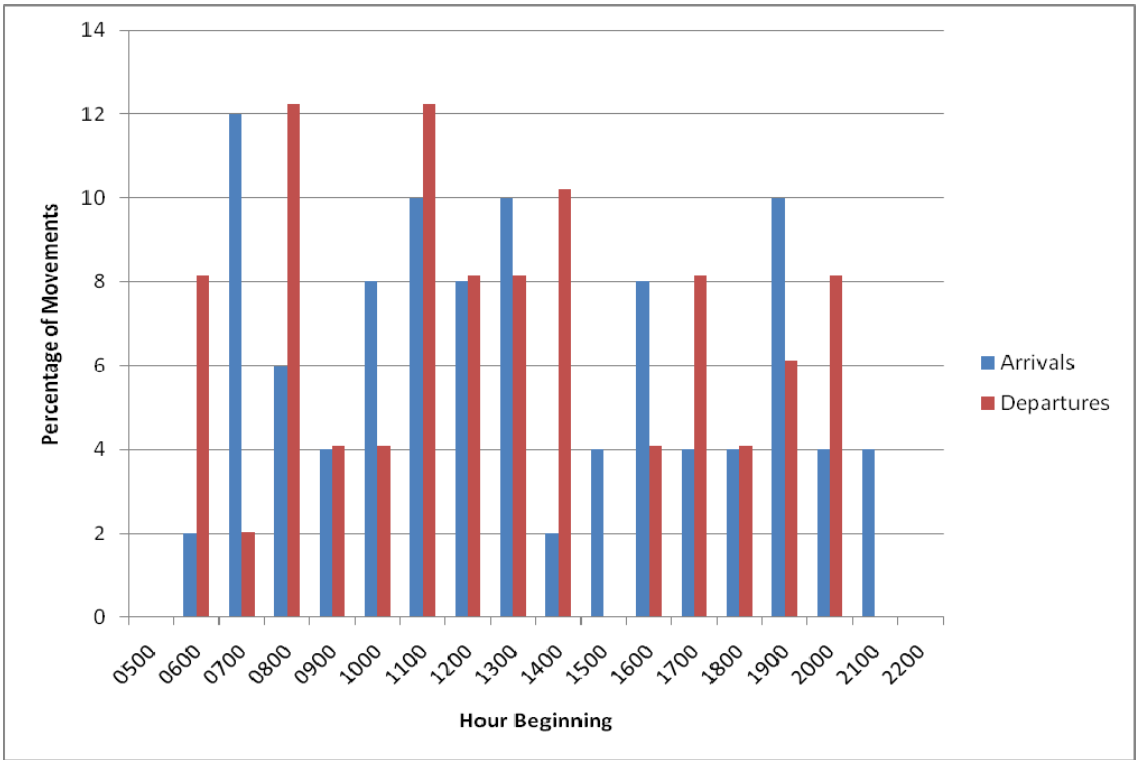

Figure 4.1 – Gold Coast Airport Current Daily Domestic Profile (Percentage of Movements)

Source: GCAPL 2010

The busy hour conclusions from Figure 4.1 are as follows:

- arrivals busy hour is 0700-0800 with 12% of daily arrivals; and
- departures busy hours are 0800-0900 and 1100-1200 with just over 12% of daily arrivals each.

Based on the indicative annual and average daily aircraft movement assumptions for Options A1, A2 and B shown in Table 4.1, the calculated indicative busy hour aircraft movement demand is as follows. All aircraft are assumed to be Code C.

- Domestic Arrivals 21; and
- Domestic Departures 22.

4.3.1.1 Indicative busy hour gate demand

The indicative busy hour aircraft movements above can be used to estimate the approximate levels of gate demand that will be required.

The arrivals and departures busy hours follow one another, with around 21 and 22 movements of each. A 60% allowance has been made on top of a nominal 21-22 gates (say 13 additional gates have been assumed) to cater for this overlap on-ground period.

It is normal practice to add a 10% contingency to gate planning to cater for off-schedule operations, unserviceability etc. The results in an indicative busy hour demand for 38 Code C gates.

4.3.1.2 Passenger Busy Hour

As there is no published data on passenger numbers for the respective busy hours at Gold Coast Airport, the percentage of flights has been adopted as a proxy for passengers as follows:

- Domestic Arrivals 0700-0800 3,288 passengers; and
- Domestic Departures 0800-0900 3,342 passengers.

4.3.2 Option C

4.3.2.1 Busy Hour Aircraft Movements

A current Sydney (Kingsford-Smith) Airport schedule was analysed to determine the relative proportions of flights by category and their respective arrival and departure busy hours. It is assumed Option C would operate similarly in terms of flight types and daily profiles. Figure 4.2 shows a typical daily profile of arrivals and departures (by percentage of movements) broken down by flight category.

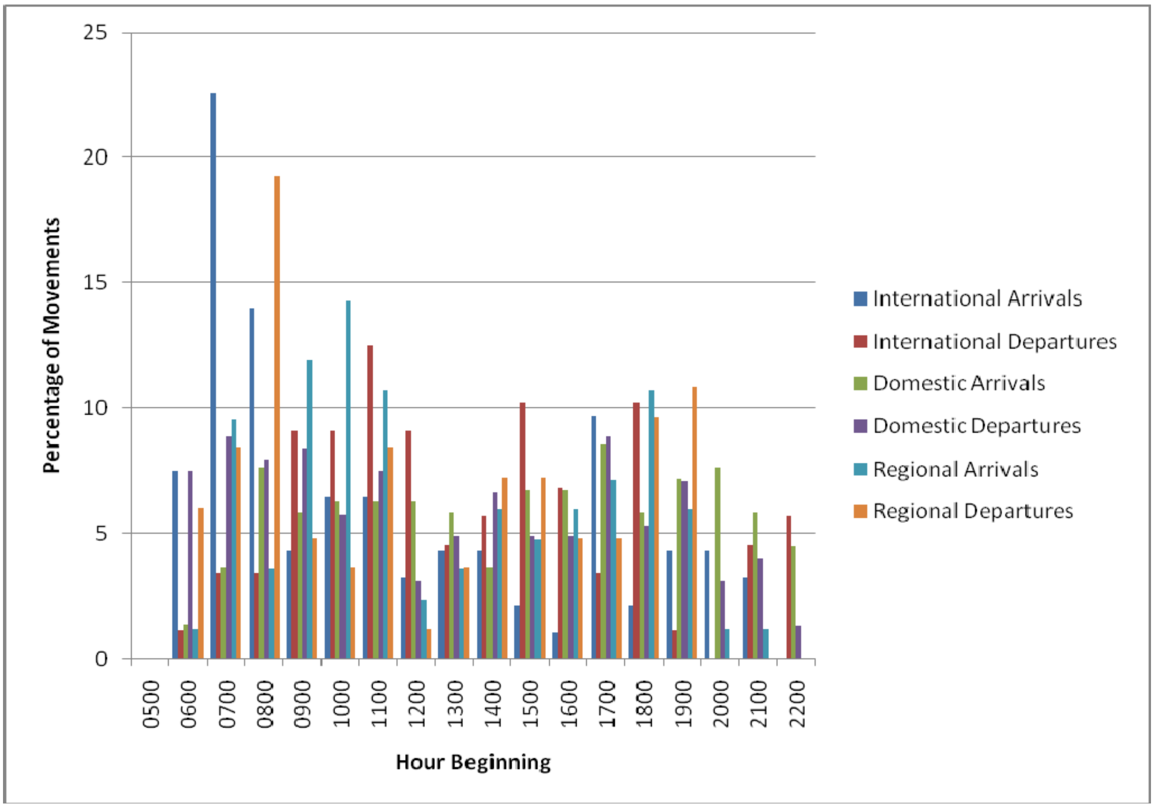

Figure 4.2 – Sydney (Kingsford-Smith) Airport Current Daily Profile (Percentage of Movements)

Source: SACL 2010

The busy hour conclusions from Figure 4.2 are as follows:

- International arrivals busy hour is 0700-0800 with 23% of daily arrivals;

- International departures busy hour is 1100-1200 with 13% of daily departures;
- Domestic arrivals busy hours are 0800-0900 each with 8% of daily arrivals;
- Domestic departures busy hours are 0700-0800 each with 9% of daily departures;
- Regional arrivals busy hour is 1000-1100 with 14% of daily arrivals; and
- Regional departures busy hour is 0800-0900 with 19% of daily departures.

Based on the indicative annual and average daily aircraft movement assumptions for Option C shown in Table 4.2, the calculated indicative busy hour aircraft movement demand by aircraft code is shown in Table 4.4.

Table 4.4 – Indicative Busy Hour Aircraft Movements for Richmond (Option C)

Movement type	Aircraft Code		
	E	C	Total Movements (Rounded)
International Arrivals	3.9	0.7	5
International Departures	2.2	0.4	3
Domestic Arrivals	1.2	11.7	13
Domestic Departures	1.4	13.2	15
Regional Arrivals	0.0	9.7	10
Regional Departures	0.0	13.1	13

The figures in Table 4.4 give a busy hour arrivals total demand of 28 and a busy hour departure total demand of 31 aircraft, but the busy hours occur at different times of the day.

4.3.2.2 Indicative Busy Hour Gate Demand

The indicative busy hour aircraft movements in Table 4.4 can be used to estimate the approximate levels of gate demand that will be required, noting the quite different respective busy hour profiles applicable to the respective flight categories shown from Figure 4.2. For this estimate, gate sharing (as might be available for some domestic and regional operations and possibly with international as well), has not been considered. This has the potential to slightly overstate the overall number of gates required.

In the case of international flights, the very pronounced morning arrival peak indicates a demand for up to 5 gates simply to meet the arrivals requirement. There would also be a need to cater for overnighters from the previous day that may not have departed prior to the 0700-0800 period. A nominal 40% allowance for this and any other on-ground aircraft (say 2 additional gates have been assumed).

In the case of domestic, the departures and arrivals busy hours follow one another with around 15 and 13 movements of each. A 60% allowance on top of a nominal 13-14 gates (say 8 additional gates have been assumed) to cater for this overlap on-ground period.

In the case of regional, the departures and arrivals busy hours are at the opposite ends of the day. A 30% allowance on top of a nominal 13 gates (say 4 additional gates have been assumed).

It is normal practice to add a 10% contingency to gate planning to cater for off-schedule operations, unserviceability and the like. Also, in the case of Option C, freight operations are a possibility (both international and domestic). Domestic freighters are assumed to utilise domestic/regional gates mainly at night and no additional gates are assumed to be required. An allowance for an additional 1 Code E gate for international freight has been made. Table 4.5 shows the resulting rounded up busy hour gate demand, broken down by aircraft code with the 10% contingency factor included.

Table 4.5 – Indicative Busy Hour Gate Demand

Movement type	Aircraft Code		
	E	C	Total
International	7	1	8
Domestic	2	23	25
Regional	0	19	19
International Freight	1	0	1

4.3.2.3 Passenger Busy Hour

As there is no published data on passenger numbers within the respective busy hours at Sydney (Kingsford-Smith) Airport, the percentage of flights has been adopted as a proxy for passengers. Table 4.6 shows the calculated indicative passenger demand busy hours by flight category.

Table 4.6 – Passenger Busy Hour Demand

Service Type	Busy Hour	No. of Passengers
International Arrivals	0700-0800	1,103
International Departures	1100-1200	623
Domestic Arrivals	0800-0900	2,110
Domestic Departures	0700-0800	2,373
Regional Arrivals	1000-1100	432
Regional Departures	0800-0900	586

4.3.3 Option D

4.3.3.1 Busy Hour Aircraft Movements

The same hourly profile assumption as shown for Option C above has been adopted for Option D, with the following busy hour conclusions:

- International arrivals busy hour is 0700-0800 with 23% of daily arrivals;
- International departures busy hour is 1100-1200 with 13% of daily departures;
- Domestic arrivals busy hours are 0800-0900 each with 8% of daily arrivals;
- Domestic departures busy hours are 0700-0800 each with 9% of daily departures;
- Regional arrivals busy hour is 1000-1100 with 14% of daily arrivals; and
- Regional departures busy hour is 0800-0900 with 19% of daily departures.

Based on the indicative annual and average daily aircraft movement assumptions for Option D shown in Table 4.3, the calculated indicative busy hour aircraft movement demand by aircraft code is shown in Table 4.7.

Table 4.7 – Indicative Busy Hour Aircraft Movements

Service Type	Aircraft Code			
	F	E	C	Total (Rounded)
International Arrivals	0.4	9.0	2.0	11
International Departures	0.2	5.1	1.1	6
Domestic Arrivals		2.4	9.3	12
Domestic Departures		2.7	10.5	13
Regional Arrivals			6.8	7
Regional Departures			9.2	9

4.3.3.2 Indicative Busy Hour Gate Demand

The indicative busy hour aircraft movements in Table 4.7 can be used to estimate the approximate levels of gate demand that will be required, noting the quite different respective busy hour profiles applicable to the respective flight categories shown from Figure 5.2. For this estimate, gate sharing (which might be available for some domestic and regional operations and possibly with international as well), has not been considered. This has the potential to slightly overstate the overall number of gates required.

In the case of international, the very pronounced morning arrival peak indicates a demand for up to 11 gates simply to meet the arrivals requirement. There would also be a need to cater for overnighters from the previous day that may not have departed prior to the 0700-0800 period. A nominal 40% allowance for this and any other on-ground aircraft (say 5 additional gates have been assumed).

In the case of domestic, the departures and arrivals busy hours follow one another with around 13 movements of each. A 60% allowance on top of a nominal 13 gates (say 8 additional gates have been assumed) to cater for this overlap on-ground period.

In the case of regional, the departures and arrivals busy hours are at the opposite ends of the day. A 30% allowance on top of a nominal 9 gates (say 3 additional gates have been assumed).

It is normal practice to add a 10% contingency to gate planning to cater for off-schedule operations, unserviceability and the like. Also, in the case of Option D, freight operations are a possibility (both international and domestic). Domestic freighters are assumed to utilise domestic/regional gates mainly at night and no additional gates are assumed to be required. An allowance for an additional 2 gates for international freight (one being Code F) has, however, been made. Table 4.8 shows the resulting rounded up busy hour gate demand broken down by aircraft code with the 10% contingency factor included.

Table 4.8 – Indicative Busy Hour Gate Demand

Service Type	Aircraft Code		
	F	E	C
International	1	14	3
Domestic	0	5	18
Regional	0	0	13
International Freight	1	1	0

4.3.3.3 Passenger Busy Hour

As there is no published data on passenger numbers within the respective busy hours at Sydney (Kingsford-Smith) Airport, the percentage of flights has been adopted as a proxy for passengers. Table 4.9 shows the calculated indicative passenger demand busy hours by flight category.

Table 4.9 – Passenger Busy Hour Demand

Service Type	Busy Hour	No. of Passengers
International Arrivals	0700-0800	3,025
International Departures	1100-1200	1,710
Domestic Arrivals	0800-0900	2,038
Domestic Departures	0700-0800	2,293
Regional Arrivals	1000-1100	345
Regional Departures	0800-0900	468

4.4 Runway Capacity Check

The notional/practical capacity of a single runway is in the order of 40 – 50 movements per hour for the assumed aircraft fleet mix. Of the three demand scenarios, Option C has the highest average daily assumed demand of 502 aircraft movements. Using a current Sydney (Kingsford-Smith) Airport schedule as a proxy for the Option C demand scenario, a check was made of the average hourly aircraft movement profile which is shown in Figure 4.4.

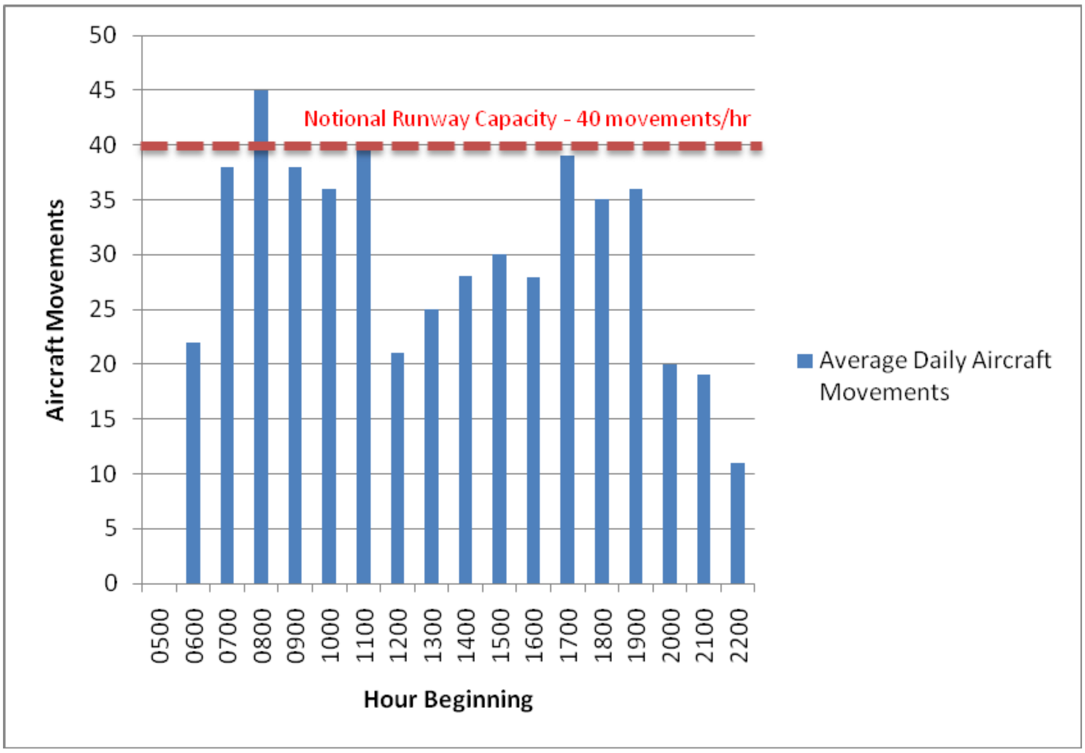

Figure 4.4 – Option C Average Hourly Aircraft Movement Profile

As can be seen from Figure 4.4 there is a possible demand for up to 45 movements in the 0800 hour. Given that it is assumed that runway 10/28 will not be used or will be used only very occasionally to minimise aircraft noise impacts on the residents of Richmond and Windsor, demand management in the form of slot controls may therefore be necessary to restrict movements to match the single runway capacity at the ultimate demand level assumed under Option C. This would most likely be in the form of peak spreading into the adjacent hours and this may also be required in order to be able to accommodate RAAF movements. A similar situation may also arise under Option D but is unlikely under Options A1, A2 and B.

5 INDICATIVE NOISE ASSESSMENTS

5.1 Aircraft Noise

The traditional system of aircraft noise assessment has been based around the Australian Noise Exposure Contour (ANEF) metric, which is a modification of the US Noise Exposure Forecast system. The ANEF is a generic name for three types of equal energy aircraft noise contours:

- The Australian Noise Exposure Forecast (ANEF) is the only metric approved and promoted by the Federal Government for use in determining the suitability of land use in regards to aircraft noise. The ANEF is generally provided for a 20-year time frame, is updated regularly and there can be only one approved set of ANEF contours at a given time. The approving authority is Airservices Australia;
- The Australian Noise Exposure Index (ANEI) provides historical data on aircraft noise exposure. Normally one year's actual traffic at an airport is used to generate the ANEI and the approval process is the same as that for the ANEF; and
- The Australian Noise Exposure Concept (ANEC) is used as a planning tool to investigate likely changes to aircraft noise exposure resulting from proposed changes to conditions at an airport. Those changes include, among other things, changes to aircraft types or numbers.

The ANEF system is described in the Australian Standard AS2021 and is the only method of controlling land use planning at all but two minor Australian aerodromes. It is not used to regulate aircraft operations, but rather to report on the effects of those activities. This system takes into account the frequency, intensity, time and duration of aircraft activities and calculates the total sound energy generated at any location. While ANEF contour charts are often miss-understood by the public at large, various expert committees that have considered the regulation of aircraft noise around Australian aerodromes have concluded that they remain the most appropriate measure available. In the last few years there have been supplementary indices developed to help better describe aircraft noise, in terms that are more readily understood by the public. These indices include N70 and Flight Track Frequency charts.

The only method of calculating ANEF contours is by use of the Integrated Noise Model (INM) developed by the Federal Aviation Agency of the USA. It cannot be directly measured. The INM calculates the aircraft noise exposure for an average day (averaged over a year) at an airport and for an ANEF, this day is an average day of a complete year at the forecast date.

The Australian Standard AS2021 provides guidance to regional, local authorities and others associated with urban and regional planning and building construction on the acceptable location of new buildings in relation to aircraft noise. Zones that are described as 'conditionally acceptable' may be approved as building sites, provided that any new construction incorporates sound proofing measures. Section 2 of the standard gives guidelines for determining the acoustic acceptability of a particular site. Conversely, the standard can be used to assess the noise impact of a new aerodrome or of altering an existing one, by the production of an ANEC.

The Australian Standard AS2021 provides recommended land use compatibility as reproduced at Table 5.1 below. For land designated 'conditionally acceptable' it should be noted that land use authorities might consider that “the incorporation of noise control features in the construction of residences or schools is appropriate”.

Table 5.1- AS2021 Table of Building Site Acceptability Based on ANEF Zones

Building Type	ANEF Zone of Site		
	Acceptable	**Conditional**	**Unacceptable**
House, home unit, flat, caravan park	Less than 20 ANEF (Note 1 of AS2021)	20 to 25 ANEF (Note 2 of AS2021)	Greater than 25 ANEF
Hotel, motel, hostel	Less than 25 ANEF	25 to 30 ANEF	Greater than 30 ANEF
School, university	Less than 20 ANEF (Note 1 of AS2021)	20 to 25 ANEF (Note 2 of AS2021)	Greater than 25 ANEF
Hospital, nursing home	Less than 20 ANEF (Note 1 of AS2021)	20 to 25 ANEF	Greater than 25 ANEF
Public building	Less than 20 ANEF (Note 1 of AS2021)	20 to 30 ANEF	Greater than 30 ANEF
Commercial building	Less than 25 ANEF	25 to 35 ANEF	Greater than 35 ANEF
Light industrial	Less than 30 ANEF	30 to 40 ANEF	Greater than 40 ANEF
Other industrial	Acceptable in all ANEF zones		

Source: AS2021-2000

For aerodromes that do not have ANEF charts published for them, AS2021 provides a land use compatibility table based on measured aircraft noise and frequency of flight. Table 5.2 reproduces that table:

Table 5.2 – AS2021 Table of Building Site Acceptability Based on Aircraft Noise Levels

Building Site	Aircraft Noise Level expected at building site, dB(A)					
	20 or less flights per day			Greater than 20 flights per day		
	Acceptable	Conditionally acceptable	Unacceptable	Accept-able	Conditionally acceptable	Unacceptable
House, home unit, flat, caravan park	<80	80 - 90	>90	<75	75 - 85	>85
Hotel, Motel, hostel	<85	85 - 95	>95	<80	80 - 90	>90
School, university	<80	80 - 90	>90	<75	75 - 85	>85
Hospital, nursing home	<80	80 - 90	>90	<75	75 - 85	>85
Public building	<85	85 - 95	>95	<80	80 - 90	>90
Commercial Building	<90	90 - 100	>100	<80	80 - 90	>90
Light industry	<95	95 - 105	>105	<90	90 - 100	>100
Heavy industry	No limit	No limit	No limit	No limit	No limit	No limit

Source: AS2021-2000

The INM model itself contains a detailed database of aircraft performance and noise characteristics that have been determined from actual detailed measurements of the required parameters. In fact, part of the certification process for new aircraft types is that the manufacturer is required to undertake the required measurements to support the model. The user of the INM is required to supply all other required data, typically covering aircraft operations over an average day, with this day representing the average aviation activities for a whole year. The data required includes:

- Physical data; descriptions of runways and flight tracks and location of any sites for which specific results are required;
- Detailed flight characteristics for any non-standard aircraft operations to be modelled;
- A detailed description of all aircraft flights for the typical, or average, day being modelled; and
- Any variations to the standard output metrics that is required.

Apart from the ANEF contours that are used for land use-planning guidelines at Australian aerodromes, there is a wide range of other metrics that can be calculated using the INM. These include:

- Eight A-weighted metrics (used for standard noise analysis where aircraft noise spectra are modified by depressing noise levels in the low and high frequency bands to approximate the response of the human ear). These metrics include day-night average sound level (the AS2021 Section 4-2 average exposure level) and LAMAX (the AS2021 Section 4-2 maximum exposure level);
- Three C-weighted metrics (used for low-frequency noise analysis where aircraft noise spectra are modified by depressing noise levels in the low and high bands but to a lesser degree than A-weighting); and
- Five perceived tone-corrected noise metrics (used for noise analysis based on aircraft noise certification tests where aircraft noise spectra are modified by depressing noise levels in the low and high frequency bands and elevating metric levels if there are tonnes in the spectra). This family of metrics includes the ANEF contours.

In the last few years there have been supplementary indices developed to help better describe aircraft noise in terms more readily understood by members of the public. These indices include N70, Flight Track Frequency charts and Single Event Contours.

The N70 contour chart is commonly used to supplement an aerodrome's ANEF charts. The N70 is calculated using the INM and indicates the number of aircraft noise events that exceed 70 dB (A). The 70 dB (A) value is used, as it is the external noise level that will be at the disturbance threshold of people in an average residence with doors and windows closed. These contour types can be calculated for whatever noise value is required. For airports with mainly GA movements in regional areas, where background noise levels may be lower and people may spend more time outdoors, the N60 level is more likely to be indicative of the noise regime.

5.2 Airspace and Environmental Constraints

RAAF Base Richmond is situated 29nm to the west of Sydney (Kingsford Smith) Airport, 22nm to the north-west Bankstown airport and has major air-routes leading to/from Sydney (Kingsford-Smith) Airport 15nm to the east and south. To enable an ILS approach to be established on either the R01 or R19 alignment would probably require some re-design of the north-eastern airspace. There appears to be sufficient airspace for aircraft to manoeuvre within the Richmond circuit area, without any conflictions with any Sydney (Kingsford-Smith) Airport traffic. However the arrival and departure routes will require careful design so as to minimise, as far as possible, airborne traffic conflictions.

There are flood plains to the north of Richmond, the townships of Windsor and Richmond close by the east and west of the current airbase, and the major metropolitan area of Penrith to the south. Due to these constraints, it is suggested the air traffic is better concentrated to the north of the existing airbase and that there is some scope for the careful design of flight tracks to minimise (to some degree) aircraft noise intrusions in built-up areas.

5.3 Runway Usage

The Bureau of Meteorology (BoM) half hourly records from 6am to 11pm daily and for the period 1994 to present were analysed for runway usability, due wind velocity and for periods when the weather conditions required an instrument approach.

In ascertaining the runway usability it was assumed that the crosswind limit would be 20KTS and downwind limit 5KTS and the order of selection of runways for use (to minimise aircraft noise impacts on Richmond and Windsor) would be Runway 19, Runway 01, Runway 28 and finally Runway 10. Only the records from 6am to 11pm inclusive (DAY) were included in the analysis:

- The 20KTS / 5KTS criteria are the general commercial limits: a lower 15KTS crosswind limit was examined but there is little difference in runway usage between the two limits;
- Runway 19 was selected for preferential usage as arriving aircraft are assumed to be established on the runway centre line by 5nm, whereas departing aircraft can be turned off the centre line much closer to the airport, thus concentrating aircraft noise over the northern flood plains; and
- The period 6am to 11pm represents the normal operating hours of a commercial airport.

From the BoM Records, the usability of the four runways (with the above criteria) was calculated to be:

- Runway 19 – 84.90%
- Runway 01 – 14.90%
- Runway 28 – 00.16%
- Runway 10 – 00.03%

With the above selection criteria, if Runway 01 were the preferred runway direction[11] then the usability would be:

- Runway 19 – 16.44%
- Runway 01 – 83.37%
- Runway 28 – 00.16%
- Runway 10 – 00.03%

To test the sensitivity of the proposed runway direction to the long term wind velocity, the above calculations (with Runway 19 used preferentially) were repeated for 30° either side of the selected runway bearing in 10° increments. Those results, as a percentage of the observations, were:

Table 5.2 Runway Useability

Runway Useability Sensitivity Test				
Increments	Runway 19	Runway 01	Runway 28	Runway 10
-30°	88.77%	10.98%	0.25%	0.00%
-20°	87.15%	12.24%	0.24%	0.01%
-10°	86.17%	13.59%	0.21%	0.02%
0°	84.90%	14.90%	0.16%	0.03%
10°	83.87%	15.98%	0.11%	0.03%
20°	83.20%	16.70%	0.07%	0.03%
30°	82.61%	17.33%	0.04%	0.02%

[11] However, useability of Runways 10 or 28 might be expected to increase if they were selected as the preferred runway direction.

Finally, with Runway 19 to be used preferentially, the crosswind limit was reduced to 15KTS and the downwind remain at 5KTS and the following usability was calculated:

- Runway 19 – 83.41%
- Runway 01 – 14.78%
- Runway 28 – 01.14%
- Runway 10 – 00.65%

From the above figures, it can be deduced that the wind velocity at Richmond is generally less than 20KTS from the very limited usage required of Runway 10/28. Further, with the similarity of usage of whichever of R01 or R19 was nominated for preferential usage, it would appear that for considerable periods the wind speed was less than 5KTS and so there is no marked preference for the use of either Runway 01 or Runway 19.

The following assumptions have been included in the noise modelling:

- Runway 19 was used in preference to Runway 01, with Runway 19 allocated 85% of aircraft movements and Runway 01 15%; and
- Runway 10/28 was removed from service[12] and therefore no usage was modelled.

Routes Modelled

With a significant amount of civil aircraft movements operating through Richmond there will need to be a system of Richmond arrival and departure routes designed that are integrated with the general traffic flown into and out of Sydney (Kingsford-Smith) Airport. It is suggested that an important design criteria will be the minimization of airborne conflicting traffic streams. The design of such a route system is beyond the scope of this preliminary noise study, as there will be required significant input from Airservices Australia staff and probably a simulation modelling exercise to support that study.

For the purposes of this report only[13], a simplified route system was used comprising five inbound / outbound routes as an example of what might be reasonably expected to eventuate. These routes were:

- Northern (Brisbane and northern ports): inland of the main inbound route via Singleton to Sydney (Kingsford-Smith) Airport;
- Eastern (New Zealand, Pacific or USA): overfly Sydney (Kingsford-Smith) Airport prior to setting course:
- Southern (Canberra, Melbourne): tracks to/from Canberra:
- Western (Adelaide, Perth): tracks to / from Cowra; and
- North/Western (Singapore etc): tracks to / from Mudgee.

Each of the above routes had distinct inbound and outbound tracks separated by 5nm to allow for the segregation of opposite direction traffic. It was assumed that aircraft would be on their track, either arriving or departing at 10nm Richmond.

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[12] This assumption is made solely for modelling purposes - in practice runway 10/28 may be used for very infrequent periods of high crosswind.

[13] Route structure design is ultimately a smatter for Airservices Australia to undertake.

Within the circuit area (a 10nm radius of Richmond), arriving aircraft tracks were designed to intercept a 5nm final at 1,500' AGL and departing aircraft turn to intercept outbound tracks. For runway 01/19 circuit direction is either left or right hand (to minimize airborne conflictions), with aircraft having a downwind leg offset 6km. Both civil and military aircraft were assumed to use this track system. There were no circuit tracks (for training aircraft) included.

In designing a track system and circuit procedures for Runway 01/19 there would appear to be some scope for utilising the Required Navigation Performance procedures to minimise aircraft noise intrusion into built-up areas. While the townships of Richmond and Windsor are both within the close circuit area of the new runway, it should be possible to avoid the normal circuit operations overflying them. There will, however, always be the visual aspect of many more aircraft than at present being active at the airport.

Note that it was assumed that the flight tracks would follow a constant path over the ground, regardless of the runway option modelled. This led to differing contour shapes for Options A1, A2 and B, even though they assume the same aircraft movements. This effect is especially noticeable to the south of the airport, as the aircraft had differing track miles to reach the point where the flight track diverged from the runway centerline. The effect is less noticeable to the north as only 15% of departures operate in that direction.

Figure 5.1 illustrates the flight tracks modelled for aircraft arriving/departing either runway 01 or 19.

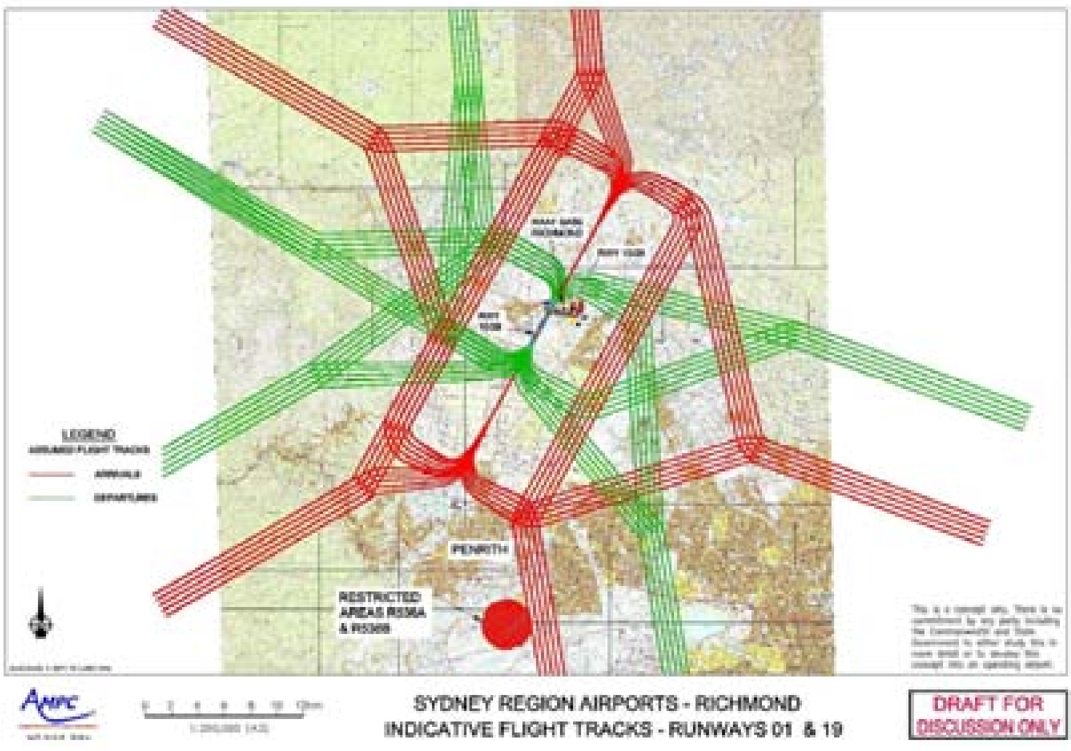


Figure 5.1: Flight Tracks Runways 01 and 19.

5.4 Civil Forecast for 20 Million Passengers

The 20 million passenger forecast was used for runway Options A1, A2 and B and assumes that Richmond will be developed as a domestic reliever airport for Sydney (Kingsford-Smith) Airport. It is assumed that this demand will be catered for by Low Cost Carriers operating Airbus A320 / Boeing

737-800 type aircraft. Assuming an 85% load factor there would need to be 130,720 annual aircraft movements (an arrival or a departure) or an average of 358 movements per day.

To model this scenario it has been assumed that:

- Total daily movements will be 358;
- Aircraft types: 50% B737800 and 50% A320;
- Routes used: North 40%; South 40%; West 20%;
- 85% of movements during the INM day (7am to 7pm) period;
- All departures to be INM Stage 1 (less than 500nm);

5.5 Civil Forecast for 25 Million Passengers

Runway Option C, a 3,000m runway, enables short to medium-haul international operations to be undertaken, as well as full domestic and regional traffic.

The forecast for this scenario assumes that 14% of aircraft movements will be International, 77% Domestic and 9% Regional. Assuming an 85% load factor there would need to be 183,274 annual aircraft movements (an arrival or a departure) or an average of 502 movements per day. Note that this average daily movement demand is close to the limits of a single runway.

To model this scenario it has been assumed that:

- Total daily movements will be 503 comprising;
- 40 International;
- 324 Domestic; and
- 138 Regional aircraft;

Aircraft types:

- International: 85% A330 and 15% B737800/A320;
- Domestic: 10% A330 and 90% B737800/A320; and
- Regional: 11% Q400 and 89% Dash 8-300.

Routes used:

- International: North 20%, East 20%, South 20%, West 10%, North/West 30%;
- Domestic: North 40%, South 40%, West 20%;
- Regional: North 40%, South 40%, West 20%;
- 85% of movements during the INM day (7am to 7pm) period and
- International departures to be INM Stage 4 (less than 2,000nm), all other departures Stage 1.

5.6 Civil Forecast for 30 Million Passengers

The availability of a 4,000m runway under this option would effectively enable the full range of passenger aircraft to operate, up to an including the Code F A380-800 (assuming a 60m wide runway).

The forecast for this scenario assumes that 32% of aircraft movements will be International, 62% Domestic and 6% Regional. Assuming an 85% load factor there would need to be 178,701 annual aircraft movements (an arrival or a departure) or an average of 490 movements per day. Note that this average daily movement demand is close to the limits of a single runway.

To model this scenario it has been assumed that total daily movements will be 503 comprising:

- 99 International;
- 293 Domestic; and
- 98 Regional aircraft.

Aircraft types:

- International: 3% A380, 27% B777-300, 53% A330 and 17% B737800/A320;
- Domestic: 20% A330 and 80% B737800/A320; and
- Regional: 40% Q400 and 60% Dash 8-300.

Routes used:

- International: North 20%, East 20%, South 20%, West 10%, North/West 30%;
- Domestic: North 40%, South 40%, West 20%;
- Regional: North 40%, South 40%, West 20%;
- 85% of movements during the INM day (7am to 7pm) period; and
- International departures to be INM Stage 4 (less than 2,000nm), all other departures Stage 1.

5.7 Military Aircraft

It has been assumed that military aircraft will continue to operate at Richmond at about the level assumed for the 2014 ANEF, that they will conform to the civil runway usage and utilize civil flight tracks. There were 8,160 annual military movements (assuming the standard 240 operational days per year), or an average of 34 movements per day.

To model the military aircraft movements it has been assumed that:

- Total daily movements will be 34;
- Aircraft types: 3 B737-700, 13 C130, 1 C17, 5 DHC6, 11 single piston engine and 1 FA-18;
- Routes used: North 40%; South 40%; West 20%;
- 89% of movements during the INM day (7am to 7pm) period; and
- All Stage 1 departure (where appropriate).

5.8 ANEC Charts

Australian Noise Exposure Concepts (ANEC) has been prepared for each of the five runway development options.

Figures 5.2 to 5.6 show the respective ANECs (with the B707 movements removed in each case):

- Figure 5.2 – Option A1 – 2,600m part on Base (crosses existing R10/28);
- Figure 5.3 – Option A2 – 2,600m off Base (to the south of existing R10/28);
- Figure 5.4 – Option B – 2,800m part on Base (crosses existing R10/28);
- Figure 5.5 – Option C – 3,000m part on Base (crosses existing R10/28); and
- Figure 5.6 – Option D – 4,000m part on Base (crosses existing R10/28).

It should be noted that the 2014 ANEF included a glider strip and a cross runway. These have been retained in the INM as they do not significantly affect the illustration of the impact of adding civilian operations to the main runway. In addition as little change as possible was made to the existing Military ANEF, other than removing the noisy B707 which no longer operates at Richmond Airport.

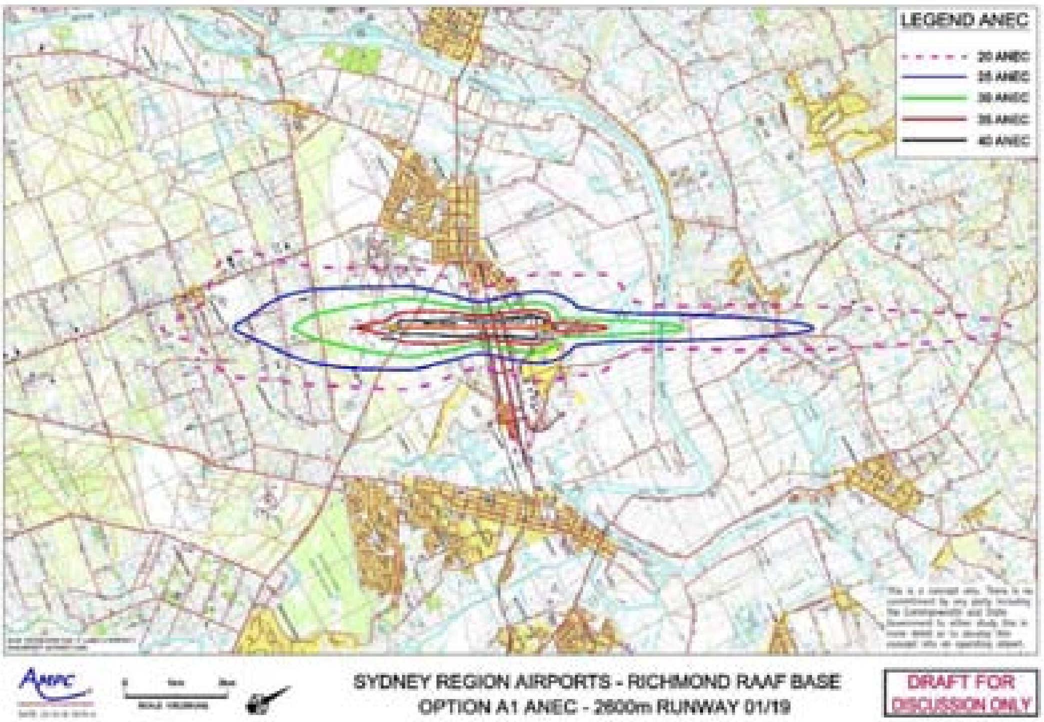


Figure 5.2 – Option A1 – 2,600m part on Base (crosses existing R10/28)

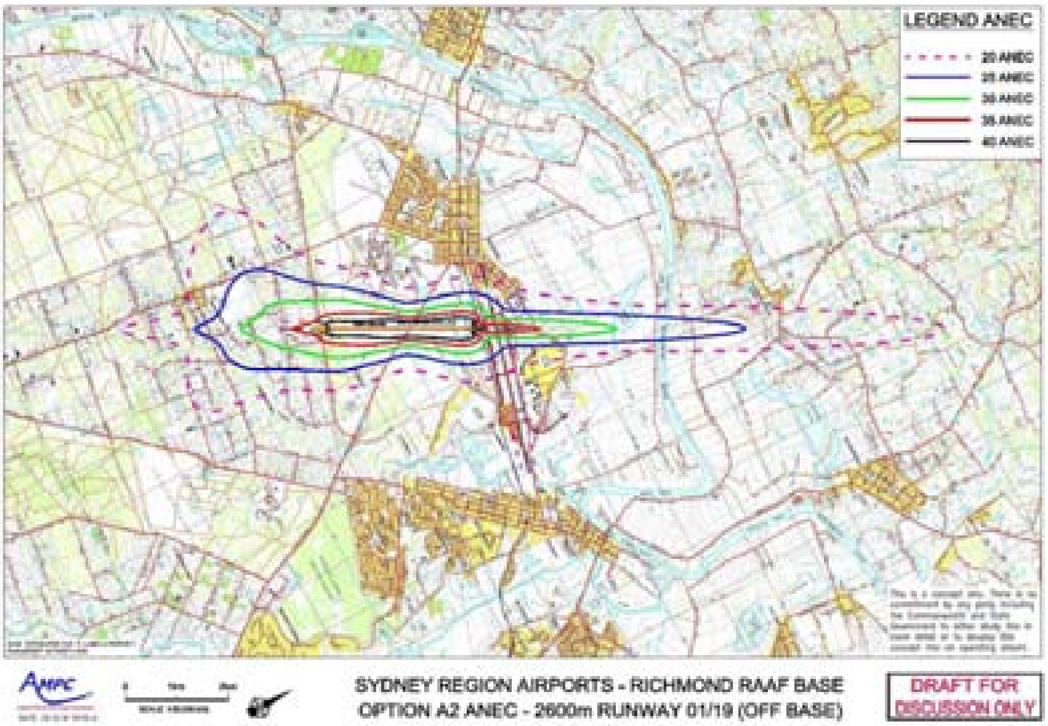


Figure 5.3 – Option A2 – 2,600m off Base (to the south of existing R10/28)

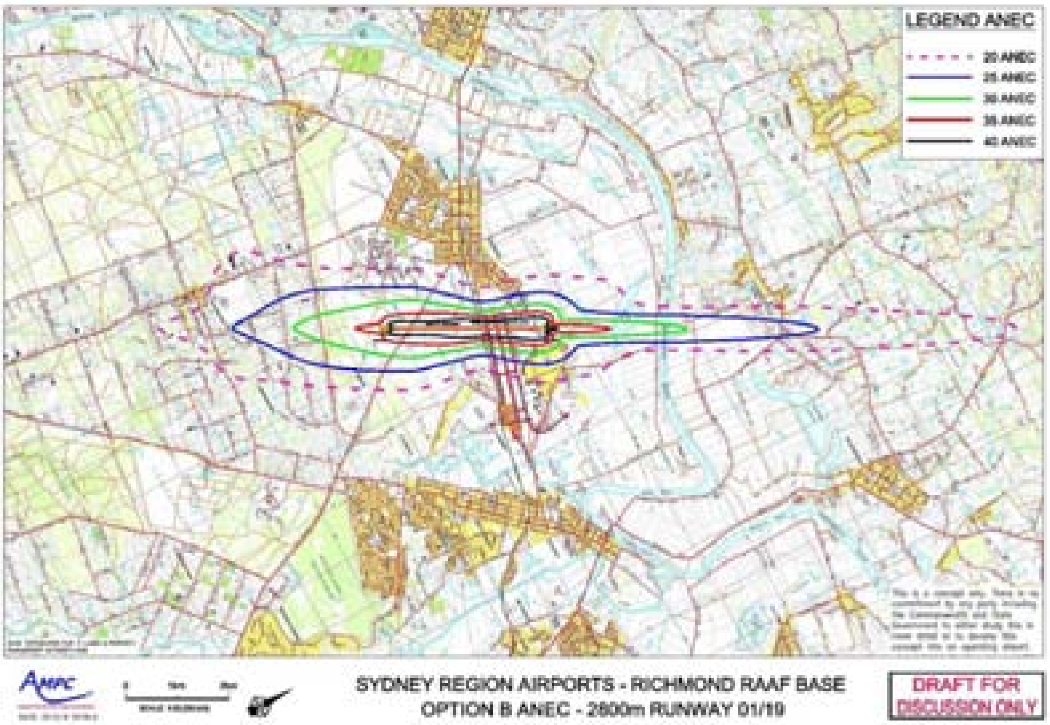


Figure 5.4 – Option B – 2,800m part on Base (crosses existing R10/28)

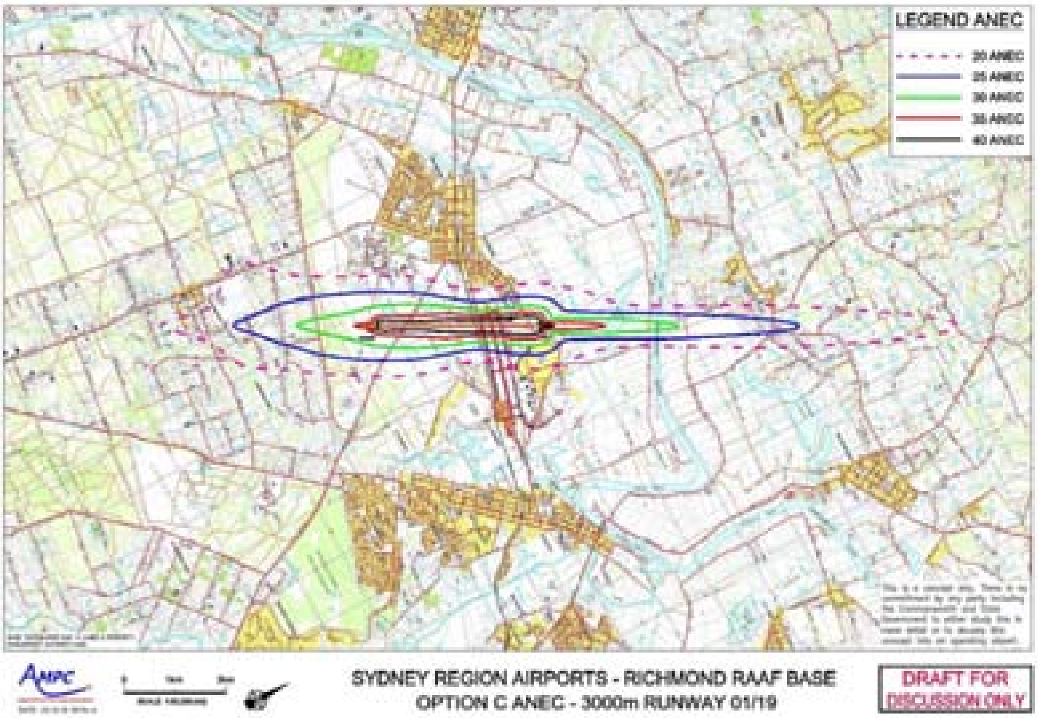


Figure 5.5 – Option C – 3,000m part on Base (crosses existing R10/28)

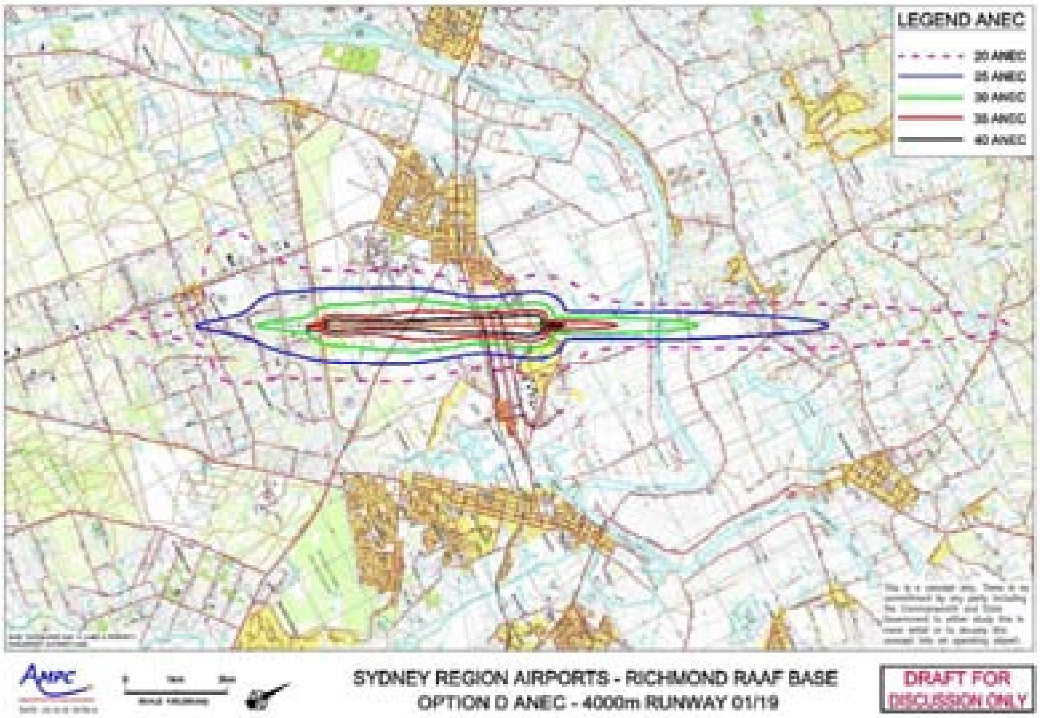


Figure 5.6 – Option D – 4,000m part on Base (crosses existing R10/28)

As may be seen from Figures 5.2 to 5.6, the ANECs for runway 01/19 operation are clear of the urban areas of Richmond and Windsor. The 20 – 25 ANEC goes close to an urban area to the south at Londonderry. The areas to the north are generally flood plain and rural. The ANEC is to the east of Freeman's Reach and well clear of Wilberforce.

With the progressive introduction to Australian airports of the Required Navigation Performance procedures it could be expected that noise abatement flight tracks (perhaps similar to those flown by the RAAF) and aircraft operational procedures would be adopted to reduce aircraft noise exposure to the maximum extent possible.

The RNP require suitably equipped aircraft, flown by qualified crew, to accurately fly flight-tracks designed to avoid the most noise sensitive areas while simultaneously reducing aircraft generated noise to the maximum practical extent. The adoption of RNP procedures could be expected to reduce the aircraft noise exposure from that shown in the current initial study.

5.9 N70 Charts

As the ANEF is a relatively insensitive measure, N70 contours have also been produced as discussed below. Figures 5.7 to 5.11 depict N70s (with the B707 movements removed in each case):

- Figure 5.7 – Option A1 – 2,600m part on Base (crosses existing R10/28);
- Figure 5.8 – Option A2 – 2,600m off Base (to the south of existing R10/28);
- Figure 5.9 – Option B – 2,800m part on Base (crosses existing R10/28);
- Figure 5.10 – Option C – 3,000m part on Base (crosses existing R10/28); and
- Figure 5.11 – Option D – 4,000m part on Base (crosses existing R10/28).

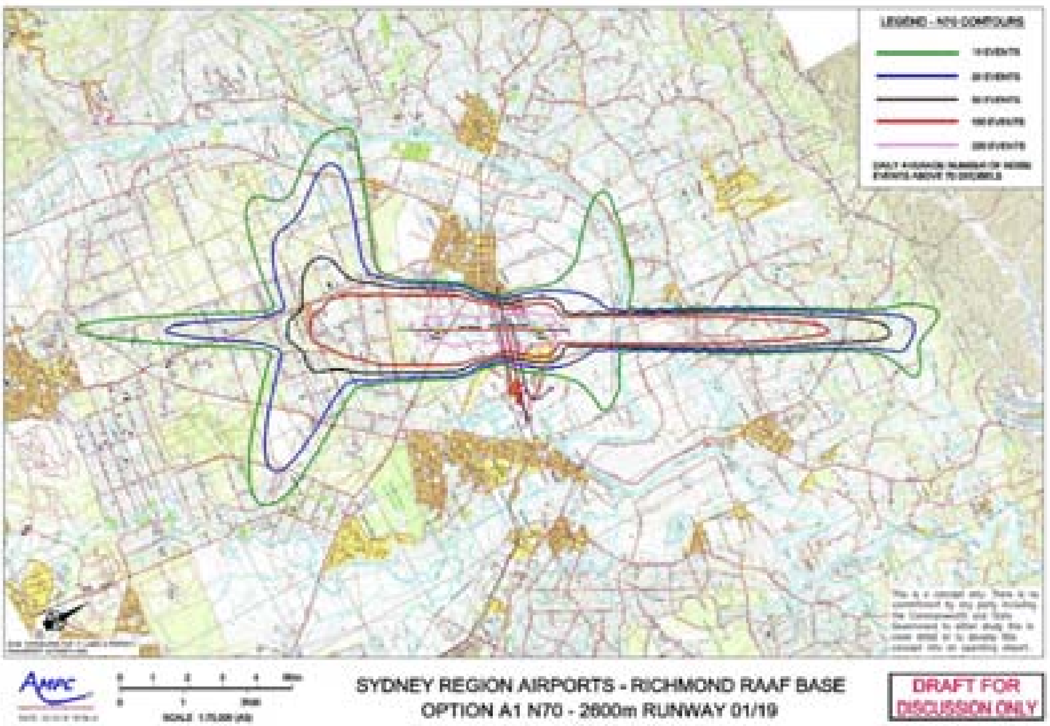


Figure 5.7–Option A1 – 2,600m part on Base (crosses existing R10/28) N70

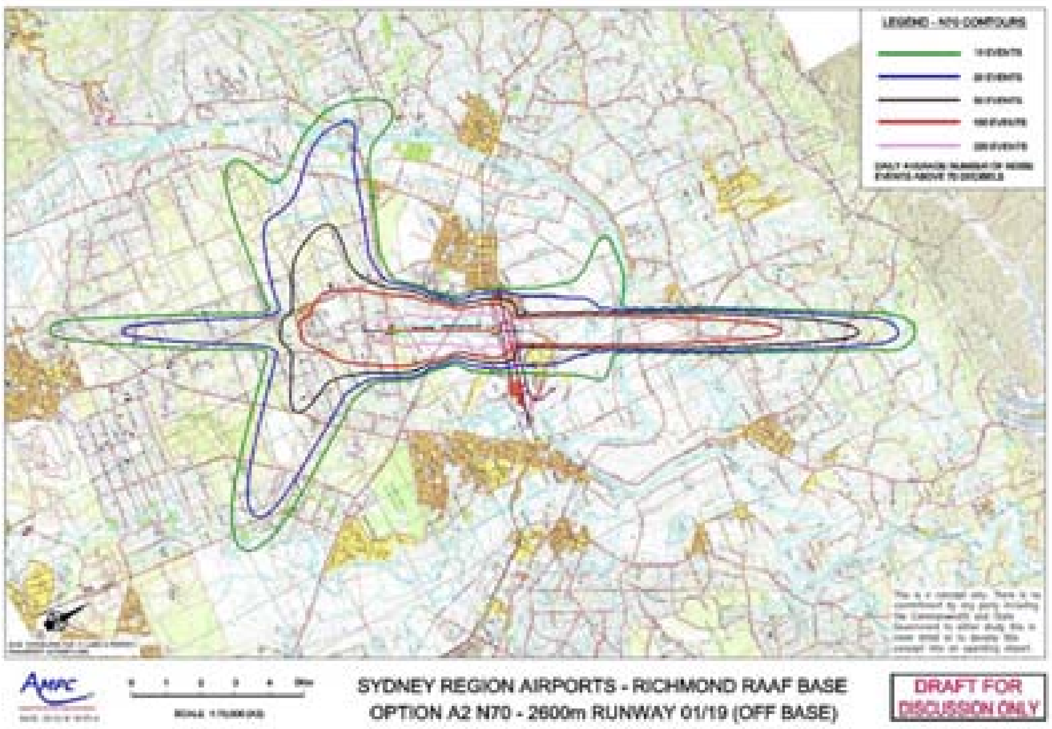


Figure 5.8–Option A2 – 2,600m off Base (to the south existing R10/28) N70

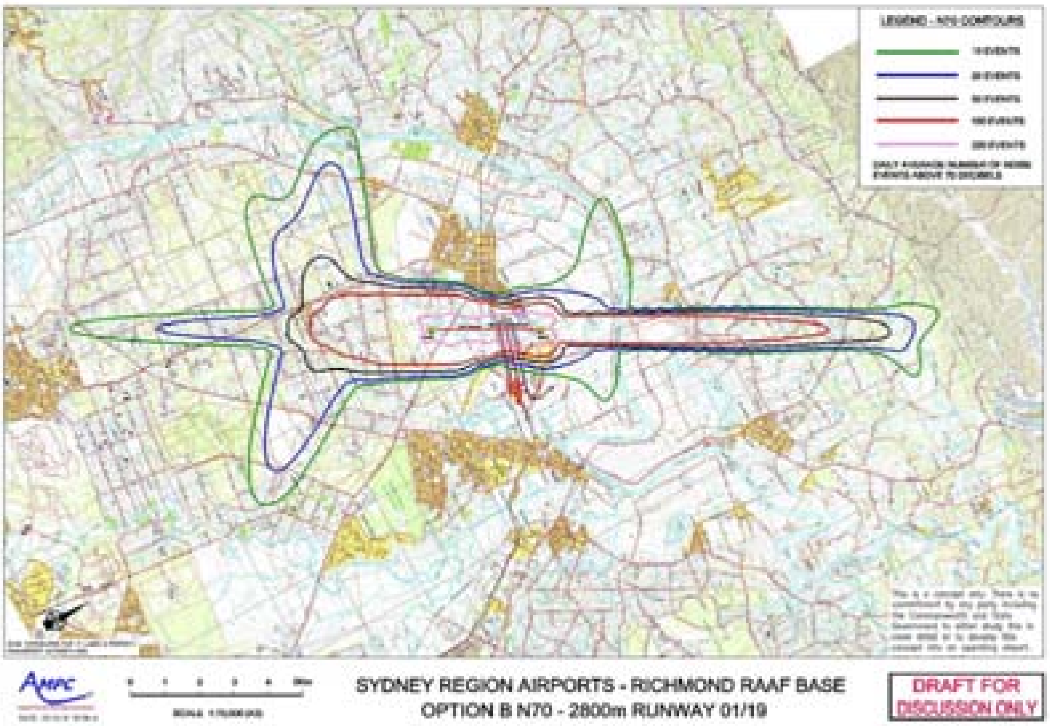


Figure 5.9 –Option B – 2,800m part on Base (crosses existing R10/28) N70

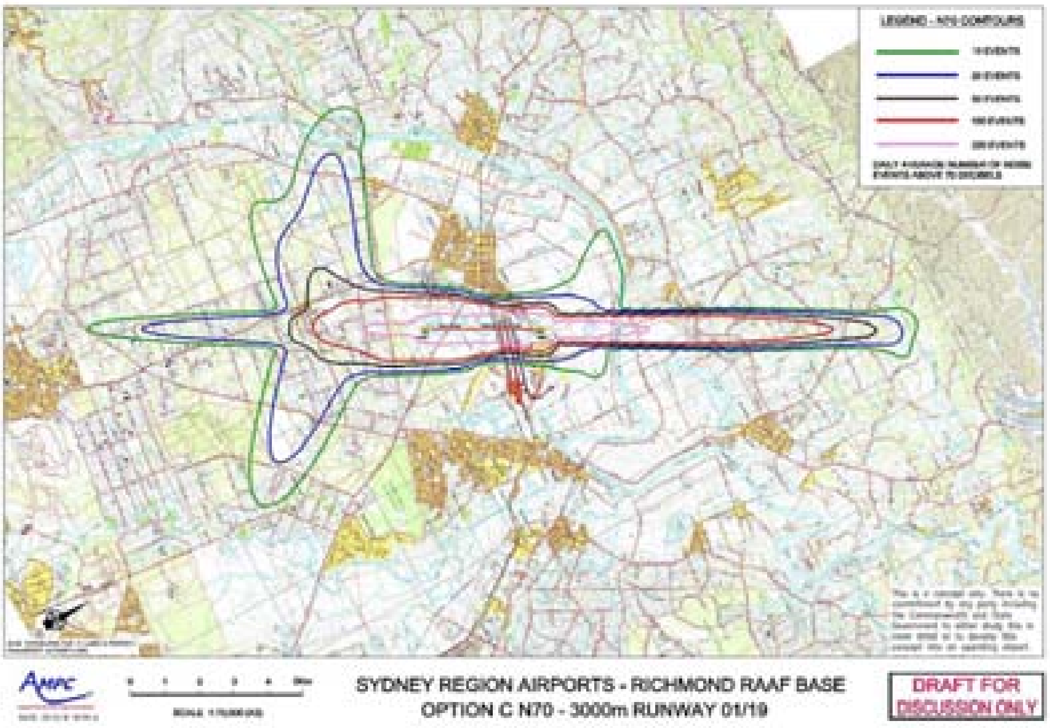


Figure 5.10 –Option C – 3,000m part on Base (crosses existing R10/28) N70

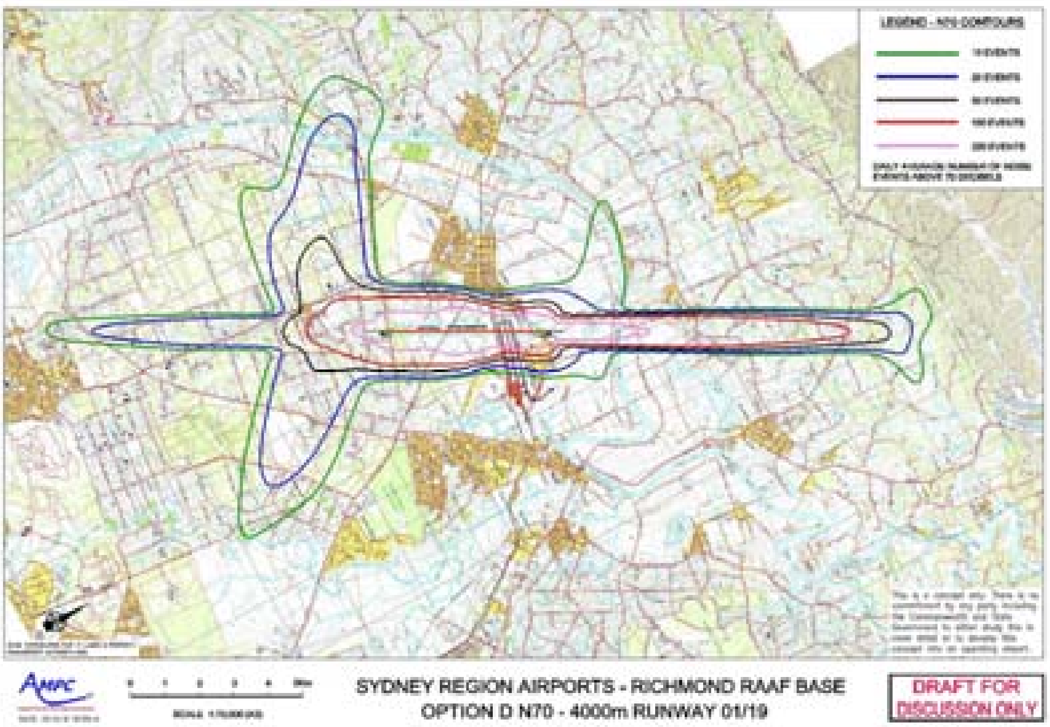


Figure 5.11 –Option D – 4,000m part on Base (crosses existing R10/28) N70

As expected the N70 contours show a larger area of impact than the ANEF contours. The most noticeable increases are the overall increases in length of the contours along the extended runway centreline and the areas east and west of the southern end of the runway and an area to the west at the northern end of the runway. Based on the topographic map the areas affected are relatively less densely populated.

6 AIRPORT DEVELOPMENT OPTIONS

6.1 A1 2,600m Runway (part on Base) – Minimal startup

The Department has expressed an interest in a minimal start up cost for civil RPT operation at Richmond. Figure 6.1 shows a version of the 2,600 m runway concept A1 with a minimal terminal development. All airfield works including on the existing 10/28 runway are assumed to be the same and all adjustments to existing transport systems and other infrastructure are assumed to be as per the full capacity development in concept A1. The standard of terminal was assumed to be similar to the minimal terminal proposed for a startup operation of the east west runway. All major relocations and airfield works are assumed to take place to their long term positions, as are also proposed in the full Concept A1.

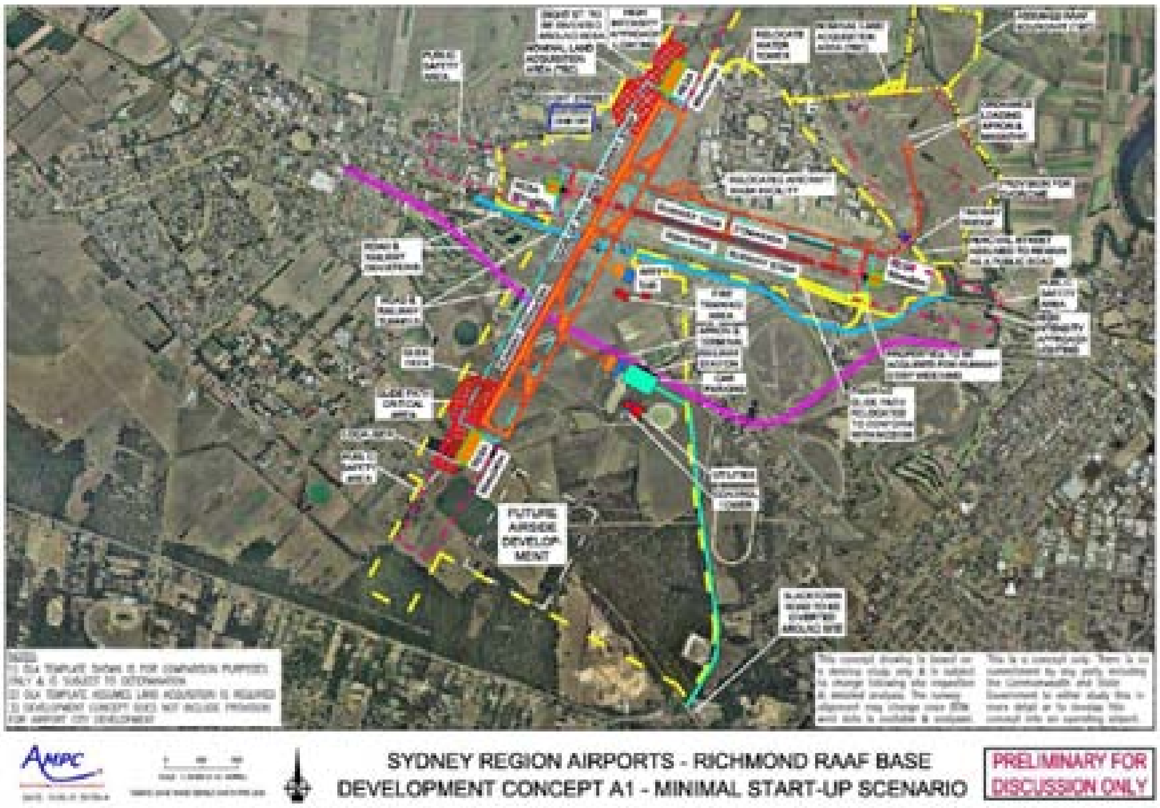


Figure 6.1 – Development Concept A1 – Minimal Start-up
Source: Base Image Google Earth Pro 2010 (Image Date January 2007)

6.2 A1 2,600m Runway (part on Base)

The development concept for Option A1 is shown in Figure 6.2. Option A1 assumes RAAF operations remain, with the development concept aiming to provide physical separation between the civil and RAAF areas. The civil part of the airport will serve essentially as a domestic reliever airport with a runway length of 2,600m. For the Development Concept A1, the new civil RPT apron, parallel and link taxiways, terminal and car park are proposed to be located to the south of the base on the UWS lands and affect the current alignments of Hawkesbury way and the Richmond rail line.

Key features are as follows:

- 2,600m long runway 01/19;
- Code E Runway 01/19 45m wide;
- 300m wide runway strip provided for Runway 01/19;
- High Intensity Approach Lighting shown for 01/19 Runways;
- Full length dual parallel taxiways for Runway 01/19 (spaced for future Code F operations);
- 300m wide runway strip provided for Runway 10/28;
- Provision of mandatory civil RESA on all runways;
- Full length Code E parallel taxiway south of Runway 10/28;
- Full length Code E parallel taxiway north of Runway 10/28;
- New domestic civil RPT apron, terminal and car park in the south-east sector of the base;
- New civil fuel farm;
- Provision for freight and aircraft maintenance facilities;
- New control tower and fire station;
- Relocated RAAF aircraft wash bay and relocation of existing elevated water tank.
- Assumed that there is no requirement for replacement of the C130 apron in the north-west sector to compensate that lost due to the Code E parallel taxiway;
- Relocated OLA apron in the north-east sector and associated taxiway link;
- Provision for a VOR/DME in the north-east sector;
- Relocation in tunnel of the rail line to the new terminal and provision of a new rail station adjacent to and integrated with the terminal; and
- Relocation of Richmond Road and provision of a road tunnel under the new runway 01/19 strip and associated taxiways.

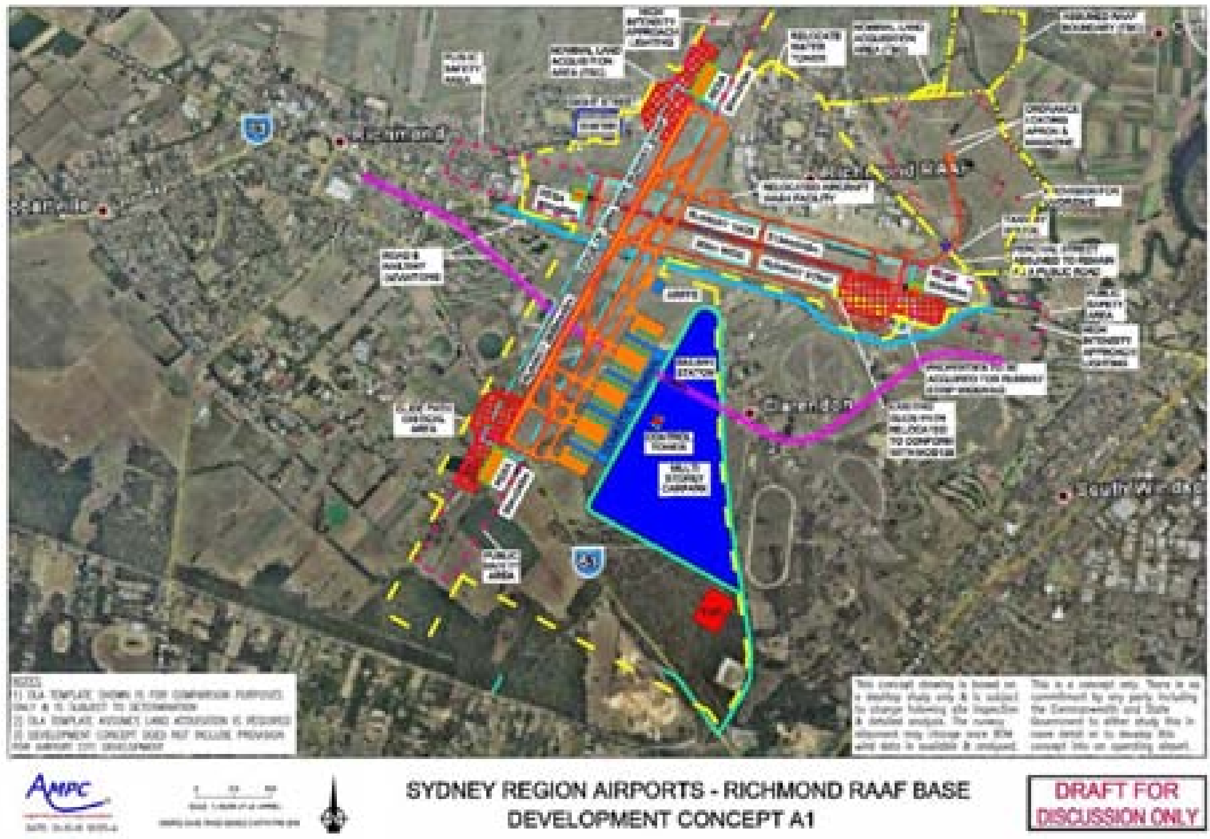


Figure 6.2 – Development Concept A1
Source: Base Image Google Earth Pro 2010 (Image Date January 2007)

6.3 Development Option A2 2,600m (off Base)

The development concept for Option A2 is shown in Figure 6.3. Option A2 assumes RAAF operations remain, with the development concept aiming to provide physical separation between the civil and RAAF areas. The civil part of the airport will serve essentially as a domestic reliever airport with a runway length of 2,800m. For the Development Concept A2, the new civil RPT apron, parallel and link taxiways, terminal and car park are proposed to be located to the south of the base on the UWS lands and affect the current alignments of Hawkesbury way and the Richmond rail line. The main difference with Option A1 is that the 2,600m starts south of the existing Runway 10/28 (off RAAF Base).

Key features are as follows:

- 2,800m long runway 01/19;
- Runway 01/19 Code E 45m wide;
- 300m wide runway strip provided for Runway 01/19;
- High Intensity Approach Lighting shown for 01/19 Runways;
- Full length dual parallel taxiways for Runway 01/19 (spaced for future Code F operations);
- 300m wide runway strip provided for Runway 10/28;
- Provision of mandatory civil RESA on all runways;

- Full length Code E parallel taxiway south of Runway 10/28;
- Full length Code E parallel taxiway north of Runway 10/28;
- New civil domestic RPT apron, terminal and car park in the south-east sector of the base;
- New civil fuel farm;
- Provision for freight and aircraft maintenance facilities;
- New control tower and fire station;
- Relocated RAAF aircraft wash bay and relocation of existing elevated water tank;
- Assumed that there is no requirement for replacement of the C130 apron in the north-west sector to compensate that lost due to the Code E parallel taxiway;
- Relocated OLA apron in the north-east sector and associated taxiway link;
- Provision for a VOR/DME in the north-east sector;
- Relocation in tunnel of the rail line to the new terminal and provision of a new rail station adjacent to and integrated with the terminal; and
- Relocation of Richmond Road and provision of a road tunnel under the new runway 01/19 strip and associated taxiways.

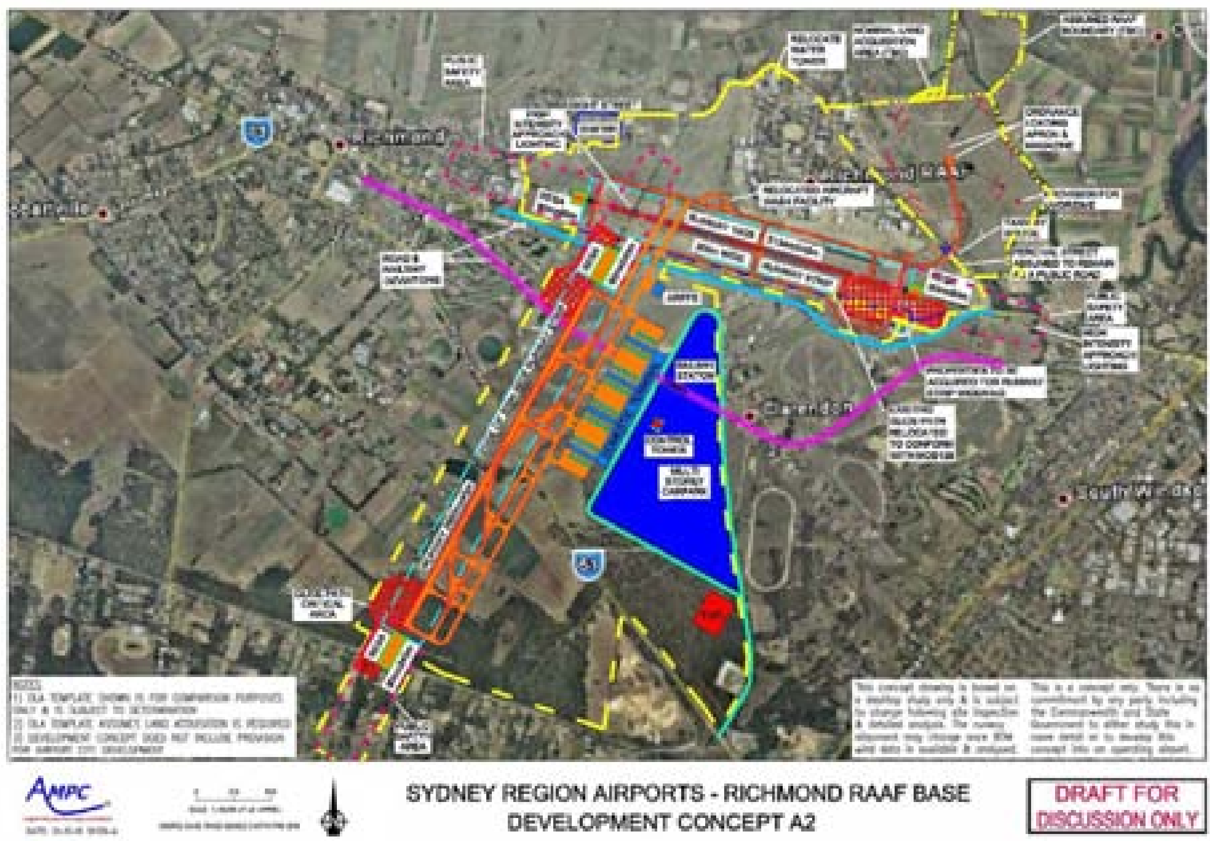


Figure 6.3 – Development Concept A2
Source: Base Image Google Earth Pro 2010 (Image Date January 2007)

6.4 Development Option B 2,800m Runway (part on base)

The development concept for Option B is shown in Figure 6.4. Option B assumes RAAF operations remain, with the development concept aiming to provide physical separation between the civil and RAAF areas. The civil part of the airport will serve essentially as a domestic reliever airport with a runway length of 3,000m. For the Development Concept B, the new civil RPT apron, parallel and link taxiways, terminal and car park are proposed to be located to the south of the base on the UWS lands and affect the current alignments of Hawkesbury way and the Richmond rail line.

Key features are as follows:

- 3,000m long runway 01/19;
- Runway 01/19 Code E 45m wide;
- 300m wide runway strip provided for Runway 01/19;
- High Intensity Approach Lighting shown for 01/19 Runways;
- Full length dual parallel taxiways for Runway 01/19 (spaced for future Code F operations);
- 300m wide runway strip provided for Runway 10/28;
- Provision of mandatory civil RESA on all runways;
- Full length Code E parallel taxiway south of Runway 10/28;
- Full length Code E parallel taxiway north of Runway 10/28;
- New domestic civil RPT apron, terminal and car park in the south-east sector of the base;
- New civil fuel farm;
- Provision for freight and aircraft maintenance facilities;
- New control tower and fire station;
- Relocated RAAF aircraft wash bay;
- Assumed that there is no requirement for replacement of the C130 apron in the north-west sector to compensate that lost due to the Code E parallel taxiway;
- Relocated OLA apron in the north-east sector and associated taxiway link;
- Provision for a VOR/DME in the north-east sector;
- Relocation in tunnel of the rail line to the new terminal and provision of a new rail station adjacent to and integrated with the terminal;
- Relocation of Richmond Road and provision of a road tunnel under the new runway 01/19 strip and associated taxiways; and
- Relocation of existing elevated water tank.

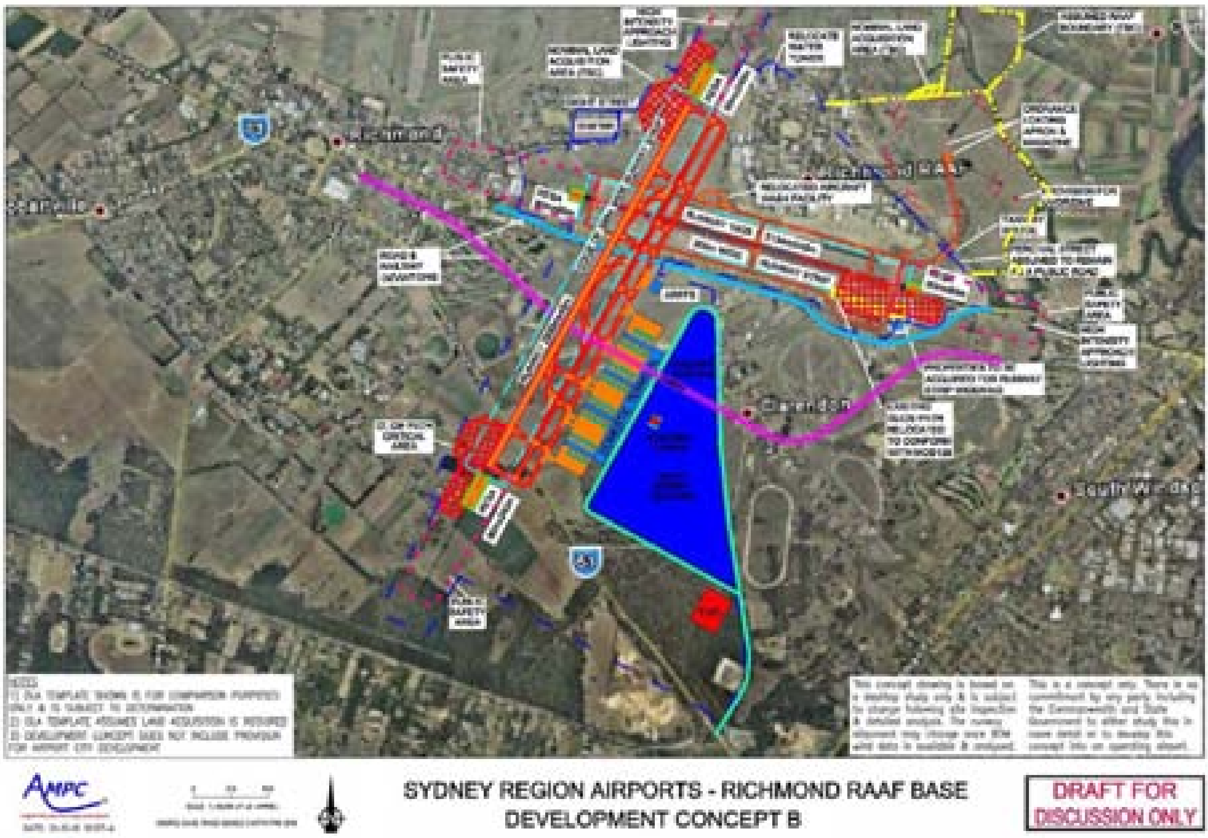


Figure 6.4 – Development Concept B
Source: Base Image Google Earth Pro 2010 (Image Date January 2007)

6.5 Development option C 3,000m Runway (part on base)

The development concept for Option C is shown in Figure 6.5. Option C assumes RAAF operations remain, with the development concept aiming to provide physical separation between the civil and RAAF areas. The civil part of the airport will serve essentially as a limited international plus domestic and regional airport with a runway length of 3,000m. For the Development Concept C, the new civil RPT apron, parallel and link taxiways, international and domestic terminals and car park are proposed to be located to the south of the base on the UWS lands and affect the current alignments of Hawkesbury way and the Richmond rail line.

Key features are as follows:

- 3,000m long runway 01/19;
- Runway 01/19 Code E 45m wide;
- 300m wide runway strip provided for Runway 01/19;
- High Intensity Approach Lighting shown for 01/19 Runways;
- Full length dual parallel taxiways for Runway 01/19 (spaced for future Code F operations);
- 300m wide runway strip provided for Runway 10/28;
- Provision of mandatory civil RESA on all runways;

- Full length Code E parallel taxiway south of Runway 10/28;
- Full length Code E parallel taxiway north of Runway 10/28;
- New civil International RPT apron, terminal and car park in the south-east sector of the base;
- New civil domestic RPT apron, terminal and car park in the south-east sector of the base;
- New civil fuel farm;
- Provision for freight and aircraft maintenance facilities;
- New control tower and fire station;
- Relocated RAAF aircraft wash bay;
- Assumed that there is no requirement for replacement of the C130 apron in the north-west sector to compensate that lost due to the Code E parallel taxiway;
- Relocated OLA apron in the north-east sector and associated taxiway link;
- Provision for a VOR/DME in the north-east sector;
- Relocation in tunnel of the rail line to the new terminal and provision of a new rail station adjacent to and integrated with the terminal;
- Relocation of Richmond Road and provision of a road tunnel under the new runway 01/19 strip and associated taxiways; and
- Relocation of existing elevated water tank.

Figure 6.5 – Development Concept C
Source: Base Image Google Earth Pro 2010 (Image Date January 2007

6.6 Development Option D 4,000m Runway (Part on base)

The development concept for Option D is shown in **Figure 6.6.** Option D assumes RAAF operations remain, with the development concept aiming to provide physical separation between the civil and RAAF areas. The civil part of the airport will serve essentially as a limited international plus domestic and regional airport with a runway length of 4,000m. For the Development Concept D, the new civil RPT apron, parallel and link taxiways, international and domestic terminals and car park are proposed to be located to the south of the base on the UWS lands and affect the current alignments of Hawkesbury way and the Richmond rail line.

Key features are as follows:

- 4,000m long runway 01/19;
- Runway 01/19 Code F 60m wide;
- 300m wide runway strip provided for Runway 01/19;
- High Intensity Approach Lighting shown for 01/19 Runways;
- Full length dual parallel taxiways for Runway 01/19 (spaced for future Code F operations);
- 300m wide runway strip provided for Runway 10/28;
- Provision of mandatory civil RESA on all runways;
- Full length Code E parallel taxiway south of Runway 10/28;
- Full length Code E parallel taxiway north of Runway 10/28;
- New civil International RPT apron, terminal and car park in the south-east sector of the base;
- New civil domestic RPT apron, terminal and car park in the south-east sector of the base;
- New civil fuel farm;
- Provision for freight and aircraft maintenance facilities;
- New control tower and fire station;
- Relocated RAAF aircraft wash bay and relocation of existing elevated water tank;
- Assumed that there is no requirement for replacement of the C130 apron in the north-west sector to compensate that lost due to the Code E parallel taxiway;
- Relocated OLA apron in the north-east sector and associated taxiway link;
- Provision for a VOR/DME in the north-east sector;
- Relocation in tunnel of the rail line to the new terminal and provision of a new rail station adjacent to and integrated with the terminal; and
- Relocation of Richmond Road and provision of a road tunnel under the new runway 01/19 strip and associated taxiways.

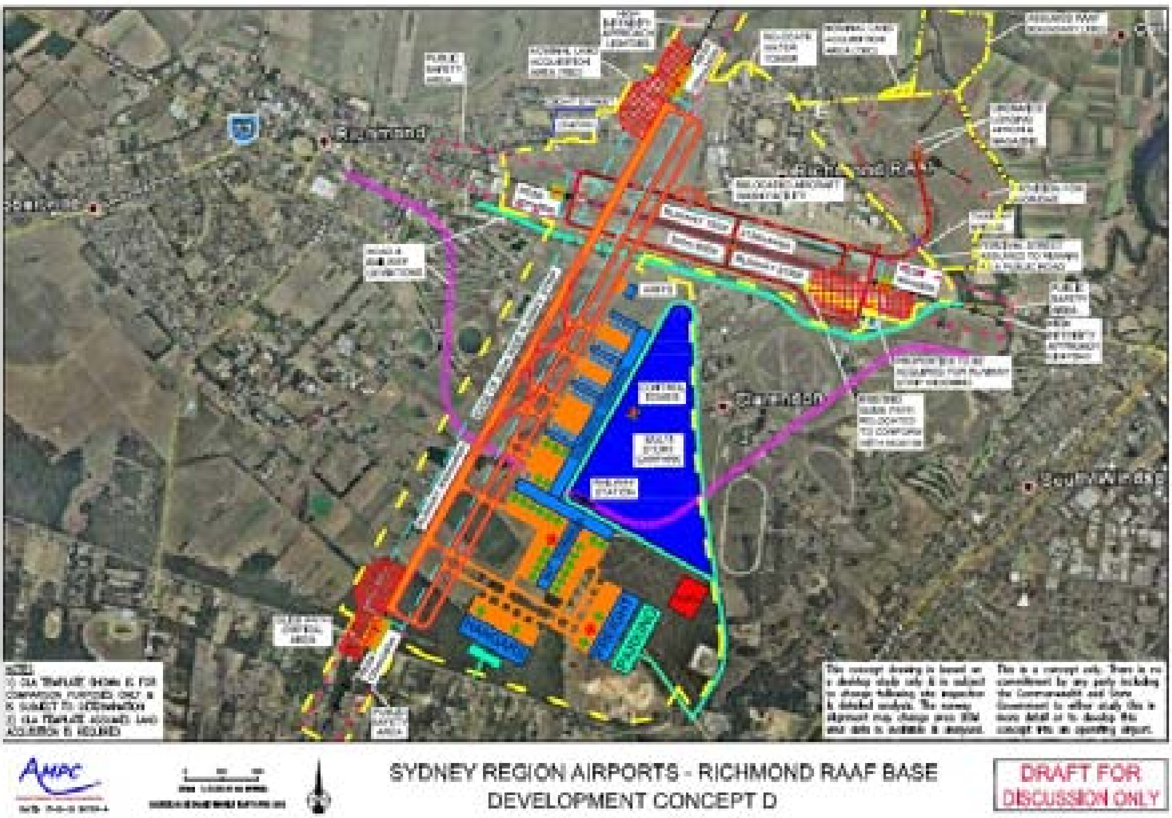


Figure 6.7 – Development Concept D

Source: Base Image Google Earth Pro 2010 (Image Date January 2007

7 MAJOR TRANSPORT INFRASTRUCTURE

7.1 Roads

Road access is likely to be the major mode of accessing any form of Civil RPT airport at Richmond.

As indicated in Figure 1.2, while Richmond is located at the far northwest of the Sydney Basin and metropolitan area, there are potentially good road connections to the major motorway and arterial road systems of Sydney. [14]

Four major roads provide access to the general area of Richmond. These are:

- From the West – Bells Line Of Road;
- From Penrith and the South - Castlereagh Road, Londonderry Road and The Northern Road;
- From Liverpool, Blacktown and the South East – Richmond and Blacktown Roads; and
- From the North and East – Windsor Road.

All of these roads make connections with the M4, M2 and M7 motorways which then permit access to and around the metropolitan area of Sydney. Given that an RPT airport will become a major source and attractor of road users, progressive upgrading of some of these roads would be expected to be required, with the prime candidates being Windsor and Richmond Roads. Examples of these connections are given in Table 7.1, assuming free flowing road conditions.

Table 7.1 Road Travel Connections

From Richmond to:	Distance (kms)	Road Travel Time (hrs:mins)
M7 Motorway	20	0:29
Sydney CBD	65	1:05
Penrith	27	0:39
Blacktown	27	0:44
Parramatta	44	0:52

There are also other lesser roads which provide some degree of alternative access to and from the Richmond area.

Depending upon the configuration of airport chosen for startup based on an 01/19 runway, it would be necessary to make modifications to the road system in and around Richmond.

- Regardless of any runway option there would be severance of the Hawkesbury Valley Way which connects Windsor and Richmond along the Southern boundary of RAAF Richmond. It is assumed that the optimum solution (though most expensive) would be to maintain such access by lowering the road into a cut and cover tunnel structure. If

[14] Refer also to *"Airport Infrastructure in the Sydney Region" WorleyParsons / AMPC for the Department of Infrastructure, Transport Regional Development and Local Government August 2010*

acceptable from a local and regional traffic planning perspective, the alternative would be to truncate the road and upgrade other roads to restore acceptable levels of accessibility in and around Richmond. This road would then be one of two primary accesses to the Airport.

- Blacktown Road would need to be diverted to the south across the Blacktown Paddocks of The University of Western Sydney to reconnect via the alignment to The Driftway in the vicinity of the intersection of George Street, Richmond Road and the Northern Road. A diverted Blacktown Road would also provide the other major access to the Airport.

7.2 Rail

With the obvious exception of Sydney (Kingsford-Smith) Airport, RAAF Richmond airport is unique for its proximity to the existing Sydney metropolitan railway network. Of all other airports in the Sydney Region only Illawarra Airport approaches Richmond for this proximity.

With only two stations beyond the existing stations to any future airport, Richmond is effectively the end of the Richmond Branch line and is likely to remain so for the foreseeable future. The line connects the main west line at Blacktown and as a part of the North Shore and Western Line component of the network, provides direct services to the Sydney CBD via Parramatta, Strathfield and intermediate stations, as well as continuing across the bridge to the North Shore and Hornsby. In the vicinity of the airport, the line is single track and is served by a half hourly service. However, a significant upgrading is taking place, with duplication of the line extending to Riverstone, in response to expected increased demand from northwest sector urbanisation.

Table 7.2 shows the current travel connections.

Table 7.2 Direct Rail Travel Connections

From Richmond (Clarendon Station) to:	Distance (kms)	Travel Time (hrs:mins)
Blacktown	22.3	0:32
Parramatta	34.0	0:50
Strathfield	45.4	1:06
Central	57.1	1:21
North Sydney	62.3	1:14
Chatswood	68.9	1:47
Hornsby	82.5	2:12

At Central, it is possible to interchange to the Airport Line, giving access to the domestic and International Terminals at Sydney (Kingsford-Smith) Airport.

As has been discussed and shown elsewhere herein, a north-south runway able to support RPT operations will cause severance of the existing rail link to Richmond. The key issue is how this is addressed in terms of:

- Firstly, that severance; and

- Secondly, facilitating the use of rail by users of and workers at an RPT airport at Richmond.

In the schemes that have been described in the preceding section, the following basic principles were adopted:

- Rail services should continue to the existing Richmond station;
- Availability of rail access to the airport is regarded as important;
- Accordingly, it would be necessary to lower the railway into a cut and cover tunnel below the proposed 01/19 runway;
- In view of the very high cost of such works, this should happen once only and accordingly whatever works are undertaken should suit the long-term structure and operation of the airport;
- From an airport user perspective, access to/from the railway from/to the terminal should have the least amount of 'friction' or difficulty of access[15] - the rail station then is ideally centrally placed; and
- For these reasons the rail link is shown significantly deviating from its existing alignment in the preceding schemes.

However other options are available as indicated in the discussion paper on rail access, provided in Appendix 2.

A decision about what form rail access should take and how to maintain existing services to Richmond requires inputs on the manner in – and rate at – which an RPT airport is developed and the profile of its potential market.

[15] 'friction' or difficulty of access is a known deterrent to use of public transport, particularly at airports for travelers with luggage. Hong Kong Airport rail link has a very low level of friction because of the absence of any steps between the floor of the train and the floor of the plane; Sydney Airport by contrast has a relatively high level of friction because of the number of steps and escalators for the same journey.

8 INDICATIVE COST ESTIMATES

8.1 Type of Estimate

WorleyParsons employs four basic types of cost estimates that are used to evaluate, approve, and/or fund projects. The estimate types vary according to purpose, applicable project phase, anticipated accuracy, available data, time available for preparation, method of pricing and work processes. The graphic below depicts the WorleyParsons standard estimate classifications, as related to typical project events over time.

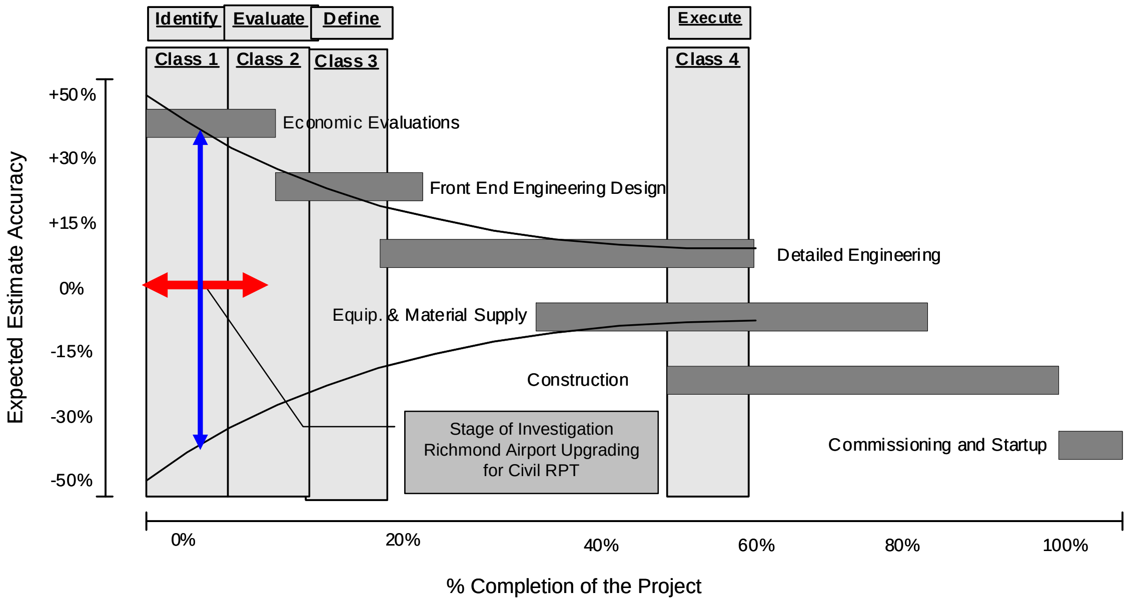


Figure 8.1 Class of Cost Estimate

On the basis of the level of work which has been undertaken to date, the resulting cost estimate would not be better than a Class 1 estimate and should be assumed to have a 50% probability of being exceeded. Additionally for this class of estimate, a contingency in the range 20% to 25% should be allowed. An estimate of this calibre is usually used for screening or comparing alternative concepts, but cannot be regarded as investment grade or suitable for budgetary purposes, particularly given the number and degree of possible items which could be unassessed and uncosted.

8.2 Cost Estimates for Concepts A1, C and D

As a part of the work being carried out for Greenfield Sites investigations for the Department, cost estimates were prepared for a number of representative airport sites in the Sydney Region. In parallel with these estimates were produced for the development of a North South Runway at Richmond. These estimates are reproduced in full in Appendix 1 and summarized below in Table 8.1.

Table 8.1 Estimated Cost of North South Runway Airport Development at Richmond

Estimated Cost of Airport Development at Richmond (millions rounded nearest $1,000,000)				
Item Reference No.	**Item**	**4000 m Runway**	**3000 m Runway**	**2600 m Runway**
0000	**Total Estimated Richmond North South Development Cost**	**$10,844**	**$8,476**	**$5,368**
1000	**General**	**$363**	**$294**	**$272**
1100	Site preparation	$363	$294	$272
2000	**Airside north-south runway works**	**$4,386**	**$3,072**	**$1,372**
2100	Site preparation	$149	$88	$68
2200	Runways	$118	$71	$62
2300	Taxiways	$361	$254	$185
2400	Apron / hardstand	$457	$264	$128
2500	Terminal	$2,402	$1,574	$619
2600	Roads / carpark / services	$320	$280	$140
2700	Other airport infrastructure	$180	$174	$163
2800	Facilities	$399	$367	$7
3000	**Airside runway 10/28 works**	**$269**	**$269**	**$269**
3100	Runway	$28	$28	$28
3200	Taxiways - northern	$80	$80	$80
3300	Taxiways - southern	$63	$63	$63
3400	Other airport infrastructure	$2	$2	$2
3500	RAAF facilities	$96	$96	$96
4000	**Landside works**	**$1,454**	**$1,448**	**$1,448**
4100	Access - road	$888	$888	$888
4200	Access - rail	$309	$307	$309
4300	Major utilities	$105	$101	$99
4400	Aviation fuel pipeline	$151	$151	$151
4500	Telecommunications	$1	$1	$1
5000	**Miscellaneous**	**$4,372**	**$3,393**	**$2,007**
5100	Preliminaries / margins / fees	$4,372	$3,393	$2,007
5101	Preliminaries, Profit etc (+15%)	$930	$722	$463
5102	Project Management & Consultants Fees (+15%)	$930	$722	$463
5103	Project Contingency (+25%)	$1,551	$1,203	$772
5104	Uncosted Items (+10%)	$961	$746	$309
	Passenger throughput millions	30	25	20
	Cost per annual passenger	$361	$339	$268

These estimates are based on the concepts described earlier and assume the full development of the concept, as shown occurs in a single project with no staging.

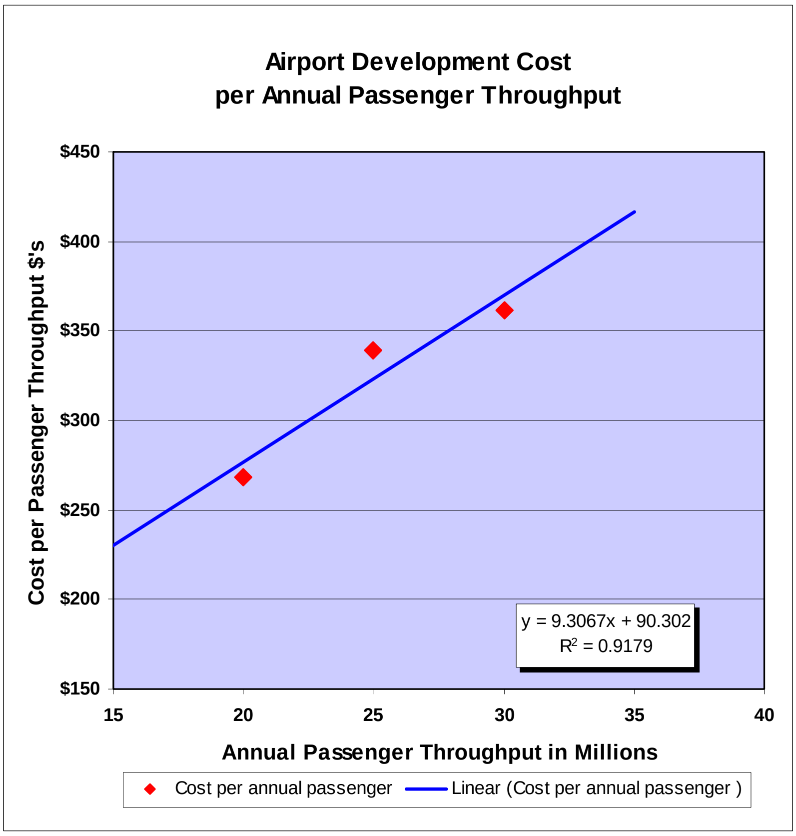
Table 8.2 presents a further break down of these costs. The key objective of this table is to shown that of the total costs projected the sum of airport development capital costs is about 68%-70% of the total, project management and design costs are about 9% while (as is appropriate to this stage of investigations), provisions for risks are about 20% - 23% of the total projected costs.

Table 8.2 Breakdown of Airport Development Costs

Breakdown of Airport Development Costs						
Runway Length	**4000 m**		**3000 m**		**2600 m**	
	$ millions	**% of Total**	**$ millions**	**% of Total**	**$ millions**	**% of Total**
General	$363	3%	$294	3%	$272	5%
Airside north-south runway works	$4,386	40%	$3,072	36%	$1,372	26%
Airside runway 10/28 works	$269	2%	$269	3%	$269	5%
Landside works	$1,454	13%	$1,448	17%	$1,448	27%
Preliminaries, Profit etc (+15%)	$930	9%	$722	9%	$463	9%
Sum of Project Capital Costs	**$7,402**	**68%**	**$5,805**	**68%**	**$3,824**	**71%**
Project Management & Consultants Fees (+15%)	$930	9%	$722	9%	$463	9%
Sum of Project management and design costs	**$930**	**9%**	**$722**	**9%**	**$463**	**9%**
Project Contingency (+25%)	$1,551	14%	$1,203	14%	$772	14%
Uncosted Items (+10%)	$961	9%	$746	9%	$309	6%
Sum of Risk Provisions	**$2,512**	**23%**	**$1,949**	**23%**	**$1,081**	**20%**
Total Estimated Richmond North South Development Cost (millions)	**$10,844**	**100%**	**$8,476**	**100%**	**$5,368**	**100%**

A further way to illustrate these costs is shown in Figure 8.2 which shows the total cost per annual passenger capacity for which the concept provides but it should be noted that that this is not based on a forecast of demand.

Figure 8.2 Airport Development costs per Annual Passenger Throughput Capacity



8.3 Cost Estimate for Minimal Start – Up North-South Runway Airport

While this has not been explicitly costed, an approximation can be made as follows, by removing cost items in the estimate for a 2,600 m runway and 20 million passenger per annum capacity, and substituting the cost for a minimal terminal as assessed in the study of using the East-West runway[16].

[16] *"Civil RPT Aviation Operations RAAF Base Richmond"* November 2010, WorleyParsons – AMPC for the Department of Infrastructure and Transport.

Table 8.3 Cost Estimate for Minimal Start – Up North-South Runway Airport

Item	2600 m Runway and Startup Terminal
Total Estimated Richmond North South Development Cost	**$3,849**
General	**$272**
Site preparation	$272
Airside north-south runway works	**$344**
Site preparation	$68
Runways	$62
Taxiways	$185
Apron / hardstand	$7
Terminal	$15
Roads / carpark / services	$4
Other airport infrastructure	$3
Other facilities	-
Airside runway 10/28 works	**269**
Runway	$28
Taxiways - northern	$80
Taxiways - southern	$63
Other airport infrastructure	$2
RAAF facilities	$96
Landside works	**$1,448**
Access - roads	$888
Access - rail	$309
Major utilities	$99
Aviation fuel pipeline	$151
Telecommunications	$1
Miscellaneous	**$1,516**
Preliminaries / margins / fees	$1,516
Preliminaries, Profit etc (+15%)	350
Project Management & Consultants Fees (+15%)	350
Project Contingency (+25%)	583
Uncosted Items (+10%)	233

In this case, the total costs projected the sum of airport development capital costs as about 70% of the total, project management and design costs are about 9% while, again as is appropriate to this stage of investigations, provisions for risks are about 21% of the total projected costs (of a full 2600 m airfield development but with a minimal terminal at startup).

9 DISCUSSION AND CONCLUSIONS

The previous study[17], which considered use of the existing 10/28 runway and inputs made to it by the Department, RAAF and Defence, has shown that:

- There are several alternate ways to provide a civil operation at RAAF Base Richmond;
- RAAF are apparently intending to remain at Richmond, preferably with full functionality. This requires any civil operation to account for RAAF's security and safety management needs;
- RAAF have expressed a firm preference for maximising the separation between civilian and military precincts, operations and access. All options for a north-south runway configuration respond to this preference;
- An alternative location for the OLA in Defence owned land in the Rickaby's Creek is considered technically feasible by RAAF – this is essential for any north-south runway; and
- A full length parallel taxiway on the southern side of runway 10/28 was preferred to eliminate the need for civil aircraft to pass by Defence aircraft and facilities on the northern side of the 10/28 runway.

This study to examine options for a notional north-south runway has shown that:

- Regardless of length, any notional north-south runway would have an orientation close to 01/19, due to the constraints of the RAAF Base and approach and departure paths and existing urbanised areas.
- A range of development concepts catering from a basic start-up operation of, say, 1 million passengers per annum to 20-30 million, with a new runway aligned 01/19 and of lengths in the range 2,600m to 4,000m, are possible, pending more intensive studies and investigations (including survey of the approaches);
- The majority of any new airport development would be on lands which are currently undeveloped but are used for educational purpose by the University of Western Sydney; Some additional affects – depending on the scale of development – are likely to impact on public and private recreation areas, including the Clarendon Racecourse, as well as on a number of private properties (some of which have a local heritage listing);
- Major relocations and adjustments to the existing road and rail systems would be required, with the form and scale depending upon decisions about whether a close connection between the airport terminal and the rail system is required;
- The costs, assessed P50 level, and inclusive of allowances for project management, design, contingencies and risks, range from $3.85 billion for a full airfield and 2,600m runway but a minimal terminal up to $10.84 billion for full airfield with a 4,000m runway and terminal facilities suitable for 30 million passengers per annum;

[17] *"Civil RPT Aviation Operations RAAF Base Richmond"* November 2010, WorleyParsons – AMPC for the Department of Infrastructure and Transport.

- A major benefit with the new runway alignment could be the reduction in usage of the 10/28 runway and potentially consequent reduction in aircraft noise impacts on the existing residential areas of Richmond and Windsor;
- The acoustic "footprint" of all north south options avoids the majority of urban areas in Windsor and Richmond, though not the residential and workplace areas within RAAF Richmond; and
- An 01/19 runway alignment for civil operations is also likely to be more compatible with operations of the main 16/34 north-south runways at Sydney (Kingsford-Smith) Airport.

10 BIBLIOGRAPHY

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Appendix 1 Cost Estimates

Department of Infrastructure and Transport

SYDNEY AVIATION CAPACITY STUDY

COST ESTIMATE

Richmond North-South Runway

DISCLAIMER:
The cost estimates presented herein have been prepared primarily intended to highlight comparative differences between sites rather than being a project budget cost estimate for initial development. The costs estimates are subject to change at the design stage when more information is developed for the actual design and location. The estimated costs will also vary with the passage of time between the finalisation of this estimate and the project go-ahead.

	Revision	Document No.
WorleyParsons resources & energy; AMPC Airport Master Planning Consultants	F	301015-02388-ES-EST-0002

Sydney Aviation Capacity Study

Cost Estimate - Richmond North-South Runway

EXCLUSIONS

A	**General**
A1	All prices exclude GST
A2	Excludes market forces, escalation, currency hedging
A3	Maintenance and operational works are excluded
A4	Excludes compensation costs
A5	No allowance has been made for growth within systems that may also serve a future airport.
B	**Airside**
B1	Contaminated land remediation / demolition costs
B2	Government Fees, charges and levies
B3	Flood Mitigation or environmental works
B4	Relocations of existing services
B5	Heritage / Archaeological
B6	Mine Subsidence areas / water catchment/ earthquake zone
B7	Meteorology / Hydrological assessments
B8	Approvals i.e. Environmental Impact Statement
B9	Geotechnical
B10	Business Park / Offices
B11	Excavation: Dewatering / Sheet piling / shoring / Diaphragm walls / secant pile walls / ground anchors / bored piers / piles / screw piles / waterproofing etc
B12	Disposal of any material from site
B13	No allowance for Weeds or Termite Control
B14	No Noise insulation allowance for properties under Flight path
B15	Master Grading
B16	No allowances for effects of proposed Airport Site on existing Land usage / structures / Bldgs. / services
B17	Costs do not include a survey for OLS and any consequential impacts of any obstacles including earthworks, relocation of structures, trees, or associated lighting, marking or lowering of obstacles
C	**Environmental**
C1	Excludes costs associated with protection of flora and fauna (protected, vulnerable, endangered, critically endangered)
C2	Excludes costs associated with protection of indigenous cultural and heritage items
C3	Excludes costs associated with protection of non-aboriginal heritage items

D **Rail**

D1 No Allowance made for cost of relocating Clarendon Race Track and Richmond Show ground

D2 No allowances made for upgrading of the existing network to accommodate additional trains paths - refer to Data matrix for comments on possible works needed

D3 Does not include works required to allow service to operate on Existing tracks to Central

E **Power**

E1 Does not include network upgrade costs

E2 Does not include the cost of the electrical plant (motors, lights, radar, electronics etc) that the electricity supply and reticulation system supplies.

E3 Does not include the cost of buildings to house the electrical supply equipment except the 11 kV switchroom in the airport substation

F **Water & Sewer**

F1 Prices do not include resizing and redesigning existing water and sewer reticulation and infrastructure including STPs and WFPs

F2 Does not include relocation of existing water and sewer infrastructure

NOTES & ASSUMPTIONS

A **General**

A1 Prices based on previous work, quotes from projects, informed estimates based on industry knowledge or previous work, database information or professional pricing guidelines

A2 Estimates are based on April 2011 Australian dollars

A3 Indicative costs are for comparison purposes only and should not be used for any other purpose, i.e. budgetory purposes etc

A4 Indicative costs are provided without detailed survey and prelim. grading design

A5 No consultation with authorities has been undertaken in preparation of these estimates.

A6 Assumed entire airport footprint is within the Crown's land

A7 All demand has been considered to be in addition to existing demand. No assessment has been made for the reduction in existing demand due to existing residences, businesses or industries being displaced by a new airport

B **Airside**

B1 Select fill can be procured within 5kms of Site and CBR 15 is achievable using select fill and compaction methods

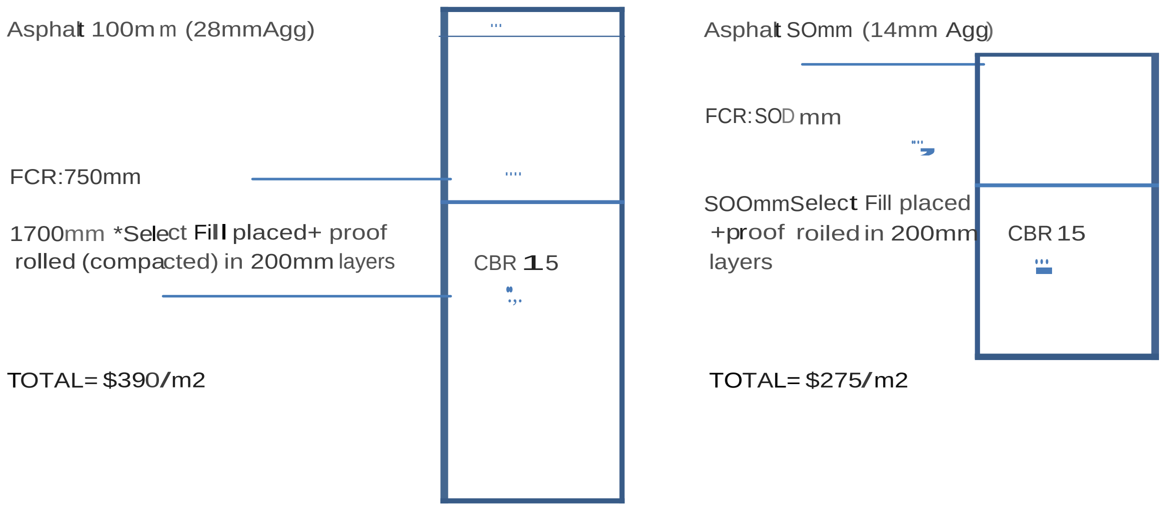
B2 No rock or contaminated material in any excavations

B3 Indicative Pavement Design for airfield Pavements / Aprons for Type 1 and 3 for costing purposes only and have been prepared in absence of site geotechnical information and for assumed traffic loading. Assume existing subgrade material will need excavation and replacement with compacted select fill to achieve necessary CBR.

B4 Apron / Hardstand Indicative pavement design for Code C, D and E aircraft are the same pavement profile for the purposes of this Estimate

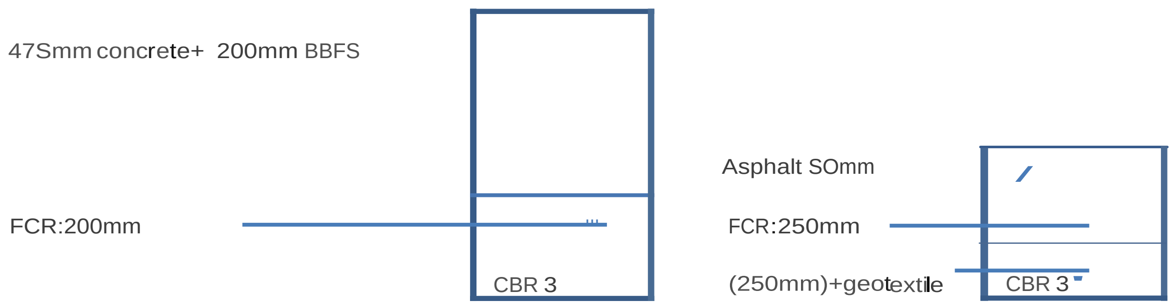
B5 The Airport Layout Drawings are Indicative and Preliminary only.

FIGURE 1: SRA:PAVEMENT TYPES 1& 3- PREUMINARY PROFILE AND COSTINGS



SKETCH 1: RUNWAY FLEXIBLE PAVEMENT*

SKETCH 2: RUNWAY, TAXIWAY FLEXIBLE SHOULDER & FIRE TRAINING PAVEMENT



TOTAL = $SSO/m2

TOTAL =S180/m2

SKETCH 3: APRON & TAXIWAY**

SKETCH 4: ROAD/ CARPARK (EXTERNAL)

"'Sketch 1 (Flexible Pavement) - assuming Ground Insitu CBR 3 with removal & replacement of SOOmm unsuitable subgrade included.

*"'*Sketch 3 (Rigid Pavement) Assuming Ground Insitu CBR 3, a200mm FCR layer is used to provide a working platform for Rigid Pavement construction.*

Note 1: Sketch 1 & 2 Pavement Rate excludes supply of Select Fill (allows {or placement & compaction of Select Fill)
Note 2: Sketches 1, 2, 3 & 4 Pavement Rate excludes Excavation of Pavements (construction only)

C Earthworks

C1 Earthworks volumes and costs are notional only and for the purposes of distinguishing between sites only.

C2 Assumed source of fill materials / borrovv pits are within 10 km of the site.

C3 Assumptions have had to be made about the relative proportions of geotechnical materials liable to be encountered during earthworks to create a platform on which an airport could be created. Notwithstanding these limitations the relativities appear to align with observations on these sites themselves.

C4 Bulk earthworks volumes have been calculated between the existing surface level and proposed finished surface level.

C5 Stripping and disposal of existing topsoil has not been accounted for.

C6 Proposed pavements and building slab thickness have not been accounted for.

C7 Bulking factors have not been accounted for.

C8 These earthworks volumes are based on a design that approximately balances cut and fill. No investigations have been undertaken to determine flooding levels across the site and no freeboard requirements of any infrastructure above flood levels has been allowed for.

D Rail

D1 Services Each Way per day at 4 per hour assuming 0600 to 2400 operating hours

D2 Rollingstock as per Heathrow Express

E Power

CAPEX Assumptions:

E1 Costs will be dependent on supply and demand at the time any tender is called. In times of high demand outstripping supply, costs will be higher than otherwise. There has been considerable demand for electrical supply infrastructure from rapid growth economies such as China and India over the last decade or so and this has had a serious upward impact on material prices.

E2 As much of the equipment or materials for making the equipment in Australia is imported, costs will also vary with the exchange rate which itself has shown some volatility over the last few years

E3 When projecting costs for a given year in the future, it is not appropriate to use the consumer price index as this only relates to a basket of consumer goods. In fact, the volatility of electrical equipment costs and that of the key materials used to make the equipment means that use of any price index is unwise. This is particularly true of critical raw materials such as copper which is used extensively in transformers and underground cabling.

E4 The source of the equipment can also have a significant impact on prices of electrical equipment. In the past year WorleyParsons has witnessed some equipment such as transformers being quoted by Korean manufacturers at almost half the cost of equivalent Australian-sourced equipment.

E5 The estimates may also be adversely impacted by any future carbon tax or market-based mechanism to cost carbon dioxide emissions.

E6 In summary, the use of the costs estimated in this report for any airport's electrical supply, reticulation and energy needs to be cognisant of the volatility and variability of the market prices on which the cost estimates have been based and the likely increases in real electricity prices in NSW.

E7 Network augmentations are likely to be required at the two Connection Points (bulk supply points) to increase their capacity to supply the additional load of the airport

E8 Network Service Provider (distributor) builds, owns, operates the supply lines from the Connection Point to the airport substation

E9 The supply to the airport and reticulation of electricity within the airport is designed for a N-1 reliability criteria meaning any major element can fail without causing a full or partial loss of supply

E10 Given the size of the load, a connection voltage of 66 kV has been conservatively assumed in the studies for all sites except at Richmond RAAF Base in which case a 33 kV supply has been assumed for annual passenger numbers below 30 million

E11 A line length of 20 km has been used in the costings as all sites appear to be notionally within this distance of a potential network connection point. Exact line length would be subject to the final locations of the Connection Point and the airport substation and the route chosen. The line includes OPGW to improve protection and communication functions and support any future "smart grid".

E12 The analysis assumes that overhead lines can be run from the network connection points to the airport substation. The cost will increase if it is necessary to run underground cabling for any part of the route, such as from the airport boundary to the airport substation. As an order of magnitude, underground cabling can be five times the cost of overhead lines though this factor varies with voltage, capacity, terrain and world copper prices

E13 Emergency diesel generation is installed to provide power to essential services (eg control tower and radar) on loss of network supply

E14 Reticulation prices are based on per km supply and install generic industry rates

E15 Estimate of power factor correction subject to network modelling - assumed 20% capacitive of maximum site demand MVA

Demand assumptions:

E16 Maximum demand (in MVA) based on the empirical equation Max Dem = 1.1 Annual Passengers rounded up to nearest 10 MVA

E17 Annual energy use (MWh) is based on industry capacity factors for commercial loads

F Water & Sewer

CAPEX Assumptions:

F1 Assessments of the location and capacity of existing potable water and sewerage systems have been based on publicly available information and local experience

F2 No assessment has been made for the relocation of existing water authority infrastructure eg Warragamba Supply Pipeline, Mardi Mangrove Transfer Pipeline, reticulation.

F3 The total flows in equal the total flows out (i.e. sewage flows are equal to that of water flows for sizing purposes only regardless of recycling)

F4 All pipes inside the airport grounds will be assumed to the same size and size less than that of the delivery main

Demand assumptions:

F5 Water demand for this study was based on current Sydney Airport consumption of 31L/pax but adjusted to reflect the 30% demand reduction recently achieved by Brisbane Airport. This was achieved by greater water efficiency and leak detection.

F6 It would be expected the resultant 22L/pax would be readily achievable by construction of a new airport with a contentious commitment to water efficiency. Water demand for the site is based on an assumed 50% potable and 50% non potable/recycled split.

F7 Potable water consumption is assumed to be 50% of water demand 11 L/pax. However, potable water supply infrastructure is based on the full 22 L/pax water demand as backup capacity, should alternative sources of water be disrupted.

F8 Sewage generation, transport infrastructure and treatment has been sized at either 22 L/pax or 11 L/pax, depending on proximity to existing sewerage systems.

F9 Recycled water demand has been assumed to be 11 L/pax and is sourced from water from reclaimed sewage, although in reality alternative sources may be available.

F10 Where in proximity to a sufficiently large existing sewage treatment system, 50% of sewage is tertiary treated for reuse, with the remainder of the raw sewage pumped to the existing sewage system for disposal.

F11 Where not in proximity to a sufficiently large existing sewage treatment system, all sewage is treated to tertiary standards with 50% recovered for reuse and the remainder disposed of onsite or to local waterways

F12 No allowance has been made for provision recycled water from an external supplier.

F13 No allowance has been made for supply of additional fire fighting water to the site, based on the assumption that the redundancy in the potable system would have sufficient capacity and storage for fire fighting.

WorleyParsons resources & energy

AMPC Airport Master Planning Consultants

SUMMARY

Sydney Aviation Capacity Study

Cost Estimate - Richmond North-South Runway

	4000m Runway	3000m Runway	2600m Runway
DESCRIPTION	AMOUNT		
TOTAL: RICHMOND *	$ 10,850,000,000	$ 8,480,000,000	$ 5,370,000,000

* Figures rounded up to nearest $10,000,000

Sydney Aviation Capacity Study
Cost Estimate - Richmond North-South Runway

LOCATION	ITEM	DESCRIPTION	4000m Runway QUANTITY	3000m Runway QUANTITY	2600m Runway QUANTITY	UNIT	UNIT RATE	4000m Runway AMOUNT	3000m Runway AMOUNT	2600m Runway AMOUNT
RICHMOND	0000	TOTAL: RICHMOND *						10,850,000,000	8,480,000,000	5,370,000,000
	1000	GENERAL						363,147,531	293,894,178	272,465,504
	1100	SITE PREPARATION						363,147,531	293,894,178	272,465,504
	1101	Land acquisition						-	-	-
		Assumed airport footprint within Crown's land				ha		-	-	-
	1102	Environmental protection works						5,000,000	5,000,000	5,000,000
		Allowance	1	1	1	Item	5,000,000	5,000,000	5,000,000	5,000,000
	1103	Land Clearing						12,897,612	8,005,140	5,519,280
		Heavily treed	229	124	58	ha	39,000	8,915,400	4,851,600	2,262,000
		Lightly treed	76	31	29	ha	19,500	1,485,900	606,450	565,500
		Scrub	-	-	-	ha	13,650	-	-	-
		Open farmland	457	467	493	ha	5,460	2,496,312	2,547,090	2,691,780
	1104	Earthworks to create platform						110,934,919	89,624,038	83,596,224
		Cut to Fill - Rippable Rock	2,322,428	1,893,466	1,766,117	m3	22	51,093,412	41,656,243	38,854,583
		Cut to Fill - Sandy clay harder	3,870,713	3,155,776	2,943,529	m3	12	46,448,556	37,869,312	35,322,348
		Cut to Fill - Sandy clay easier	1,548,285	1,262,310	1,177,412	m3	8	12,386,282	10,098,483	9,419,293
		General Fill - Win material (from borrow pits 5-10km, load, haul and place)	28,762	-	-	m3	35	1,006,670	-	-
	1105	Site drainage and pollution control works						228,600,000	186,600,000	174,000,000
		Sediment and site water management – 600m/ha for site table drains and sed fence + settlement pond and spillway – EXCLUDES MAINTENANCE	762	622	580	ha	300,000	228,600,000	186,600,000	174,000,000
	1106	Site rehabilitation						5,715,000	4,665,000	4,350,000
		Planting and Seeding	229	187	174	ha	25,000	5,715,000	4,665,000	4,350,000
	2000	AIRSIDE NORTH-SOUTH RUNWAY WORKS						4,386,619,717	3,071,931,160	1,371,164,354
	2100	SITE PREPARATION						148,706,539	87,615,594	68,164,184
	2101	Earthworks						148,706,539	87,615,594	68,164,184
		Apron / Hardstand areas	602,588	328,500	175,219	m3	28	16,872,464	9,198,011	4,906,125
		Runway Pavement	630,360	358,020	312,120	m3	28	17,650,080	10,024,560	8,739,360
		Runway Shoulders	48,825	33,224	26,924	m3	28	1,367,100	930,267	753,867
		RESA (120mx240m)	57,600	43,200	43,200	m3	28	1,612,800	1,209,600	1,209,600
		Taxiway Pavement	375,038	312,038	226,288	m3	28	10,501,068	8,737,068	6,336,068
		Taxiway Shoulders & Fire Training	481,186	225,711	166,088	m3	28	13,473,212	6,319,912	4,650,463
		Airside / Landside Road & Carpark	246,605	236,647	221,206	m3	28	6,904,929	6,626,115	6,193,760
		Select Imported Fill	730,226	405,182	321,590	m3	110	80,324,888	44,570,061	35,374,941
	2200	RUNWAYS						118,300,756	70,834,737	62,164,737
	2201	Runway Pavement						118,107,500	70,641,481	61,971,481
		Runway Pavement (Flexible)	247,200	140,400	122,400	m2	390	96,408,000	54,756,000	47,736,000
		Runway Shoulders (Flexible)	46,500	31,642	25,642	m2	275	12,787,500	8,701,481	7,051,481
		RESA	57,600	43,200	43,200	m2	120	6,912,000	5,184,000	5,184,000
		Interface New Rwy with Rwy 10/28	1	1	1	No.	2,000,000	2,000,000	2,000,000	2,000,000
	2202	Runway Line Markings						193,256	193,256	193,256
		Runway fixed distance (6x45m white)	2	2	2	No.	878	1,756	1,756	1,756
		Runway TDZ (3 x 30m)	2	2	2	No.	3,515	7,030	7,030	7,030
		Runway threshold (piano keys)	2	2	2	No.	485	970	970	970
		Runway designations	2	2	2	No.	2,650	5,300	5,300	5,300
		Runway end marking (1.2 x 30m white)	2	2	2	No.	6,100	12,200	12,200	12,200
		Displaced threshold marking	2	2	2	No.	8,000	16,000	16,000	16,000
		Edge Line Markings etc	1	1	1	No.	150,000	150,000	150,000	150,000
	2300	TAXIWAYS						360,665,688	254,155,575	184,639,975
	2301	Taxiway Pavement						360,415,688	253,905,575	184,389,975
		Taxiway Pavement (Concrete)	428,615	356,615	258,615	m2	550	235,738,250	196,138,250	142,238,250
		Taxiway Shoulders (Flexible)	453,373	210,063	153,279	m2	275	124,677,438	57,767,325	42,151,725
	2302	Taxiway Line Markings						250,000	250,000	250,000
		Taxiway Markings	1	1	1	No.	250,000	250,000	250,000	250,000
	2400	APRON / HARDSTAND						457,143,100	264,220,950	128,427,000
	2401	Apron Pavement						378,769,600	206,485,950	110,137,500
		Apron / Hardstand areas (Concrete)	688,672	375,429	200,250	m2	550	378,769,600	206,485,950	110,137,500
	2402	Apron Line Markings						300,000	300,000	300,000
		Apron Markings	1	1	1	No.	300,000	300,000	300,000	300,000
	2403	Apron Facilities						78,073,500	57,435,000	17,989,500
		Aerobridges (Code F)	1	-	-	No.	1,750,000	1,750,000	-	-
		Aerobridges (Code E)	22	9	-	No.	1,000,000	22,000,000	9,000,000	-
		Aerobridges (Code C)	43	43	-	No.	500,000	21,500,000	21,500,000	-
		Apron Edge Lights including cabling and transformers	525	390	152	No.	3,500	1,837,500	1,365,000	532,000
		New Floodlights - Mast + Lamps	69	57	40	No.	140,000	9,660,000	7,980,000	5,600,000
		NIG	67	55	38	No.	150,000	10,050,000	8,250,000	5,700,000
		Provision for GPU	67	55	38	No.	100,000	6,700,000	5,500,000	3,800,000
		Emergency Eyewash/shower	67	55	38	No.	3,000	201,000	165,000	114,000
		Bay Parking Position Marker	67	55	38	No.	5,000	335,000	275,000	190,000
		Guard Rail (under Terminal concourse)	5,800	5,000	2,610	m	350	2,030,000	1,750,000	913,500
		Fuel Hydrants	134	110	76	No.	15,000	2,010,000	1,650,000	1,140,000
	2500	TERMINAL						2,402,366,500	1,574,005,000	618,722,500
	2501	International Terminal						1,640,600,000	782,522,000	-
		International Terminal (2 level)	252,400	120,388	-	m2	6,500	1,640,600,000	782,522,000	-
	2502	Domestic Terminal						761,766,500	791,483,000	618,722,500
		Domestic Terminal (Ground Level)	138,503	143,906	112,495	m2	5,500	761,766,500	791,483,000	618,722,500
	2600	ROADS / CARPARK / SERVICES						320,277,834	279,736,954	139,600,958
	2601	Airside Road						26,202,564	24,952,824	21,564,216
		Airside Road (including under Concourse - 8.6m wide)	145,570	138,627	119,801	m2	180	26,202,564	24,952,824	21,564,216
	2602	Landside Road						20,804,940	20,804,940	20,804,940
		Landside Road (17.5m wide - 4 lane -including under Elevated road w	115,583	115,583	115,583	m2	180	20,804,940	20,804,940	20,804,940
	2603	Elevated Road (Landside)						73,237,500	74,865,000	-
		Elevated Road (10.5m wide)	23,625	24,150	-	m2	3,100	73,237,500	74,865,000	-
	2604	Carpark						64,430,100	61,803,360	49,603,500
		Carpark - External	357,945	343,352	275,575	m2	180	64,430,100	61,803,360	49,603,500
	2605	Services						135,602,730	97,310,830	47,628,302
		Site Services	1	1	1	Item		135,602,730	97,310,830	47,628,302
	2700	OTHER AIRPORT INFRASTRUCTURE						180,197,000	174,135,000	162,695,000
	2701	Control Tower / Utilities Building						25,000,000	25,000,000	25,000,000
		Control Tower (Adelaide - 44m /Melb -78m)	1	1	1	No.	25,000,000	25,000,000	25,000,000	25,000,000
	2702	Movement Area Lighting						45,000,000	45,000,000	45,000,000
		Runway / Taxiway Lighting & CASA Facilities	1	1	1	No.	45,000,000	45,000,000	45,000,000	45,000,000
	2703	Fire Station (ARFSFS)						13,855,000	13,855,000	10,445,000
		Fire Training	4,900	4,900	4,900	m2	550	2,695,000	2,695,000	2,695,000
		Fire Station Bldg. 50 x 50m	3,600	3,600	2,500	m2	3,100	11,160,000	11,160,000	7,750,000
	2704	Fuel Lines						34,050,000	30,810,000	23,400,000
		Fuel lines	11,350	10,270	7,800	m	3,000	34,050,000	30,810,000	23,400,000
	2705	Security Fence						32,412,000	29,850,000	29,850,000
		Security Fence Crash proof (Electric)	21,608	19,900	19,900	m	1,500	32,412,000	29,850,000	29,850,000
	2706	NavAids i.e DVOR/DME, ILS, MAGS, HIALs,TAR & ASMGRS:						29,880,000	29,620,000	29,000,000
		TAR	1	1	1	No.	10,000,000	10,000,000	10,000,000	10,000,000
		DVOR / DME	1	1	1	No.	2,500,000	2,500,000	2,500,000	2,500,000
		ILS	2	2	2	No.	1,500,000	3,000,000	3,000,000	3,000,000
		ASMGRS (Sydney)	1	1	1	No.	9,000,000	9,000,000	9,000,000	9,000,000
		GBAS (Sydney)	1	1	1	No.	3,000,000	3,000,000	3,000,000	3,000,000
		PAPI	2	2	2	No.	250,000	500,000	500,000	500,000
		MAGS (Sydney)	188	162	100	No.	10,000	1,880,000	1,620,000	1,000,000
	2800	FACILITIES						398,962,300	367,227,350	6,750,000
	2801	Freight Building						78,522,300	47,147,350	-
		Freight Bldg (14m high)	36,522	21,929	-	m2	2,150	78,522,300	47,147,350	-
	2802	Hangars						315,000,000	315,000,000	-
		Hangars	70,000	70,000	-	m2	4,500	315,000,000	315,000,000	-
	2803	Business Park (Site Preparation Only)						5,440,000	5,080,000	6,750,000
		Business Park (Site Preparation only)- Allowance	1,088,000	1,016,000	1,350,000	m2	5	5,440,000	5,080,000	6,750,000
	3000	AIRSIDE RUNWAY 10/28 WORKS						269,074,016	269,074,016	269,074,016
	3100	RUNWAY						28,055,496	28,055,496	28,055,496
	3101	Earthworks - Strip Widening						4,406,688	4,406,688	4,406,688
		Site Establishment	1	1	1	Item	25,000	25,000	25,000	25,000
		Clearing & grubbing	91,650	91,650	91,650	m2	5	458,250	458,250	458,250
		Strip topsoil & stockpile	50,625	50,625	50,625	m3	10	506,250	506,250	506,250
		Cut to fill	84,375	84,375	84,375	m3	13	1,054,688	1,054,688	1,054,688
		Replace & trim Topsoil & grassing	337,500	337,500	337,500	m2	7	2,362,500	2,362,500	2,362,500
	3102	Pavements						16,499,600	16,499,600	16,499,600
		60mm Asphalt overlay	96,030	96,030	96,030	m2	60	5,761,800	5,761,800	5,761,800
		Shoulder – new 7.5m wide	31,820	31,820	31,820	m2	275	8,750,500	8,750,500	8,750,500
		Temp. Ramps - place and remove	1	1	1	Allow	150,000	150,000	150,000	150,000
		Runway Grooving	96,030	96,030	96,030	m2	10	960,300	960,300	960,300
		Blast Protection at Runway Ends	3,600	3,600	3,600	m2	55	198,000	198,000	198,000
		Allowance for night works & staging	1	1	1	Item	200,000	200,000	200,000	200,000
		Place topsoil on flanks	2,000	2,000	2,000	m3	10	20,000	20,000	20,000
		Trim Topsoil & grassing	27,000	27,000	27,000	m2	5	135,000	135,000	135,000

LOCATION	ITEM	DESCRIPTION	QUANTITY 4000m Runway	QUANTITY 3000m Runway	QUANTITY 2600m Runway	UNIT	UNIT RATE	AMOUNT 4000m Runway	AMOUNT 3000m Runway	AMOUNT 2600m Runway
RICHMOND		Lay & fix reinforced turf grassing	27,000	27,000	27,000	m2	$ 12	$ 324,000	$ 324,000	$ 324,000
	3103	**Stormwater & Subsoil Drainage**						**$ 600,000**	**$ 600,000**	**$ 600,000**
		Allowance only, subject to design	1	1	1	Item	$ 600,000	$ 600,000	$ 600,000	$ 600,000
	3104	**Navaids & Electrical Allowances**						**$ 230,000**	**$ 230,000**	**$ 230,000**
		Airfield Lighting - Runway (adjust extg.)	1	1	1	Item	$ 150,000	$ 150,000	$ 150,000	$ 150,000
		New Ducting	1	1	1	Item	$ 80,000	$ 80,000	$ 80,000	$ 80,000
	3105	**Miscellaneous Items**						**$ 6,319,208**	**$ 6,319,208**	**$ 6,319,208**
		Demolition	1	1	1	Item	$ 25,000	$ 25,000	$ 25,000	$ 25,000
		Adjustment to Hook cable arrestors	1	1	1	Item	$ 50,000	$ 50,000	$ 50,000	$ 50,000
		Linemarking & markers	1	1	1	Item	$ 220,000	$ 220,000	$ 220,000	$ 220,000
		Erosion & Sediment Controls	1	1	1	Item	$ 50,000	$ 50,000	$ 50,000	$ 50,000
		RESA	16,200	16,200	16,200	m2	$ 120	$ 1,944,000	$ 1,944,000	$ 1,944,000
		Select Fill - Taxiway Shoulder (0.5m depth)	15,910	15,910	15,910	m3	$ 110	$ 1,750,100	$ 1,750,100	$ 1,750,100
		Select Fill - RESA (0.5m depth)	8,100	8,100	8,100	m3	$ 110	$ 891,000	$ 891,000	$ 891,000
		Earthworks - Taxiway Shoulder (1.05m depth)	33,411	33,411	33,411	m3	$ 28	$ 935,508	$ 935,508	$ 935,508
		Earthworks - RESA (1.0m depth)	16,200	16,200	16,200	m3	$ 28	$ 453,600	$ 453,600	$ 453,600
	3200	**TAXIWAYS - NORTHERN**						**$ 80,019,898**	**$ 80,019,898**	**$ 80,019,898**
	3201	**Pavements**						**$ 55,217,713**	**$ 55,217,713**	**$ 55,217,713**
		New Taxiway Pavement	71,621	71,621	71,621	m2	$ 550	$ 39,391,550	$ 39,391,550	$ 39,391,550
		New Taxiway Shoulder	55,262	55,262	55,262	m2	$ 275	$ 15,196,913	$ 15,196,913	$ 15,196,913
		Allowance for night works & staging	1	1	1	Item	$ 150,000	$ 150,000	$ 150,000	$ 150,000
		Temp. Ramps - place and remove	1	1	1	Item	$ 100,000	$ 100,000	$ 100,000	$ 100,000
		Place topsoil on flanks	2,000	2,000	2,000	m3	$ 12	$ 24,000	$ 24,000	$ 24,000
		Trim Topsoil & grassing	12,250	12,250	12,250	m2	$ 5	$ 61,250	$ 61,250	$ 61,250
		Lay & fix reinforced turf grassing	24,500	24,500	24,500	m2	$ 12	$ 294,000	$ 294,000	$ 294,000
	3202	**Stormwater & Subsoil Drainage**						**$ 500,000**	**$ 500,000**	**$ 500,000**
		Allowance only, subject to design	1	1	1	Item	$ 500,000	$ 500,000	$ 500,000	$ 500,000
	3203	**Navaids & Electrical Allowances**						**$ 4,459,400**	**$ 4,459,400**	**$ 4,459,400**
		Airfield Lighting - Taxiway (new)	4,130	4,130	4,130	m	$ 880	$ 3,634,400	$ 3,634,400	$ 3,634,400
		New Ducting	1	1	1	Allow	$ 100,000	$ 100,000	$ 100,000	$ 100,000
		Holding Point lighting	1	1	1	Allow	$ 125,000	$ 125,000	$ 125,000	$ 125,000
		MAGS	1	1	1	Allow	$ 600,000	$ 600,000	$ 600,000	$ 600,000
	3204	**Miscellaneous Items**						**$ 19,842,785**	**$ 19,842,785**	**$ 19,842,785**
		**Demolition extg pavements (say avg. 0.25m thick) & Diposal to	21,750	21,750	21,750	m3	$ 608	$ 13,224,000	$ 13,224,000	$ 13,224,000
		Linemarking	1	1	1	Item	$ 150,000	$ 150,000	$ 150,000	$ 150,000
		Erosion & Sediment Controls	1	1	1	Item	$ 50,000	$ 50,000	$ 50,000	$ 50,000
		Select Fill - Taxiway Shoulders (0.5m depth)	27,631	27,631	27,631	m3	$ 110	$ 3,039,383	$ 3,039,383	$ 3,039,383
		Earthworks - Taxiway Pvmt (0.875m depth)	62,668	62,668	62,668	m3	$ 28	$ 1,754,715	$ 1,754,715	$ 1,754,715
		Earthworks - Taxiway Shoulders (1.05m depth)	58,025	58,025	58,025	m3	$ 28	$ 1,624,688	$ 1,624,688	$ 1,624,688
	3300	**TAXIWAYS - SOUTHERN**						**$ 63,284,402**	**$ 63,284,402**	**$ 63,284,402**
	3301	**Pavements**						**$ 51,677,088**	**$ 51,677,088**	**$ 51,677,088**
		New Taxiway Pavement	64,942	64,942	64,942	m2	$ 550	$ 35,718,100	$ 35,718,100	$ 35,718,100
		New Taxiway Shoulder	55,745	55,745	55,745	m2	$ 275	$ 15,329,738	$ 15,329,738	$ 15,329,738
		Allowance for night works & staging	1	1	1	Item	$ 150,000	$ 150,000	$ 150,000	$ 150,000
		Temp. Ramps - place and remove	1	1	1	Item	$ 100,000	$ 100,000	$ 100,000	$ 100,000
		Place topsoil on flanks	2,000	2,000	2,000	m3	$ 12	$ 24,000	$ 24,000	$ 24,000
		Trim Topsoil & grassing	12,250	12,250	12,250	m2	$ 5	$ 61,250	$ 61,250	$ 61,250
		Lay & fix reinforced turf grassing	24,500	24,500	24,500	m2	$ 12	$ 294,000	$ 294,000	$ 294,000
	3302	**Stormwater & Subsoil Drainage**						**$ 500,000**	**$ 500,000**	**$ 500,000**
		Allowance only, subject to design	1	1	1	Item	$ 500,000	$ 500,000	$ 500,000	$ 500,000
	3303	**Navaids & Electrical Allowances**						**$ 4,459,400**	**$ 4,459,400**	**$ 4,459,400**
		Airfield Lighting - Taxiway (new)	4,130	4,130	4,130	m	$ 880	$ 3,634,400	$ 3,634,400	$ 3,634,400
		New Ducting	1	1	1	Allow	$ 100,000	$ 100,000	$ 100,000	$ 100,000
		Holding Point lighting	1	1	1	Allow	$ 125,000	$ 125,000	$ 125,000	$ 125,000
		MAGS	1	1	1	Allow	$ 600,000	$ 600,000	$ 600,000	$ 600,000
	3304	**Miscellaneous Items**						**$ 6,647,915**	**$ 6,647,915**	**$ 6,647,915**
		Demolition extg pavements	250	250	250	m3	$ 608	$ 152,000	$ 152,000	$ 152,000
		Linemarking	1	1	1	Item	$ 150,000	$ 150,000	$ 150,000	$ 150,000
		Erosion & Sediment Controls	1	1	1	Item	$ 50,000	$ 50,000	$ 50,000	$ 50,000
		Select Fill - Taxiway Shoulders (0.5m depth)	27,872	27,872	27,872	m3	$ 110	$ 3,065,948	$ 3,065,948	$ 3,065,948
		Earthworks - Taxiway Pvmt (0.875m depth)	56,824	56,824	56,824	m3	$ 28	$ 1,591,079	$ 1,591,079	$ 1,591,079
		Earthworks - Taxiway Shoulders (1.05m depth)	58,532	58,532	58,532	m3	$ 28	$ 1,638,888	$ 1,638,888	$ 1,638,888
	3400	**OTHER AIRPORT INFRASTRUCTURE**						**$ 2,000,000**	**$ 2,000,000**	**$ 2,000,000**
	3401	**Navaids**						**$ 2,000,000**	**$ 2,000,000**	**$ 2,000,000**
		Replace existing ILS to Cat 2	1	1	1	Item	$ 1,500,000	$ 1,500,000	$ 1,500,000	$ 1,500,000
		PAPI	2	2	2	Item	$ 250,000	$ 500,000	$ 500,000	$ 500,000
	3500	**RAAF FACILITIES**						**$ 95,714,221**	**$ 95,714,221**	**$ 95,714,221**
	3501	**Aircraft Wash Bay**						**$ 7,991,250**	**$ 7,991,250**	**$ 7,991,250**
		Pavement demolition & grassing	7,100	7,100	7,100	m2	$ 150	$ 1,065,000	$ 1,065,000	$ 1,065,000
		Pavements	7,100	7,100	7,100	m2	$ 550	$ 3,905,000	$ 3,905,000	$ 3,905,000
		Shoulders	7,350	7,350	7,350	m2	$ 275	$ 2,021,250	$ 2,021,250	$ 2,021,250
		Hydraulics & Water supply	1	1	1	Allow	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000
	3502	**Ordnance Loading Apron & Magazine**						**$ 87,722,971**	**$ 87,722,971**	**$ 87,722,971**
		Earthworks (Flood Plain fill -use on Site Excavated material))	1,118,750	1,118,750	1,118,750	m3	$ 50	$ 55,937,500	$ 55,937,500	$ 55,937,500
		Earthworks - Apron & Taxiway Pvmt (0.875m depth)	24,356	24,356	24,356	m3	$ 28	$ 681,958	$ 681,958	$ 681,958
		Earthworks - Apron /Taxiway Shoulders (1.05m depth)	21,940	21,940	21,940	m3	$ 28	$ 614,313	$ 614,313	$ 614,313
		Apron & (link) Taxiway Pavement	20,735	20,735	20,735	m2	$ 550	$ 11,404,250	$ 11,404,250	$ 11,404,250
		Taxiway Shoulders	13,545	13,545	13,545	m2	$ 275	$ 3,724,875	$ 3,724,875	$ 3,724,875
		Select Fill - Taxiway Shoulders (0.5m depth)	10,448	10,448	10,448	m3	$ 110	$ 1,149,225	$ 1,149,225	$ 1,149,225
		Taxiway (link) Lighting	645	645	645	m	$ 880	$ 567,600	$ 567,600	$ 567,600
		Apron Lighting	2	2	2	No.	$ 100,000	$ 200,000	$ 200,000	$ 200,000
		Taxiway (link) Bridge	1,496	1,496	1,496	m2	$ 7,000	$ 10,472,000	$ 10,472,000	$ 10,472,000
		Road Bridge	238	238	238	m2	$ 3,500	$ 833,000	$ 833,000	$ 833,000
		Magazine	1	1	1	Allow	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000
		Roads to site - rural - 2 lane sealed	790	790	790	m	$ 175	$ 138,250	$ 138,250	$ 138,250
		Supply Power to site	1	1	1	Allow	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000
	4000	**LANDSIDE WORKS**						**$ 1,452,497,216**	**$ 1,447,714,555**	**$ 1,445,704,144**
	4100	**ACCESS - ROAD**						**$ 887,500,000**	**$ 887,500,000**	**$ 887,500,000**
	4101	**Main Airport Entry Road connection to nearest existing road system including grade separated interchange**						**$ 15,500,000**	**$ 15,500,000**	**$ 15,500,000**
		New Connection to Airport (assumes overpasses and includes 1km of road widening)	1	1	1	km	$ 15,500,000	$ 15,500,000	$ 15,500,000	$ 15,500,000
	4102	**Upgrading existing road system to dual carriageway connection to freeway system**						**$ 872,000,000**	**$ 872,000,000**	**$ 872,000,000**
		Widening from 2 lanes to 4 (Richmond Rd)	12	12	12	km	$ 22,000,000	$ 264,000,000	$ 264,000,000	$ 264,000,000
		Widening from 2 lanes to 4 (Blacktown Rd)	5	5	5	km	$ 22,000,000	$ 110,000,000	$ 110,000,000	$ 110,000,000
		Widening from 2 lanes to 4 (Windsor St)	9	9	9	km	$ 22,000,000	$ 198,000,000	$ 198,000,000	$ 198,000,000
		Underpass (Windsor St) (Includes cutting)	9	9	9	km	$ 25,000,000	$ 225,000,000	$ 225,000,000	$ 225,000,000
		Underpass (Blacktown Rd) (Includes cutting)	3	3	3	km	$ 25,000,000	$ 75,000,000	$ 75,000,000	$ 75,000,000
	4200	**ACCESS - RAIL**						**$ 308,600,000**	**$ 308,600,000**	**$ 308,600,000**
	4201	**Airport station**						**$ 24,000,000**	**$ 24,000,000**	**$ 24,000,000**
		Simple Elevated Station	1	1	1	Item	$ 12,000,000	$ 12,000,000	$ 12,000,000	$ 12,000,000
		Rebuilding Clarendon Station	1	1	1	Item	$ 12,000,000	$ 12,000,000	$ 12,000,000	$ 12,000,000
	4202	**Double track alignment – in tunnel**						**$ 107,200,000**	**$ 107,200,000**	**$ 107,200,000**
		Cut and Cover tunnel for existing railway	1.6	1.6	1.6	km	$ 67,000,000	$ 107,200,000	$ 107,200,000	$ 107,200,000
	4203	**Double track alignment – in at Grade**						**$ 15,000,000**	**$ 15,000,000**	**$ 15,000,000**
		Realignment of railway	1	1	1	km	$ 15,000,000	$ 15,000,000	$ 15,000,000	$ 15,000,000
	4204	**Grade separated rail Junction - connection to existing main lines**						**$ 76,000,000**	**$ 76,000,000**	**$ 76,000,000**
		Elevated Railway including Junction	4	4	4	km	$ 19,000,000	$ 76,000,000	$ 76,000,000	$ 76,000,000
	4205	**Rolling Stock**						**$ 86,400,000**	**$ 86,400,000**	**$ 86,400,000**
		Rolling stock - assume 4 car single deck EMU 250 seated pax	12	12	12	Per train set	$ 7,200,000	$ 86,400,000	$ 86,400,000	$ 86,400,000
	4300	**MAJOR UTILITIES**						**$ 104,777,216**	**$ 100,694,555**	**$ 98,684,144**
	4301	**Water supply Head works on site**						**$ 149,178**	**$ 113,014**	**$ 90,411**
		Potable Water Tank	0.99	0.75	0.60	ML	$ 150,000	$ 149,178	$ 113,014	$ 90,411
	4302	**Water Pipeline from bulk supply point**						**$ 1,875,000**	**$ 1,875,000**	**$ 1,875,000**
		Supply Main costs (200mm Main Dia)	8	8	8	km	$ 250,000	$ 1,875,000	$ 1,875,000	$ 1,875,000
	4303	**Water Ring Main Reticulation around site**						**$ 1,600,000**	**$ 1,600,000**	**$ 1,600,000**
		Reticulation costs	8	8	8	km	$ 200,000	$ 1,600,000	$ 1,600,000	$ 1,600,000
	4304	**Recycled Water works on site**						**$ 149,178**	**$ 113,014**	**$ 90,411**
		Recycled Water Tank	0.99	0.75	0.60	ML	$ 150,000	$ 149,178	$ 113,014	$ 90,411
	4305	**Recycled Water Main Reticulation around site**						**$ 3,800,000**	**$ 3,800,000**	**$ 3,800,000**
		Reticulation costs	19	19	19	km	$ 200,000	$ 3,800,000	$ 3,800,000	$ 3,800,000
	4306	**Fire Water works on site**						**$ 5,300,000**	**$ 5,300,000**	**$ 5,300,000**
		Fire Water Tank	2	2	2	ML	$ 150,000	$ 300,000	$ 300,000	$ 300,000
		Fire Equipment	1	1	1	Item	$ 5,000,000	$ 5,000,000	$ 5,000,000	$ 5,000,000
	4307	**Fire Water Main Reticulation around site**						**$ 5,000,000**	**$ 5,000,000**	**$ 5,000,000**
		Reticulation costs	25	25	25	km	$ 200,000	$ 5,000,000	$ 5,000,000	$ 5,000,000
	4308	**Electrical substation on Site**						**$ 5,483,000**	**$ 4,505,000**	**$ 4,235,000**
		Substation transformer cost (40 MVA)	2			each	$ 800,000	$ 1,600,000	$ -	$ -
		Substation transformer cost (30 MVA)		2		each	$ 625,000	$ -	$ 1,250,000	$ -
		Substation transformer cost (30 MVA)			2	each	$ 537,500	$ -	$ -	$ 1,075,000
		Substation supply bay cost (electrical plant) (High)	4			each	$ 400,000	$ 1,600,000	$ -	$ -
		Substation supply bay cost (electrical plant) (Low)		4	4	each	$ 300,000	$ -	$ 1,200,000	$ 1,200,000
		Substation civils & architectural (High)	1			Item	$ 1,400,000	$ 1,400,000	$ -	$ -
		Substation civils & architectural (Low)		1	1	Item	$ 1,300,000	$ -	$ 1,300,000	$ 1,300,000
		Substation 11 kV system cost including PFC (High)	1			Item	$ 883,000	$ 883,000	$ -	$ -
		Substation 11 kV system cost including PFC (Medium)		1		Item	$ 755,000	$ -	$ 755,000	$ -
		Substation 11 kV system cost including PFC (Low)			1	Item	$ 660,000	$ -	$ -	$ 660,000
	4309	**Power connection to bulk supply point**						**$ 4,800,000**	**$ 4,000,000**	**$ 4,000,000**
		Network supply line costs (High)	20			km	$ 240,000	$ 4,800,000	$ -	$ -
		Network supply line costs (Low)		20	20	km	$ 200,000	$ -	$ 4,000,000	$ 4,000,000

LOCATION	ITEM	DESCRIPTION	QUANTITY 4000m Runway	QUANTITY 3000m Runway	QUANTITY 2600m Runway	UNIT	UNIT RATE	AMOUNT 4000m Runway	AMOUNT 3000m Runway	AMOUNT 2600m Runway
RICHMOND	4310	**Power Reticulation around site**						**$ 8,800,000**	**$ 8,400,000**	**$ 7,850,000**
		11 kV / 415 V transformer costs (High)	16			each	$ 180,000	$ 2,880,000	$ -	$ -
		11 kV / 415 V transformer costs (Low)		16	14	each	$ 160,000	$ -	$ 2,560,000	$ 2,240,000
		11 kV cable costs (High)	8			km	$ 140,000	$ 1,120,000	$ -	$ -
		11 kV cable costs (Low)		8	7	km	$ 130,000	$ -	$ 1,040,000	$ 910,000
		415 V circuit costs	8	8	7	each	$ 100,000	$ 800,000	$ 800,000	$ 700,000
		Emergency diesel generation	1	1	1	Item	$ 4,000,000	$ 4,000,000	$ 4,000,000	$ 4,000,000
	4311	**Gas connection to bulk supply point**						**$ 46,200,000**	**$ 46,200,000**	**$ 46,200,000**
		Connections to State/National wide network	14	14	14	km	$ 3,300,000	$ 46,200,000	$ 46,200,000	$ 46,200,000
	4312	**Gas Main Reticulation around site**						**$ 11,200,000**	**$ 11,200,000**	**$ 11,200,000**
		Reticulation of gas system around the site	4	4	4	km	$ 2,800,000	$ 11,200,000	$ 11,200,000	$ 11,200,000
	4313	**Sewer Head works on site**						**$ 9,558,360**	**$ 7,726,027**	**$ 6,580,822**
		Emergency / Wet Weather Storage Costs	2.0	1.5	1.2	ML	$ 150,000	$ 298,356	$ 226,027	$ 180,822
		Onsite Treatment Plant (Large)	1			Item	$ 9,260,003	$ 9,260,003	$ -	$ -
		Onsite Treatment Plant (Medium)		1		Item	$ 7,500,000	$ -	$ 7,500,000	$ -
		Onsite Treatment Plant (Small)			1	Item	$ 6,400,000	$ -	$ -	$ 6,400,000
	4314	**Sewer Main to bulk discharge point**						**$ 725,000**	**$ 725,000**	**$ 725,000**
		Transfer Pump Station Cost	1	1	1	each	$ 600,000	$ 600,000	$ 600,000	$ 600,000
		Transfer pipeline costs (200mm Main Dia)	0.5	0.5	0.5	km	$ 250,000	$ 125,000	$ 125,000	$ 125,000
	4315	**Sewer Main Reticulation around site**						**$ 137,500**	**$ 137,500**	**$ 137,500**
		Reticulation costs	0.5	0.5	0.5	km	$ 275,000	$ 137,500	$ 137,500	$ 137,500
	4400	**AVIATION FUEL PIPELINE**						**$ 151,300,000**	**$ 150,600,000**	**$ 150,600,000**
	4401	**Connections to existing petroleum products pipelines (if any)**						**$ 148,500,000**	**$ 148,500,000**	**$ 148,500,000**
		Connection to Bulk Storage centre	45	45	45	km	$ 3,300,000	$ 148,500,000	$ 148,500,000	$ 148,500,000
	4402	**Fuel supply head works on site**						**$ 2,800,000**	**$ 2,100,000**	**$ 2,100,000**
		Fuel Bulk Storage Tanks	4	3	3	ML	$ 700,000	$ 2,800,000	$ 2,100,000	$ 2,100,000
	4500	**TELECOMMUNICATIONS**						**$ 320,000**	**$ 320,000**	**$ 320,000**
	4501	**Reticulation of bulk comms system around the site**						**$ 320,000**	**$ 320,000**	**$ 320,000**
		Reticulation of bulk comms system around the site	4	4	4	km	$ 80,000	$ 320,000	$ 320,000	$ 320,000
	4502	**Connections to State/National wide network**						**$ -**	**$ -**	**$ -**
		Connections to State/National wide network				km	$ -	$ -	$ -	$ -
	5000	**MISCELLANEOUS**						**$ 4,372,596,447**	**$ 3,393,545,625**	**$ 2,008,067,101**
	5100	**PRELIMINARIES / MARGINS / FEES**						**$ 4,372,596,447**	**$ 3,393,545,625**	**$ 2,008,067,101**
	5101	**Preliminaries, Profit etc (+15%)**						**$ 930,339,670**	**$ 722,030,984**	**$ 463,400,100**
	5102	**Project Management & Consultants Fees (+15%)**						**$ 930,339,670**	**$ 722,030,984**	**$ 463,400,100**
	5103	**Project Contingency (+25%)**						**$ 1,550,566,116**	**$ 1,203,384,973**	**$ 772,333,500**
	5104	**Uncosted Items (+10%)**						**$ 961,350,992**	**$ 746,098,684**	**$ 308,933,400**

* Figures rounded up to nearest $10,000,000

Appendix 2 Discussion Paper on Rail Access

Rail Access to a North-South runway RPT Airport at Richmond

A2.1 Introduction

Currently the Richmond Branch of the Sydney Metropolitan Railways passes close by, and parallel to, RAAF Richmond. However, the adjacent Clarendon station currently serves Hawkesbury Racecourse and Showground, rather than the RAAF base.

Development of a civil airport with a north-south runway would cut across the current route of the Richmond Branch and sever connections between the Richmond township, plus the lower Blue Mountains communities from North Richmond to Kurrajong and suburban passenger train services back towards Blacktown, Parramatta and the Sydney CBD.

The issue thus arises as to how existing suburban passenger rail services might be maintained, and if considered worthwhile, augmented to serve a new civil airport. If developed to be a major passenger transport hub served by rail, then it should have good rail connectivity with the Sydney Region.

A2.2 Passenger Demand

The Richmond Branch, which was the first branch line built on the NSW railway network, is currently a minor traffic generator for the Sydney metropolitan Railways. The 2010 Compendium of CityRail Travel Statistics estimates that the whole line attracts 15,660 trips out of a total of 999,000 daily trips across the whole network. However, the Richmond Branch is expected to attract substantial future passenger traffic as the North- West Sector grows. It is currently being duplicated towards Riverstone (and beyond to Vineyard) in anticipation of this traffic growth. In the future, peak period levels of service are expected to grow from 4 trains per hour at Quakers Hill to 8 trains per hour at Riverstone. However, it is not expected that the current daylong 2 trains per hour level of service from Richmond would change.

When the North-West Rail Link is built, it is expected that provision will be made for it to be extended beyond the currently proposed terminus and car stabling sidings at Rouse Hill to Vineyard on the Richmond Branch. If an RPT airport were to be built at Richmond, with a passenger throughput of 30 million passengers per year, this may attract about 100,000 passenger movements per weekday, half inbound and half outbound. On the assumption that it would attract some rail public transport patronage, some demand ranges for dimensioning purposes and in the absence of definitive demand forecasts could be:

- 5,000 inbound and 5,000 outbound rail daily passengers at a 10% mode split (as currently being achieved by the existing Airport Line to Sydney (Kingsford-Smith) Airport), equivalent to Newtown station; and
- 15,000 inbound and 15,000 outbound rail daily passengers at a 30% mode split (as a stretch target), equivalent to St Leonards station.

The lower estimate is 60% of the current patronage for the whole of the Richmond Branch, while the upper estimate is 200% of the current patronage for the whole of the line. This excludes any estimate of the amount of employee travel which could be added to this passenger demand.

If 10% of passengers could arrive or depart in a peak hour on the assumption that air travel demand would be less peaky than commuter travel demand (where 33% of daily travel occurs during the peak period and probably 15% of daily travel occurs in the peak hour) then:

- 500 inbound and 500 outbound hourly rail passengers at 10% mode split; and
- 1500 inbound and 1500 outbound hourly rail passengers at 30% mode split

being generated by the airport. By way of comparison, a typical 8-car Sydney double deck suburban passenger train seats approximately 900 passengers and is not purpose set up to cater for passengers with airline luggage. Nevertheless, roughly 150 of these seats could be used by passengers encumbered with luggage, without unduly hindering access to other seats.

A2.3 Current Infrastructure and Operations

The Richmond Branch physically joins the Main Western Railway at a grade-separated junction at Seven Hills (32.1 km) although it officially starts at Blacktown (34.9 km). It is currently double track between Blacktown and Quakers Hill (40.1 km), i.e. for 6.2 kilometres. It is currently being duplicated to the far side of Schofields (43.7 km), i.e. for a further 3.6 kilometres. This stretch of line is now fully grade-separated from road and pedestrian cross traffic. There are plans to extend duplication to Riverstone (46.0 km), which is a future traffic shed, and onwards to Vineyard (49. 2 km), i.e. for an ultimate length of 14.3 kilometres of double track. Even with double track as far as Vineyard, about 45% of the length of the branch would remain single track.

Figure 1 shows a longitudinal section of the Richmond Branch Line

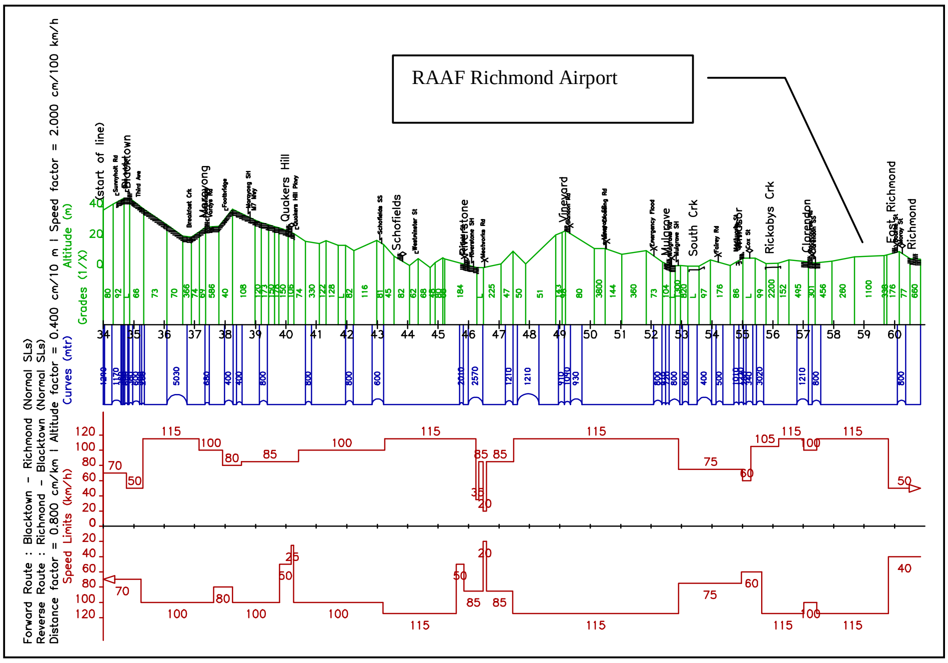


Figure A2.1 Longitudinal profile of the Richmond Line

There are two major single track viaducts on the branch, all to the west of Vineyard, i.e. over South Creek between Mulgrave (52.6 km) and Windsor (55.0 km), and over Rickaby's Creek between Windsor and Clarendon (57.2 km). There are also two underpasses at Windsor. Otherwise, the railway is at grade between Riverstone and Richmond, with 12 road and/or pedestrian level crossings.

The branch is wholly electrified at 1500 V DC. It is now exclusively served by suburban passenger trains. No freight trains now run over the line.

It is controlled from the Blacktown Control Centre. The bi-directional double track currently runs from Blacktown to Quakers Hill. There are crossing loops at Riverstone, Mulgrave and Clarendon with a 2-platform terminus at Richmond (60.6 km) in the single track beyond.

The current single track section lengths and running times are such that the railway could not reliably sustain better than 3 trains per hour in each direction. Hence, an all-day 2 trains per hour service is run between the Sydney CBD and Richmond, supplemented by an additional 2 trains per hour between the Sydney CBD and Quakers Hill during peak periods.

Once duplication has reached Vineyard, it would be possible to run 4 trains per hour to and from Richmond. However, the sequencing of, and timetabling dependencies between trains running over a single track railway could produce operational problems back towards the Sydney CBD (in the same way that the previously single track Cronulla Branch affected operations of the Illawarra Line).

Currently, most of the trains that start or finish work on the Richmond Branch are stabled at Blacktown. There is storage for 12x8-car trains, 8 of which could drive out towards Richmond. There also appears to be storage for at most 2x8-car trains at Richmond.

A2.4 Airport Passenger Rail Levels of Service

There are no explicit levels of service standards for passenger rail services to a major civil airport. It is understood that the Domestic and International stations at Sydney (Kingsford-Smith) Airport were required to be served by 6 trains per hour in each direction during the major portions of weekdays, dropping to 4 trains per hour at other times and on weekends. There was no explicitly defined maximum headway between successive services, so the intervals between train services can be erratic.

The Airtrain service for Brisbane Airport provides 2 trains per hour over much of the day, but strengthens to 4 trains per hour between 0800 and 1000 in the morning and between 1600 and 1800 in the afternoon.

By way of contrast, Zurich Airport is served by S-bahn, regional and long distance trains. While S-bahn trains run every 30 minutes between the airport and central Zurich, the combination of S-bahn and other trains offers travellers a service at least every 10 minutes.

As an alternative, the RER Line B3 offers 8 trains per hour during much of the day between Paris (Charles de Gaulle) Airport and central Paris. Half of the off peak services run express to Gare du Nord and the other half run all stops. Lines B4 and C2 each offer at least 4 trains per hour between Paris (Orly) Airport and central Paris.

London Heathrow is served by up to 8 trains per hour on London Underground's Piccadilly Line which runs into and across central London. Alternatively, Heathrow Express offers 4 fast trains per hour to and from Paddington, whenre passengers need to connect to other services to travel onwards.

It therefore seems reasonable that if an attractive level of suburban passenger train service to a civil airport at Richmond is to be offered it will require at least 4 trains per hour throughout the day at regular headways along a well-defined route. Then:

- at 10% mode split, peak loads would be 125 passengers per train in either direction; and
- at 30% mode split, peak loads would be 375 passengers per train in either direction.

Both loads would be within the competence of an 8-car double deck suburban train. However, there may be train loading conflicts closer to the Sydney CBD.

A2.5 Rail Connectivity to the Sydney Region

If trains were routed along the Richmond Branch then there would be direct access to Blacktown, Parramatta and the Sydney CBD with onwards travel to the North Shore. The Northern, Southern, Eastern Suburbs and Illawarra/Bankstown/East Hills Lines would be accessible by transfer.

If trains were routed along the yet to be constructed link to the North West Rail Link then there would be direct access to Castle Hill, Epping and Macquarie Park, Chatswood and the lower North Shore and the Sydney CBD. The Northern, Eastern Suburbs and Illawarra/Bankstown/East Hills Lines would be accessible by transfer.

No one routing probably provides enough accessibility without having better knowledge of passenger origins and destinations across the Sydney Region. However, a combination of routing via the Richmond Branch and the North-West Rail Link would definitely provide superior suburban rail accessibility, but operations would still have to be efficient.

A2.6 General Pedestrian Access Issues

The likely configuration of a civil airport terminal developed at RAAF Richmond would place it some distance (e.g. 1.6-2.0 kilometres), from the existing Clarendon station. Transport planning practice suggests that the maximum commuter walking distance should not exceed 800 metres. However, it is likely that air passengers are likely to be encumbered by luggage and that they will have already walked possibly 400 metres within the terminal building between a gate and a terminal exit. Accordingly, walking to, or from, existing rail services does not appear to be an acceptable mode of access to remote public transport services.

A2.7 Rail Access Issues to a Civil Airport

A fundamental assumption is that the Richmond Branch should continue to serve its existing customers, regardless of the presence of a civil airport at RAAF Richmond.

Existing rail and road links between Richmond and communities to the east would have to be severed to enable construction of a civil airport with a north-south runway. Therefore, an alternative suburban rail connection to Richmond needs to be in place before severance. It also seems quite likely that the railway line would have to be placed under the proposed north-south runway, although there are a number of options where this crossing could take place.

Any new Richmond (township) station should be at least as accessible to pedestrians, feeder bus services and commuter parking, as they currently are now. On the experience at other Australian capital city airports, it is quite likely that there would be problems in establishing accessible free commuter parking within airport precincts, if a new township station were placed within the airport. There may also be issues in providing accessible kerb space for feeder bus services within airport precincts.

A Richmond (airport) station must be able to handle the proposed levels of train services of at least 4 trains per hour in each direction, with a possible peak throughput of up to 8 trains per hour. This suggests that the station must have two tracks with K-crossovers if it is a terminus, or it must lie on double track if it is a through station. It should be possible to route trains from this station to either Blacktown (via the existing line) or Castle Hill (via an extended North-West Rail Link).

There will need to be close pedestrian coupling between the railway station and the passenger arrival and departure terminal halls. The railway station at Brisbane International terminal is an example. However, at the same time, there needs to be close vehicular coupling to the airport terminal for taxis and private vehicles picking up or setting down passengers. Furthermore, there needs to be convenient pedestrian access between airport parking areas and the airport terminal. This suggests that the railway station must be either above ground (such as at Brisbane) or below ground (such as at Sydney).

The level of suburban rail traffic attracted to the airport, of at least 4 trains per hour in each direction, would require duplication of the remainder of the Richmond Branch, i.e. from Vineyard. Splitting services between the airport and Richmond township might require an extra 2 trains per hour on the Richmond Branch.

This level of service for an airport service would probably require at least:

- 4 extra trains in the network, if trains ran exclusively along either the Richmond Branch or the North West Rail Link to the Sydney CBD; or
- 8 extra trains in the network if trains ran along both the Richmond Branch and the North West Rail Link to the Sydney CBD.

Splitting services between the airport and Richmond township might require an extra 2 trains in the network. It might be easier to augment existing train stabling at Blacktown or the proposed stabling sidings beyond Rouse Hill to accommodate these extra trains, rather than to burden the airport railway with a purpose-built stabling yard.

A2.8 Use of People Movers

Flexible link

The simplest type and probably cheapest form of people mover, particularly for any minimalist start up operation at Richmond, would be the use of buses. Two forms of operation could be adopted.

- Airport Terminal to station shuttle – this would use buses similar in configuration to those used airside to transport passengers to aircraft with low level floors and suitable space for luggage. A high frequency service would need to be available in order to encourage usage of rail. This service would probably need to be an integral part of the airport operation.
- Airport Terminal to metropolitan destinations – a series of regional bus connection, again using buses specifically configured for airport users with luggage could be operated to and from key sources of demand such as CBD via M2; Parramatta via M7/M2; Penrith via the northern road and so on. These services would be likely to be operated under contract by the private sector.

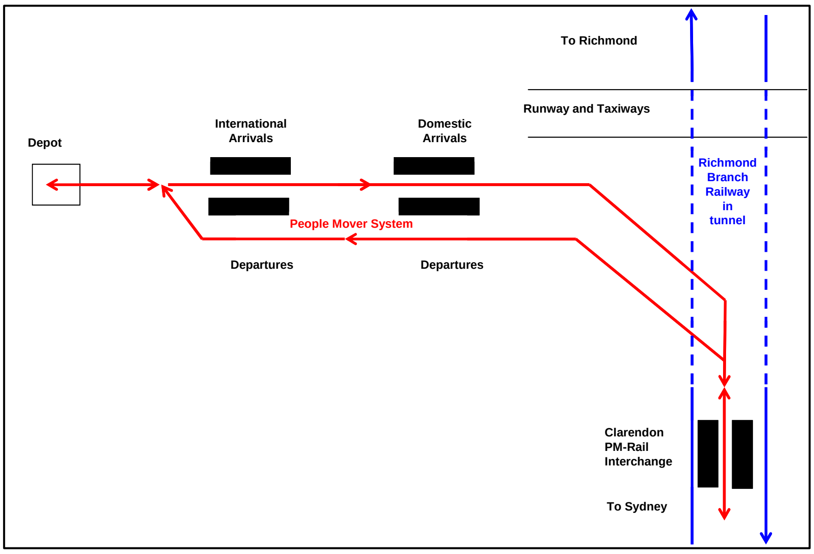
If effective, these services may prove adequate to avoid the need for more expensive fixed systems.

In respect of the airport to station shuttle, a suitably dimensioned shuttle bus service could provide the necessary link between the passenger terminal and Clarendon station. To limit passenger queuing for bus services, either at the terminal or at the railway station, a bus service should have a capacity of 140% of the expected peak numbers of passengers to be picked up. Assuming 50 passenger buses (i.e. with a mixture of seating and standing space, plus considerable luggage space as in the Melbourne SkyBus vehicles) we would estimate:

- 5 minutes to unload or reload passengers;
- 7 minutes to unload and reload passengers;
- at least 5 minutes to run between the passenger terminal and the railway station;
- 5 minutes for buses to circulate between the air departures and air arrivals levels of the passenger terminal;
- 14 services per hour operating out of 2 sawtooth platform bays at each passenger set-down or pick-up location, to cater for a 10% public transport mode split;
- 42 services per hour operating out of 5 sawtooth platform bays at each passenger set-down or pick-up location, to cater for a 30% public transport mode split; and
- a maximum of between 8 and 22 buses in service, depending upon the intensity of passenger demand.

The bus platform bays would have to be dedicated to the shuttle bus service and there would need to be efficient, preferably step free, passenger access to train services.

Fixed link



As an alternative to running "heavy" metropolitan railway into or through the airport terminals, some form of people mover system could be substituted. Such a system would then have to be closely connected with the railway for travel back to the Sydney region. Fixed people movers are in place in a number of airports both providing linkages from airport terminal to rail stations and providing in the case of very large terminals – such as Denver and Hong Kong – linkages within airport terminals. While these systems can be effective in terms of moving people, they introduce another mode (and possibly another cost) to users and in particular increased "friction" for travellers. This may discourage rather than encourage use of rail.

Use of small high-powered vehicles[18] would allow a people mover system to directly serve multiple terminals (e.g separate domestic and international terminals). A people mover system with relatively light guide ways (i.e. for 10+ tonnes axle load rather than the 15-18 tonne axle load for trains) could be designed to separately serve arrivals and departures at an international and domestic terminal. The object would be to provide step-free access between both arrival and departure terminals and the people mover system. The people mover system would then connect the airport terminals to an interchange station on the Richmond Branch, say at Clarendon. It would be highly desirable that there be level-boarding cross-platform transfers between people movers and trains. Figure 2 presents a suggested configuration.

If a people mover system was in place – rather than diverted or branched heavy rail – then the configuration of the Richmond Branch could be considerably simplified. After passing through the Clarendon interchange station it would then only need to run under the airport runway and taxiways and surface again before East Richmond to terminate in the existing Richmond terminus station. The Richmond Branch would still have to be duplicated because of the need to run at least 4 trains per hour throughout much of the working day, and Richmond would have to be reconfigured so that trains could still terminate in both Platforms 1 and 2. The transportation needs of Richmond Branch and airport travellers would be served by the same train service.

[18] As an example only, a people mover system would use automated 11.8-12.8 m, 21 t, 55 -70 km/h, 105-person vehicles (e.g. Bombardier APM 100) which could be run singly or coupled.

A2.9 Options for Passenger Rail Access to a Civil Airport

From the above discussion and a survey of the general site there appear to be at least six distinct options to provide passenger access to a Richmond airport:

- truncation of the Richmond Branch at the airport at a joint commuter and air passenger station beside the airport terminal;
- diversion of the Richmond Branch through the airport terminal before returning to the existing terminus at Richmond township;
- diversion of the Richmond Branch through the airport terminal before running to a new Richmond township terminus;
- circumnavigation of the airport by the Richmond Branch, with a station beside the airport terminal, before the railway runs to a new Richmond township terminus;
- splitting the Richmond Branch into an airport terminal spur and continuation to the current terminus at Richmond township; and
- provision of a people mover system to access different airport terminals and connect them with the Richmond Branch whose terminus would remain where it currently lies in Richmond township.

Where the airport railway station runs parallel to the airport terminal it should be possible to offer either an elevated station or an underground station. However, it is suggested that an elevated station should be easier to integrate into the airport terminal structure, such as has been done at Brisbane International, since the pedestrian flow between terminal and station could be affected without major vertical transportation.

A people mover system would desirably also be elevated.

Table 1 presents a high level assessment of these options.

The “truncate” option fails because it cannot maintain connections to Richmond township.

All options that have to be built and operational before construction of the runway, taxiways and terminal would probably impose a cost burden on construction of the civil airport.

Those options that route the railway through or past the airport terminal would necessarily incur additional construction costs because of a longer length of railway construction than otherwise required.

The “diversion” options would necessarily infringe public spaces, such as the Hawkesbury Showgrounds, Richmond Golf Course and/or the Hawkesbury Campus of the University of Western Sydney. This suggests that the railway would have to be placed underground for longer distances than just running under the airport terminal, taxiways and runway.

The “circumnavigate” option should avoid infringing public space, but at the expense of the longest length of new railway construction.

The “diversion” and “circumnavigate” options that terminate in Hobartville, rather than in Richmond township, destroy current accessibility between Richmond and the communities on the other side of the Hawkesbury River and the existing suburban railway. It is also not clear whether these options would draw the railway into the Hawkesbury-Nepean River floodplain. It is worth noting that the existing railway has largely avoided flooding in the past by virtue of it taking the high ground that exists between Riverstone and Richmond.

Splitting the railway seems to offer a good compromise between maintaining access to Richmond township and efficiently serving a new civil airport. The only work required before runway and taxiway construction would be diversion of the Richmond Branch into a cut-and-cover trench beneath the future runway and taxiways. Thereafter, suburban train services would be maintained, unaffected by airport construction. The spur line to the airport terminus could be built in step with the construction of the passenger terminal(s). An elevated configuration of the railway spur similar to Brisbane Airport would provide the best pedestrian coupling between the terminal and the railway while permitting efficient road and parking access to the terminal. The spur would start in a grade-separated junction, with the Richmond Branch roughly 1100 metres west of Clarendon station.

The “people mover” option would likewise only require the existing railway to be sunk under the future runway and taxiways as part of early enabling works. Provision should be made for a people mover terminus at Clarendon at the same time. Suburban train services would then be maintained unaffected by airport construction. Finally, the people mover system would be installed during terminal construction. A suitable depot would have to be built beyond the end of the passenger-carrying section of the people mover system.

Table A1 High level assessment of Fixed link Rail Options

Option	Transportation	Disamenity	Airport Station	Station Configuration	Richmond Station	Cost implications	New Construction	Construction Staging
Truncate	Severs suburban railway from its community	Imposes new travel patterns on rail users.	2-track terminus	Above ground	Abandoned	Avoids cost of extending railway under runway	~1.7 km of double track	All before any airport construction
Divert and return to Richmond	Maintains suburban railway accessibility	Infringes Hawkesbury Showground and golf course	2-track through station	Below ground	Retained	Additional length rail deviation for optimal terminal location and cut and cover tunnels	~5.5 km of double track	All before airport construction
Divert to a new Richmond station	Lesser suburban railway accessibility	Infringes Hawkesbury Showground and golf course	2-track through station	Below ground	Abandoned and replaced by a new 2-track terminus	New Richmond station and major surface alignment deviation	~4.6 km of double track	All before airport construction
Circumnavigate the airport	Lesser suburban railway accessibility	Increased effects on educational and recreational facilities	2-track through station	Above ground	Abandoned and replaced by a new 2-track terminus	New Richmond station and major surface alignment deviation	~6.0 km of double track	All before airport construction
Split the Richmond Branch	Maintains suburban railway accessibility	Operationally more complex and means not all trains serve Richmond or the airport	2-track terminus	Above ground	Retained	Grade separated junction to split the airport link and the Richmond line	~1.6 km of double track to Richmond ~1.7 km of double track to airport	Line to Richmond before airport construction Airport spur during terminal construction
Airport to Station People Mover	Maintains suburban railway accessibility	Introducing additional mode which may not be attractive to passengers.	People mover system separately serving the arrival and departure areas of each distinct terminal	Above ground	Retained	Requires standalone fixed infrastructure which is expensive to install and would need to be operated as a part of the airport infrastructure.	~1.6 km of double track to Richmond ~5.0 km of people mover guide way plus two turnouts	Line to Richmond before airport construction People mover during terminal construction

A2.9 Discussion and Conclusions

There are a number of options by which a new civil airport adjacent to RAAF Richmond could be served by the existing Sydney suburban railway, provided that the cost of the infrastructure and any additional rolling stock can be justified by the forecast level of patronage. The key issue is that in order to construct an 01/19 runway, the existing railway has to be lowered and so, given that any such major adjustments to the railway should happen once only, the question becomes one of whether the railway should be realigned to be fully able to be incorporated into any future airport terminal and how this is done.

A minimum cost approach would be to maintain the railway on or close to its existing alignment and placed in a cut-and-cover trench under the proposed north-south runway and taxiways. Access to rail could then be provided by a free airport style shuttle bus from the terminal to Clarendon Station. Such an approach could continue throughout any staged development of passenger throughput at Richmond.

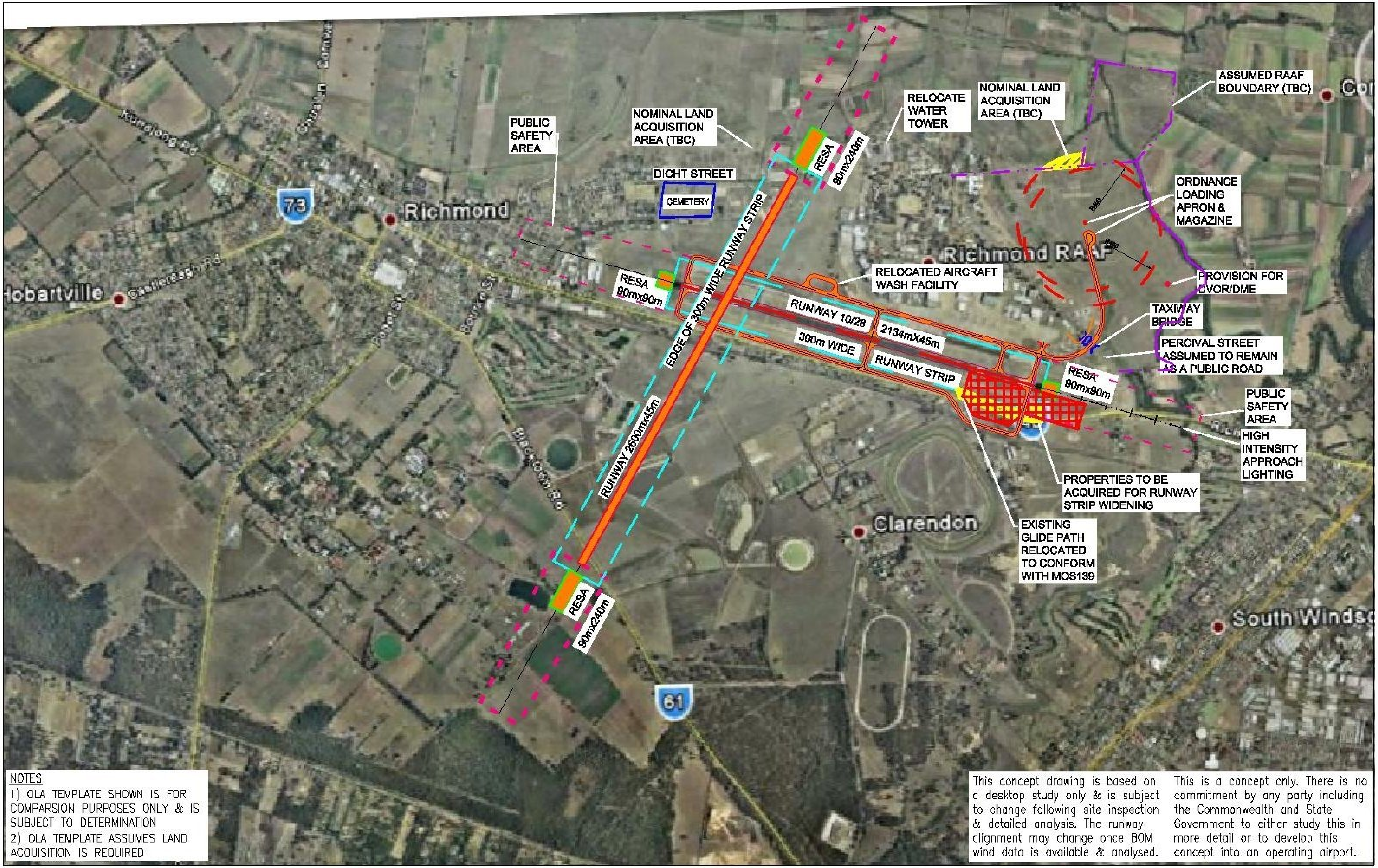
Alternatively, any major terminal development in the future would then be addressed, if warranted, by a split railway whereby a 1.7 kilometres double track, elevated spur line would be built from a grade-separated junction with the Richmond Branch to a 2-track terminus adjacent to the airport passenger terminal. This has the disadvantage of reducing the number of services accessible to airport passengers and Richmond commuters but avoids upfront costs.

As a further alternative, and if a fixed link system could be justified, a hybrid railway plus people mover system could provide a connection to the railway system. Such an arrangement would offer closer pedestrian connections to the separate arrival and departure areas of distinct airport terminals than would be possible with a rail-only solution. It would also permit simpler railway operations based on a single terminus in Richmond township with interchange between the people mover system and the railway at, say, Clarendon. Under this arrangement the 5.0 kilometres of elevated people mover guide way, plus two turnouts, would be built between the airport terminals and an interchange station at Clarendon. A depot to maintain the people mover vehicles would have to be built downstream of the last passenger stop. However, the disadvantage of this approach is its cost in comparison, to say, a shuttle bus, while still involving an additional change of mode.

The Richmond Branch trench would enable work prior to the construction of the north-south runway and taxiways. The airport terminus spur or the people mover system could then be built to coincide with the construction of the major passenger terminal(s). The duplication of the remaining 8.0 kilometres of Richmond Branch need only be completed to coincide with the construction of the airport terminus spur or people mover system. A junction and connecting railway with the proposed North-West Rail Link should be allowed for in the latter duplication, although construction of an airport terminus spur, or a people mover system, is not contingent upon it.

Under the rail-only arrangement 4 trains per hour on the airport terminus spur would be the bare minimum level of service for air passengers. These trains could be continuations of either Riverstone or Rouse Hill terminating suburban train services. If trains were extended from Riverstone then airport services would run via the Main Western line, through Parramatta to the Sydney CBD. If trains were extended from Rouse Hill then airport services would run via the North-West Rail Link to the North Shore Line, then to the Sydney CBD. The underlying Sydney CBD – Richmond service would continue to run as now. Higher levels of service could allow air passenger services to be split between the Richmond Branch and the North West Rail Link providing better connections with the Sydney Region.

Appendix 3 A3 Drawings



NOTES
1) OLA TEMPLATE SHOWN IS FOR COMPARSION PURPOSES ONLY & IS SUBJECT TO DETERMINATION
2) OLA TEMPLATE ASSUMES LAND ACQUISITION IS REQUIRED

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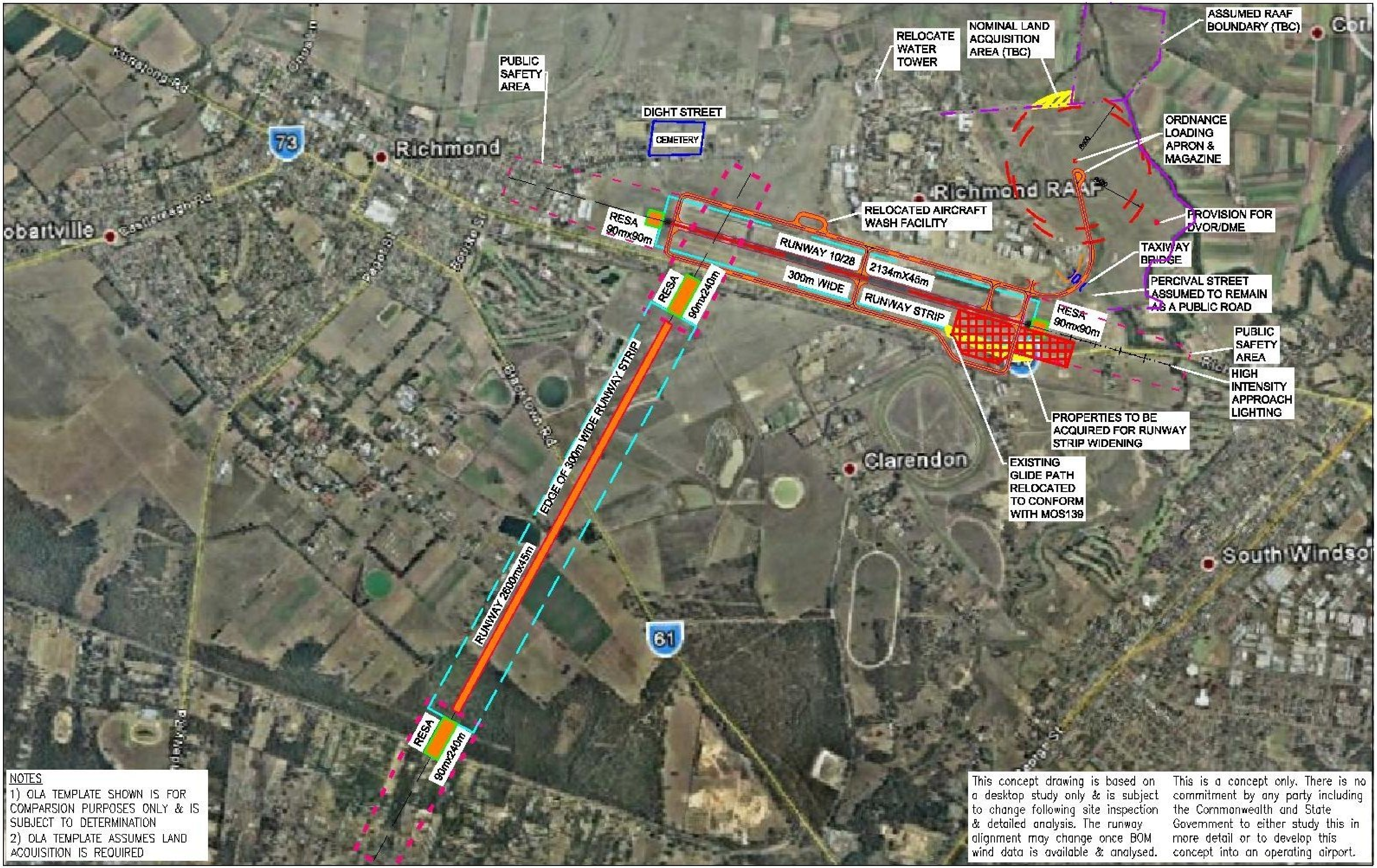
AMPC
Airport Master Planning Consultants
DATE: 23-12-10 SK101-B

0 250 500
SCALE 1:20,000 AT A3 APPROX.
SOURCE: BASE IMAGE GOOGLE EARTH PRO 2010

SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
2600m RUNWAY 01/19 (OPTION A1)



NOTES
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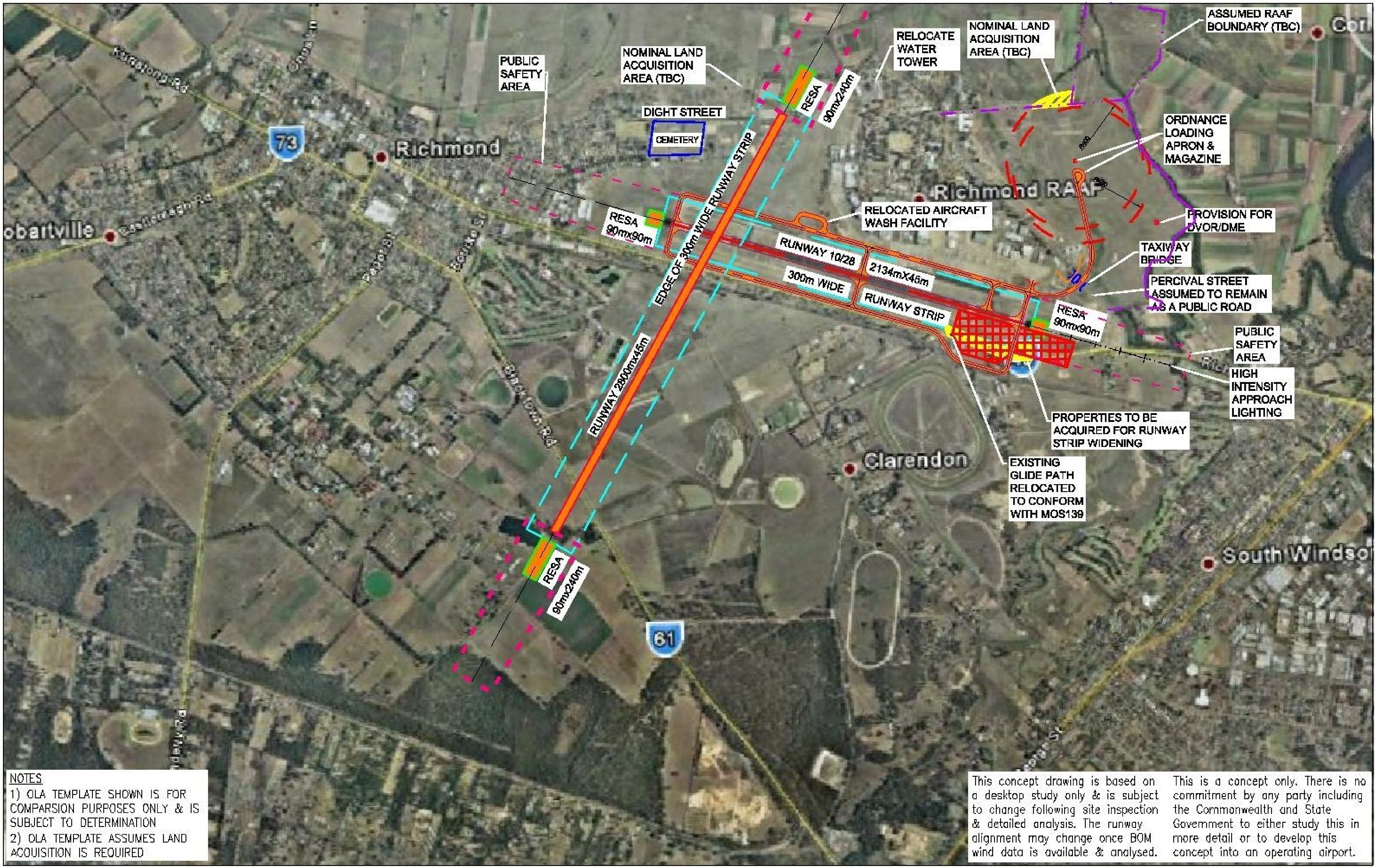
AMPC
Airport Master Planning Consultants
DATE: 23-12-10 SK102-B

0 250 500
SCALE 1:20,000 AT A3 APPROX.
SOURCE: BASE IMAGE GOOGLE EARTH PRO 2010

SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
2600m RUNWAY 01/19 (OFF BASE - OPTION A2)



NOTES
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2) OLA TEMPLATE ASSUMES LAND ACQUISITION IS REQUIRED

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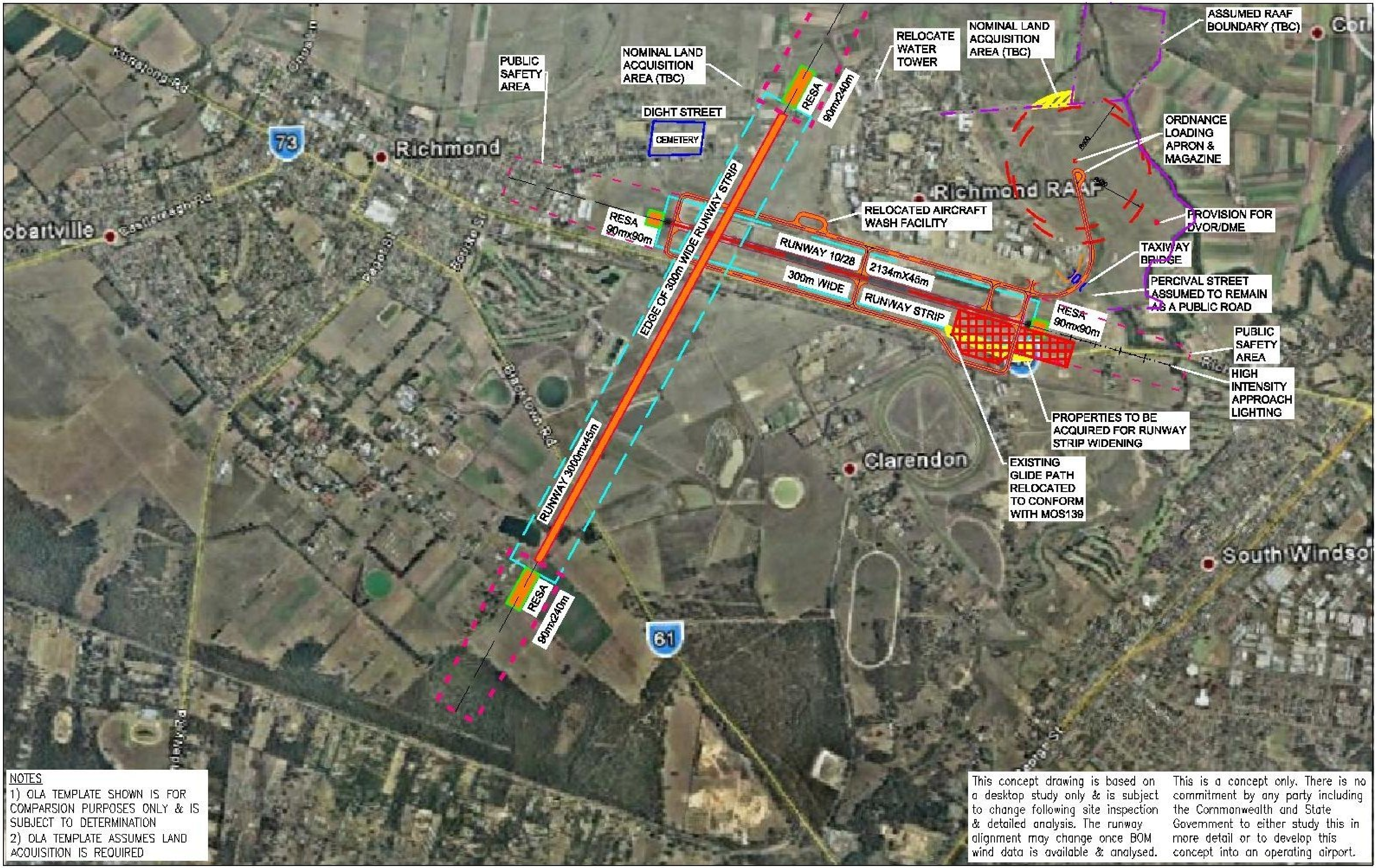
DATE: 23-12-10 SK103-B

0 250 500
SCALE 1:20,000 AT A3 APPROX.

SOURCE: BASE IMAGE GOOGLE EARTH PRO 2010

N

SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
2800m RUNWAY 01/19 (OPTION B)

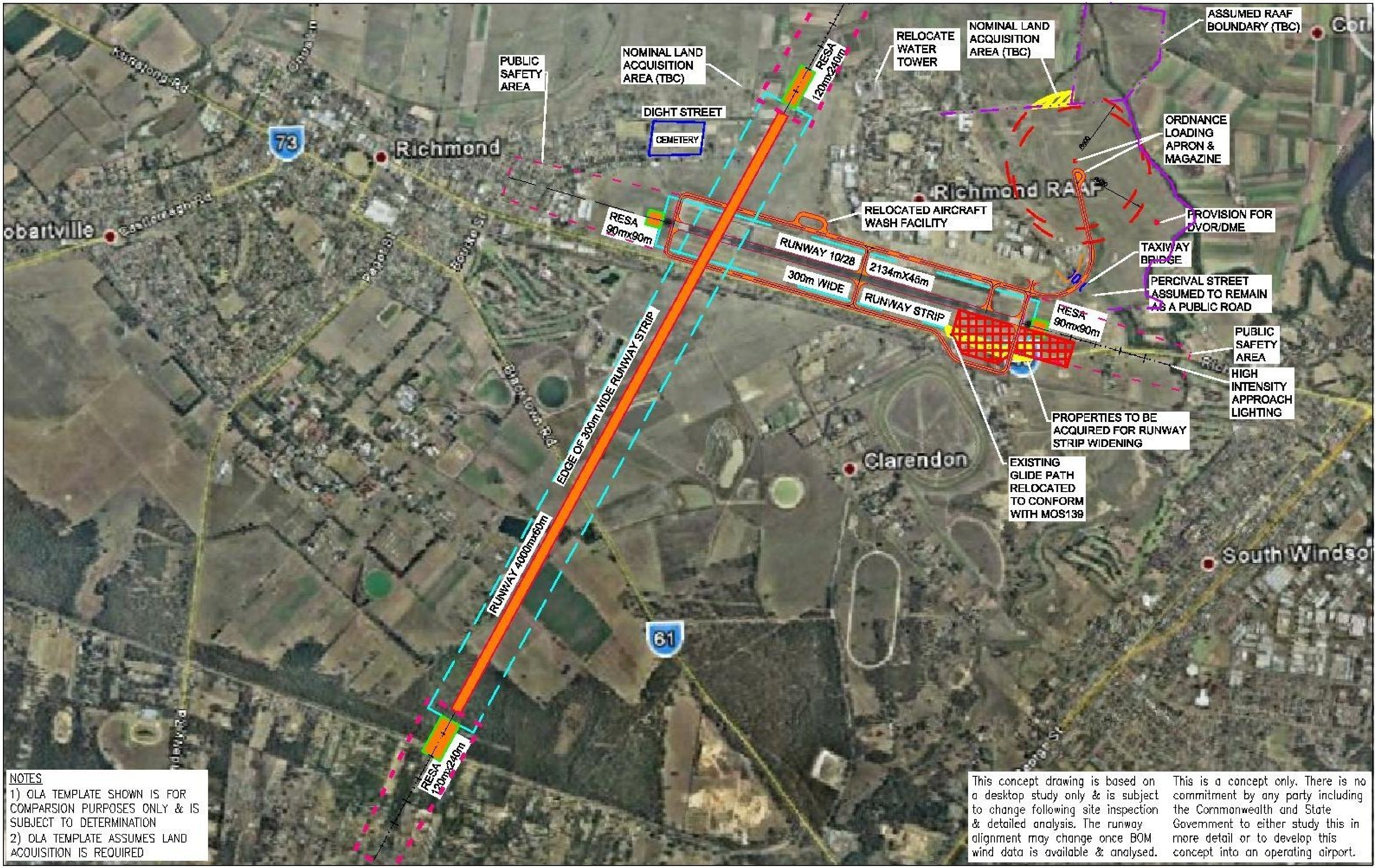


AMPC
Airport Master Planning Consultants
DATE: 23-12-10 SK104-B

0 250 500
SCALE 1:20,000 AT A3 APPROX.
SOURCE: BASE IMAGE GOOGLE EARTH PRO 2010

N

SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
3000m RUNWAY 01/19 (OPTION C)



NOTES

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2) OLA TEMPLATE ASSUMES LAND ACQUISITION IS REQUIRED

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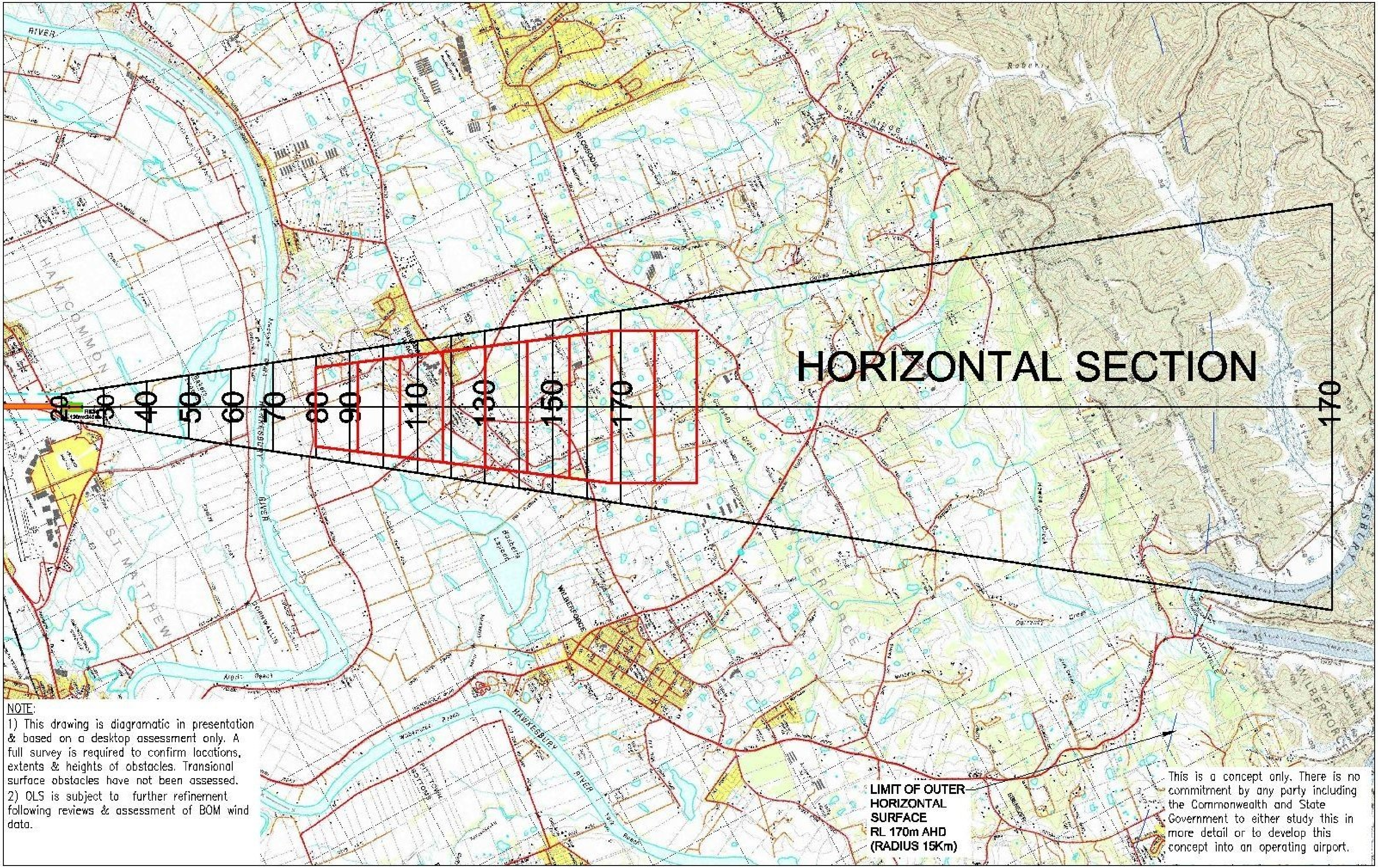
DATE: 23-12-10 SK105-B

0 250 500

SCALE 1:20,000 AT A3 APPROX.

SOURCE: BASE IMAGE GOOGLE EARTH PRO 2010

SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
4000m RUNWAY 01/19 (OPTION D)



NOTE:
1) This drawing is diagramatic in presentation & based on a desktop assessment only. A full survey is required to confirm locations, extents & heights of obstacles. Transional surface obstacles have not been assessed.
2) OLS is subject to further refinement following reviews & assessment of BOM wind data.

This is a concept only. There is no commitment by any party including the Commonwealth and State Government to either study this in more detail or to develop this concept into an operating airport.

DATE: 22–12–10
DRAWN: RN
CHKD: GM

0 1000 2000m
1:40,000 (A3)

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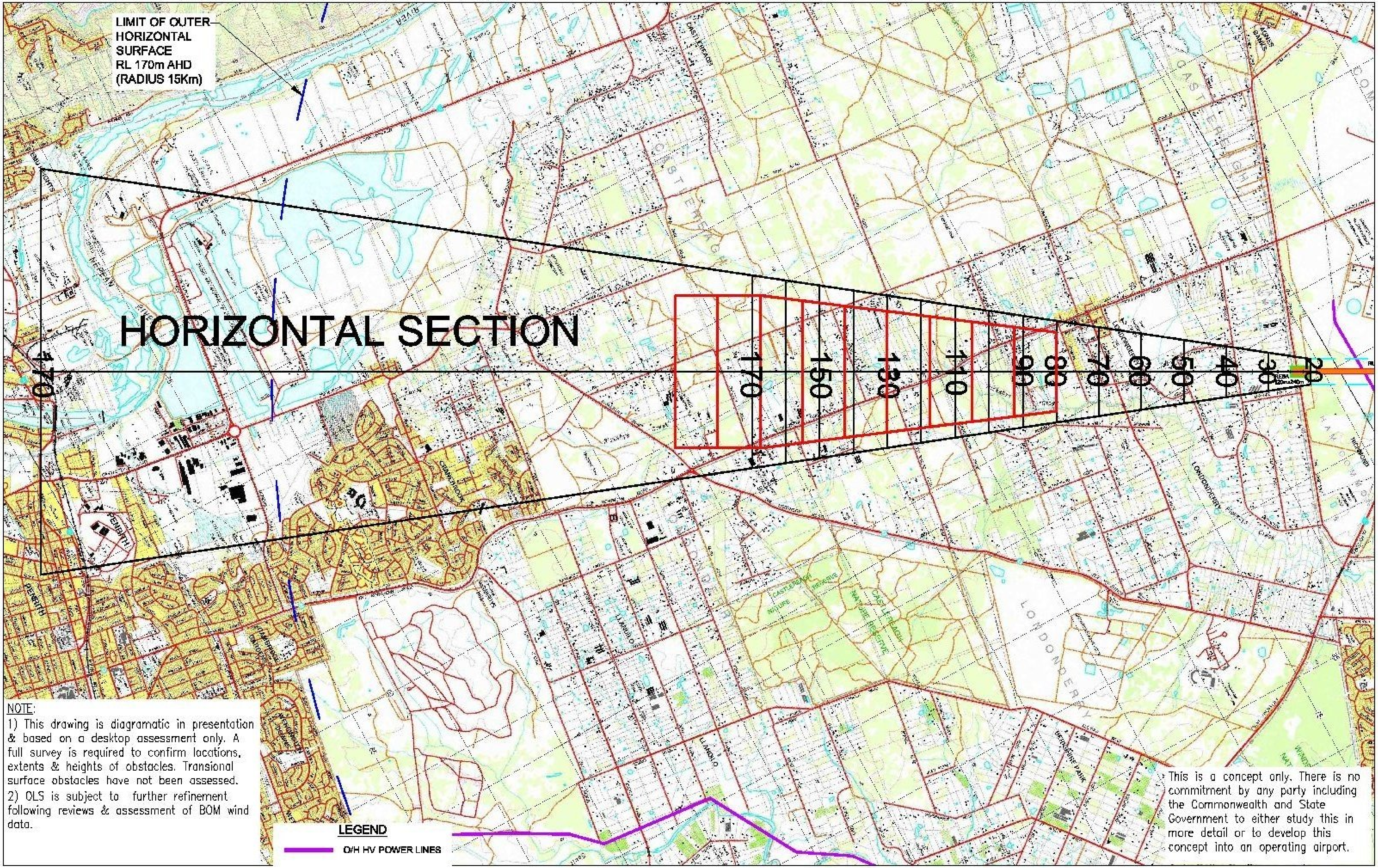
SYDNEY REGIONAL AIRPORT STUDY
RICHMOND RAAF BASE
DEVELOPMENT CONCEPT D
OBSTACLE LIMITATION SURFACES NORTH-EAST

DRAWING NO.
SK108-A



NOTE:
1) This drawing is diagramatic in presentation & based on a desktop assessment only. A full survey is required to confirm locations, extents & heights of obstacles. Transional surface obstacles have not been assessed.
2) OLS is subject to further refinement following reviews & assessment of BOM wind data.

This is a concept only. There is no commitment by any party including the Commonwealth and State Government to either study this in more detail or to develop this concept into an operating airport.

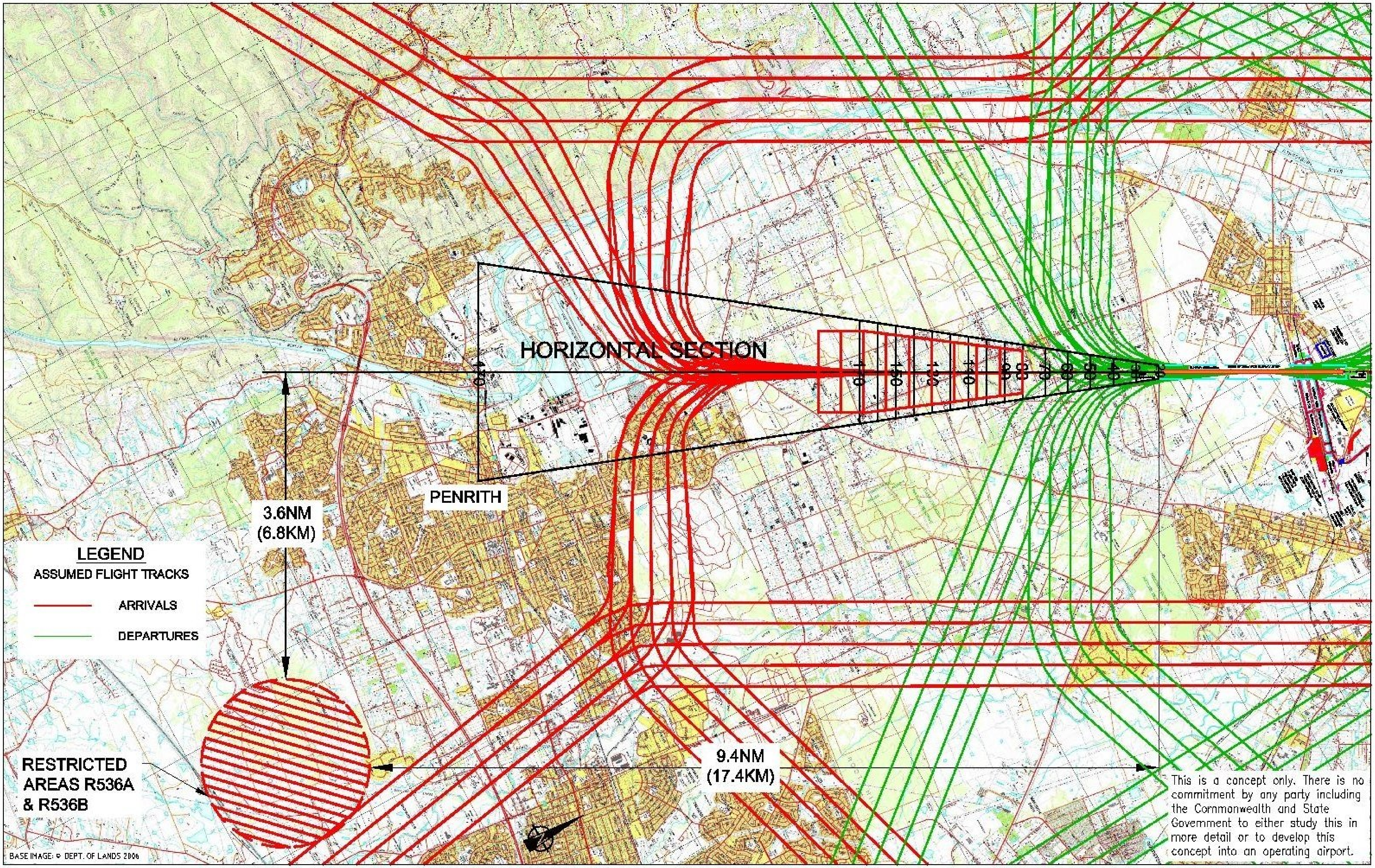
DATE: 22-12-10
DRAWN: RN
CHKD: GM

0 1000 2000m
1: 40,000 (A3)

AMPC
Airport Master Planning Consultants

SYDNEY REGIONAL AIRPORT STUDY
RICHMOND RAAF BASE
DEVELOPMENT CONCEPT D
OBSTACLE LIMITATION SURFACES SOUTH-WEST

DRAWING NO.
SK109-A



AMPC
Airport Master Planning Consultants
DATE: 22-12-10 SK197-A

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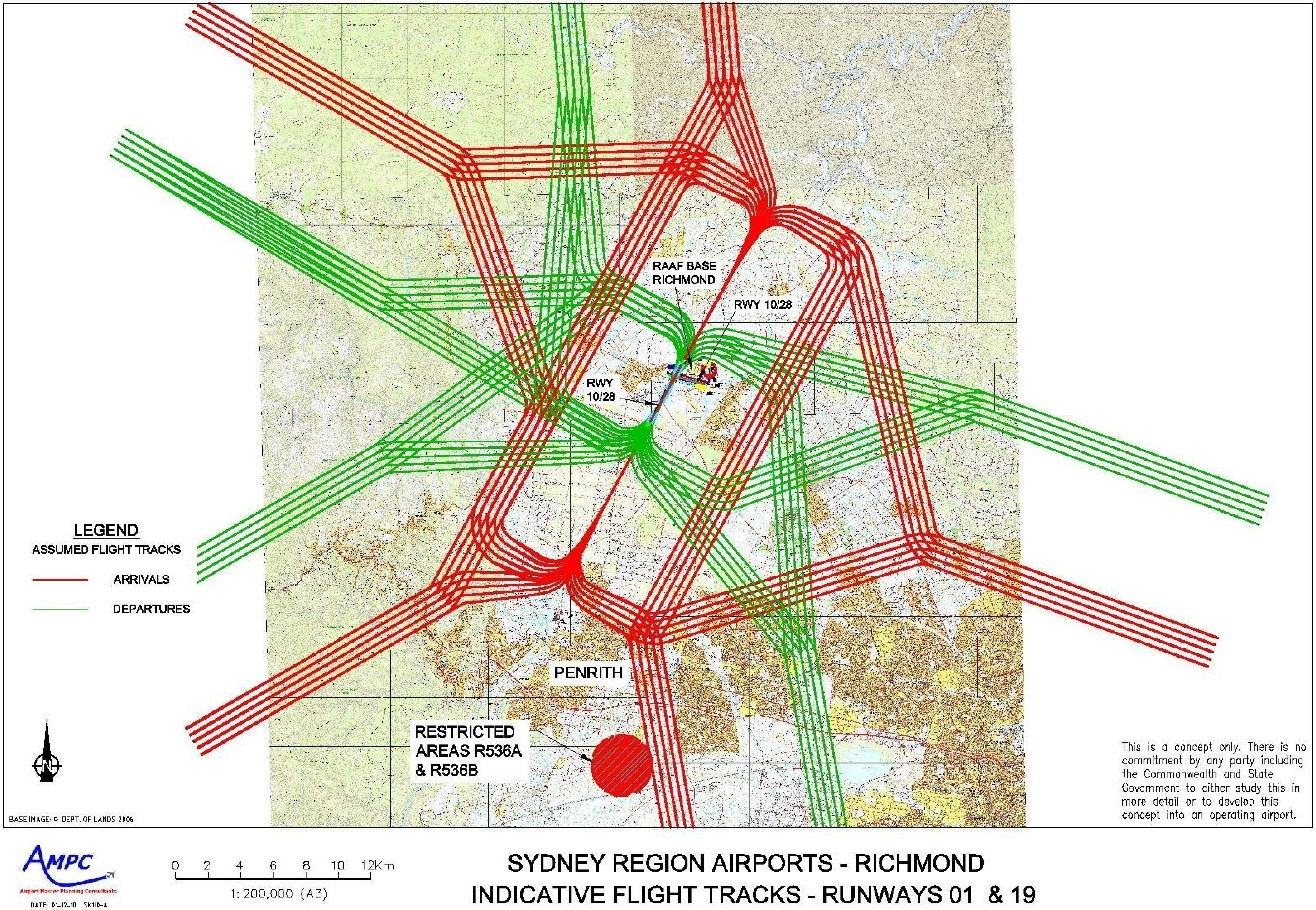
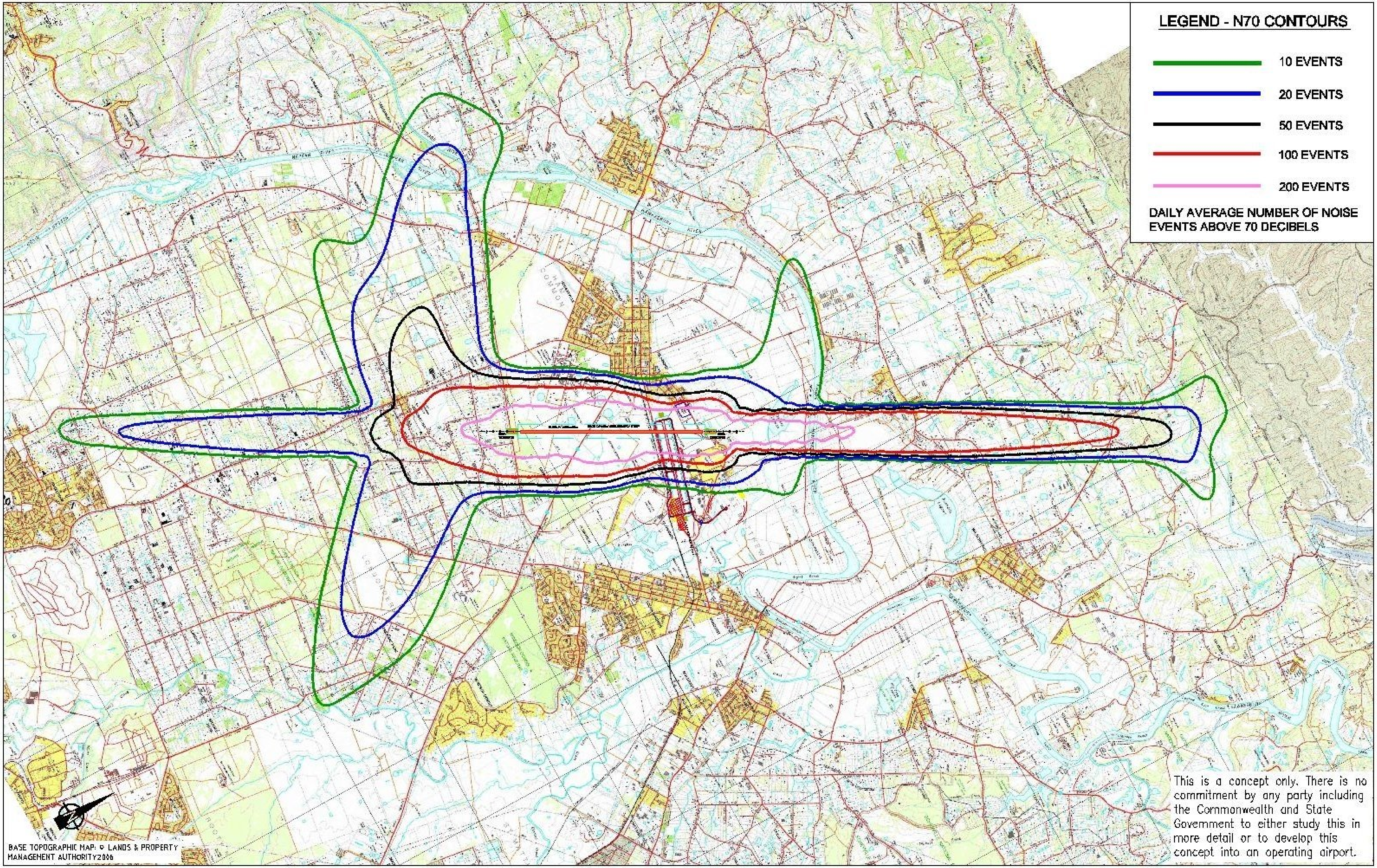
SYDNEY REGION AIRPORTS - RICHMOND
4000m RUNWAY 01/19 - SOUTHERN OLS & FLIGHT TRACKS



SYDNEY REGION AIRPORTS - RICHMOND
INDICATIVE FLIGHT TRACKS - RUNWAYS 01 & 19



AMPC
Airport Master Planning Consultants
DATE: 23-12-10 SK120-A

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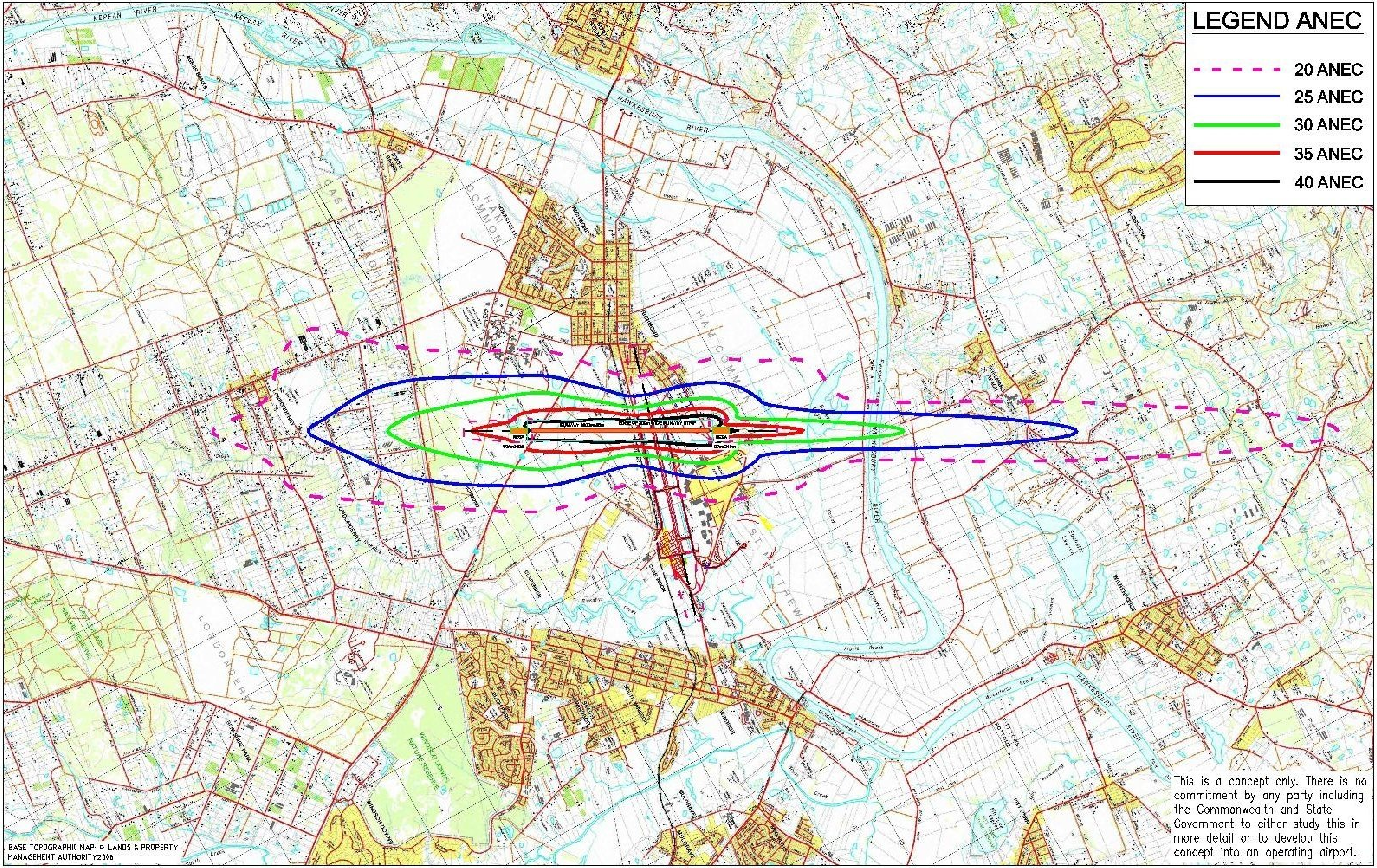
SCALE 1:75,000 (A3)

SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
OPTION D N70 - 4000m RUNWAY 01/19



AMPC
Airport Master Planning Consultants
DATE: 22-12-10 SK111-A

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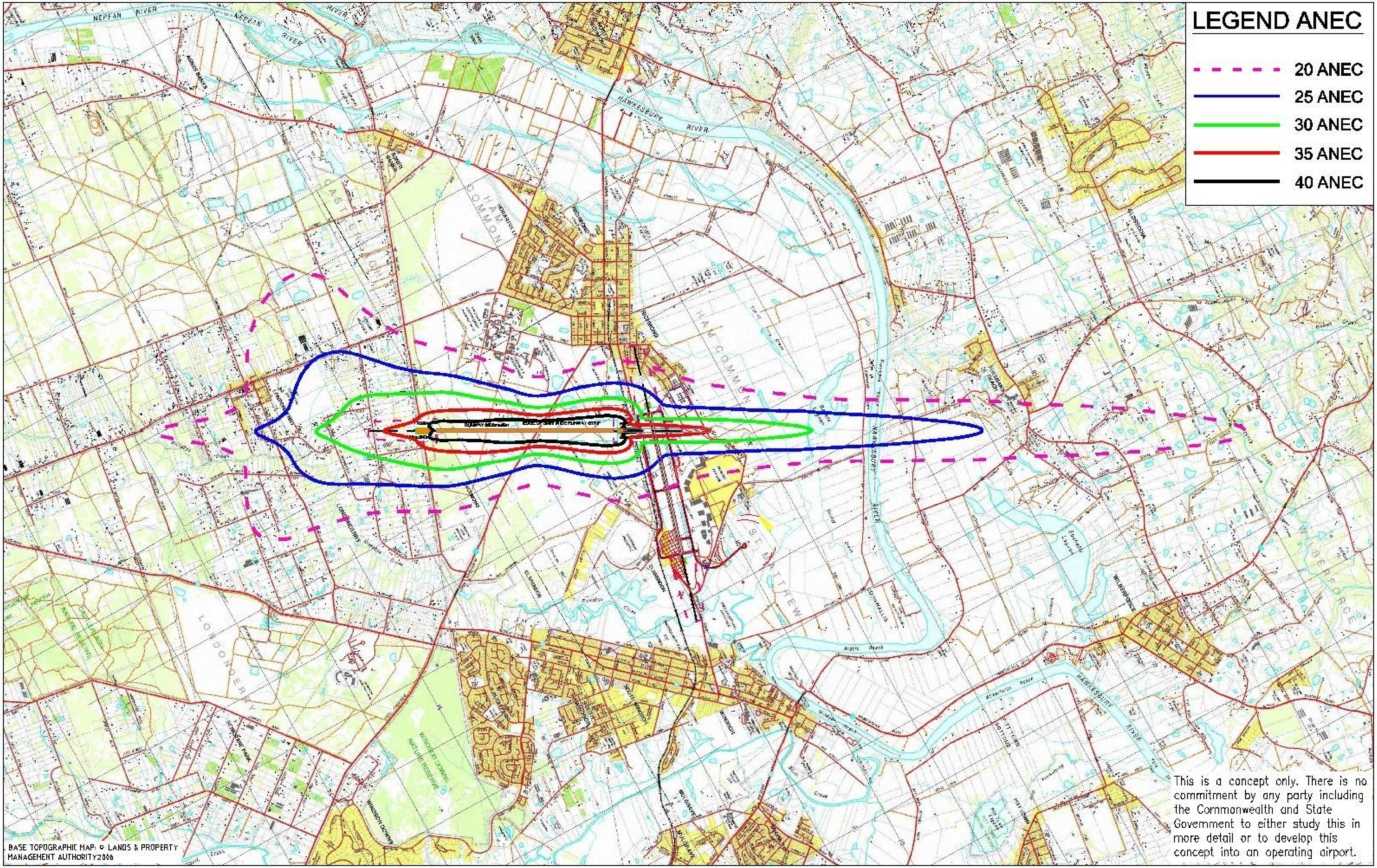
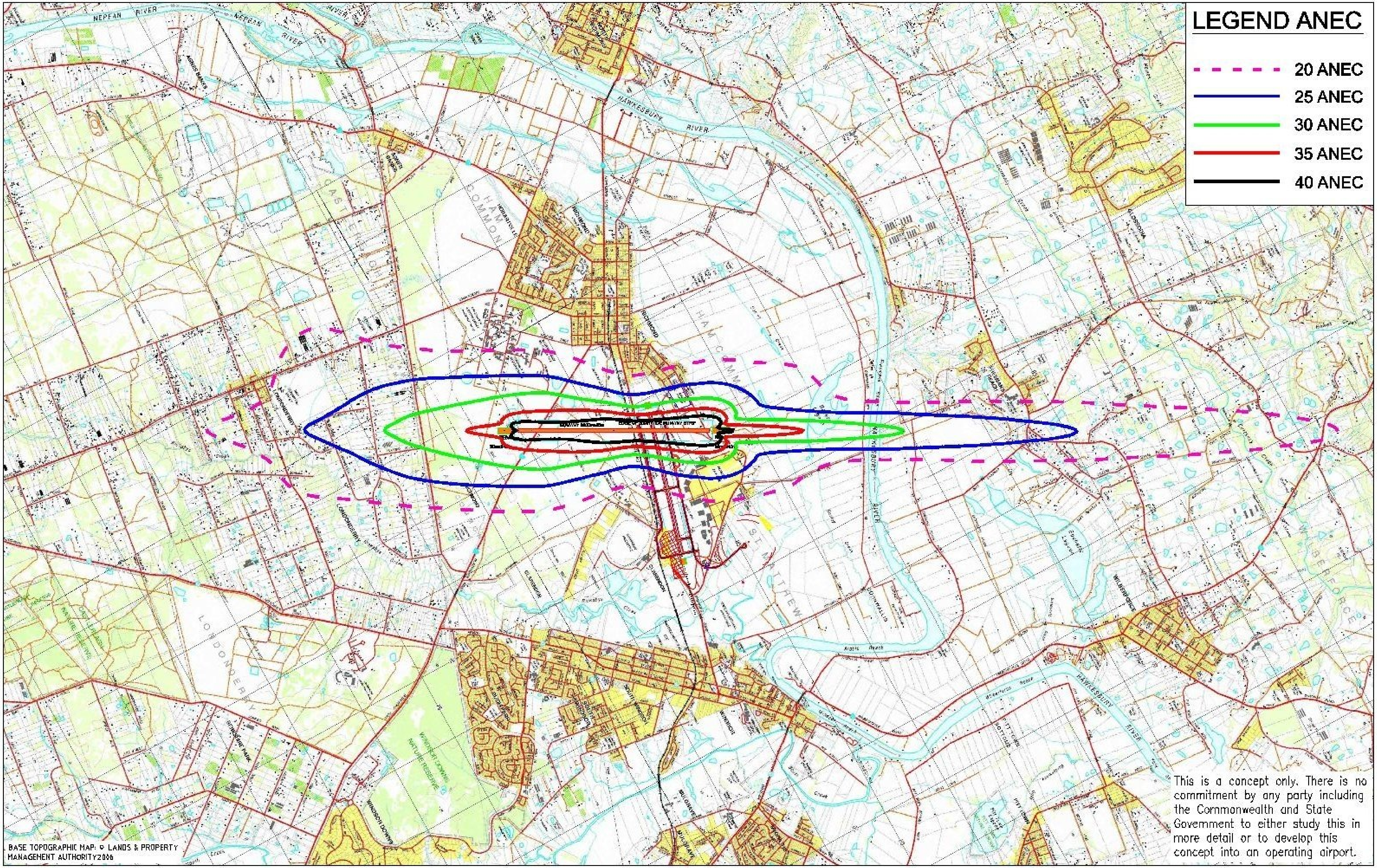
SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
OPTION A1 ANEC - 2600m RUNWAY 01/19



AMPC
Airport Master Planning Consultants
DATE: 23-12-10 SK112-A

SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
OPTION A2 ANEC - 2600m RUNWAY 01/19 (OFF BASE)



AMPC
Airport Master Planning Consultants
DATE: 23-12-10 SK113-A

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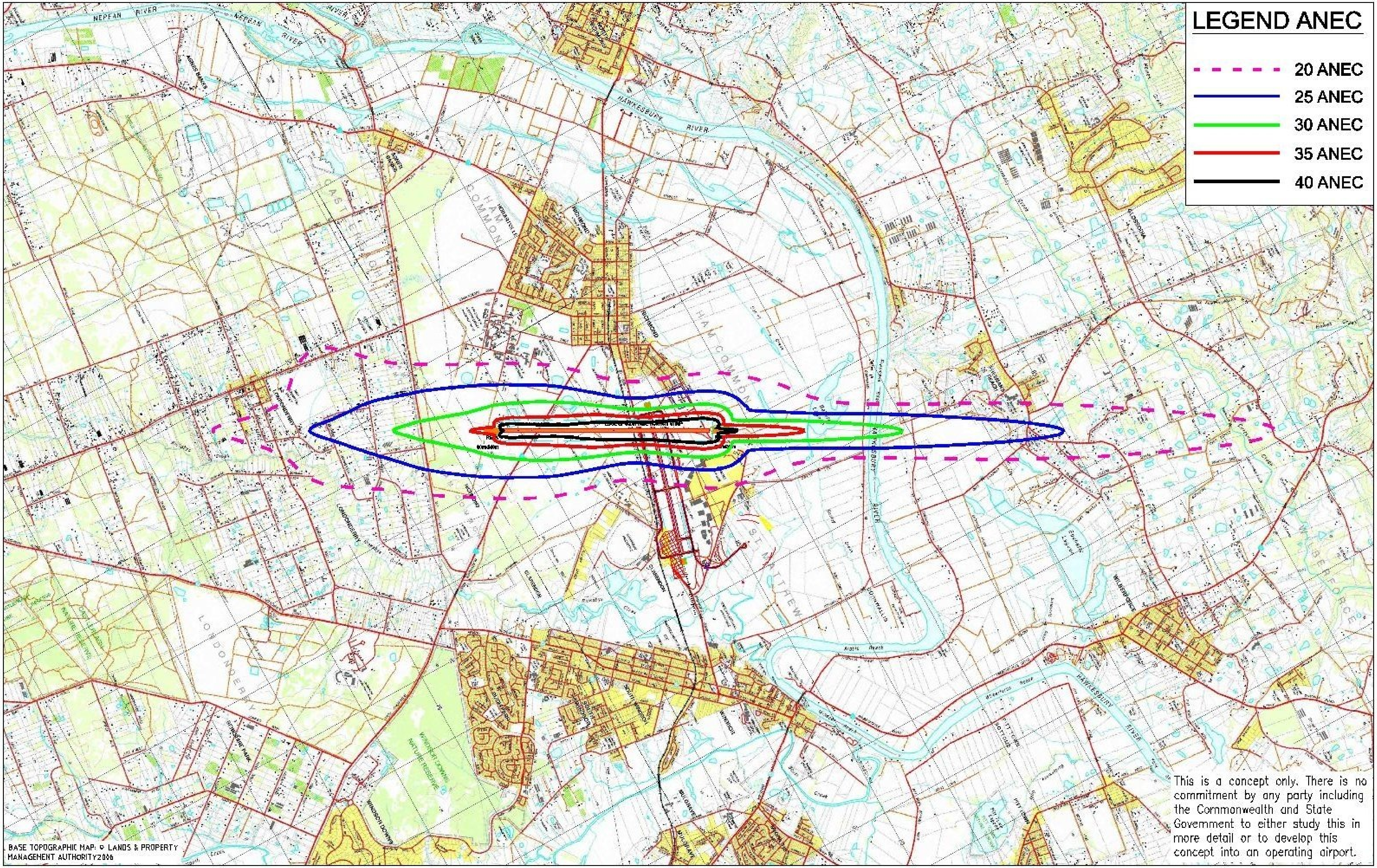
SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
OPTION B ANEC - 2800m RUNWAY 01/19



AMPC Airport Master Planning Consultants

DATE: 23-12-10 SK114-A

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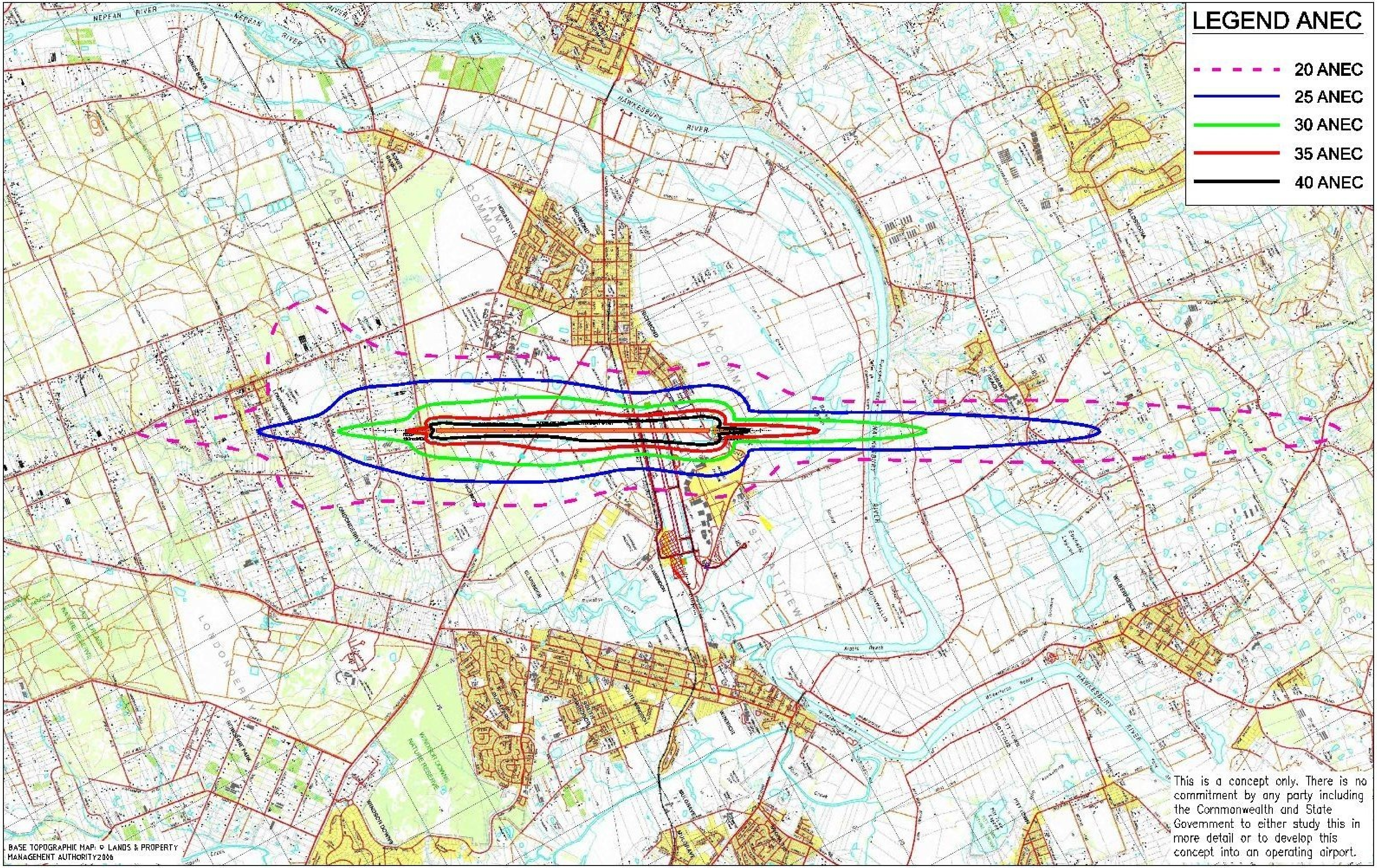
SCALE 1:50,000 (A3)

SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
OPTION C ANEC - 3000m RUNWAY 01/19



AMPC
Airport Master Planning Consultants
DATE: 23-12-10 SK115-A

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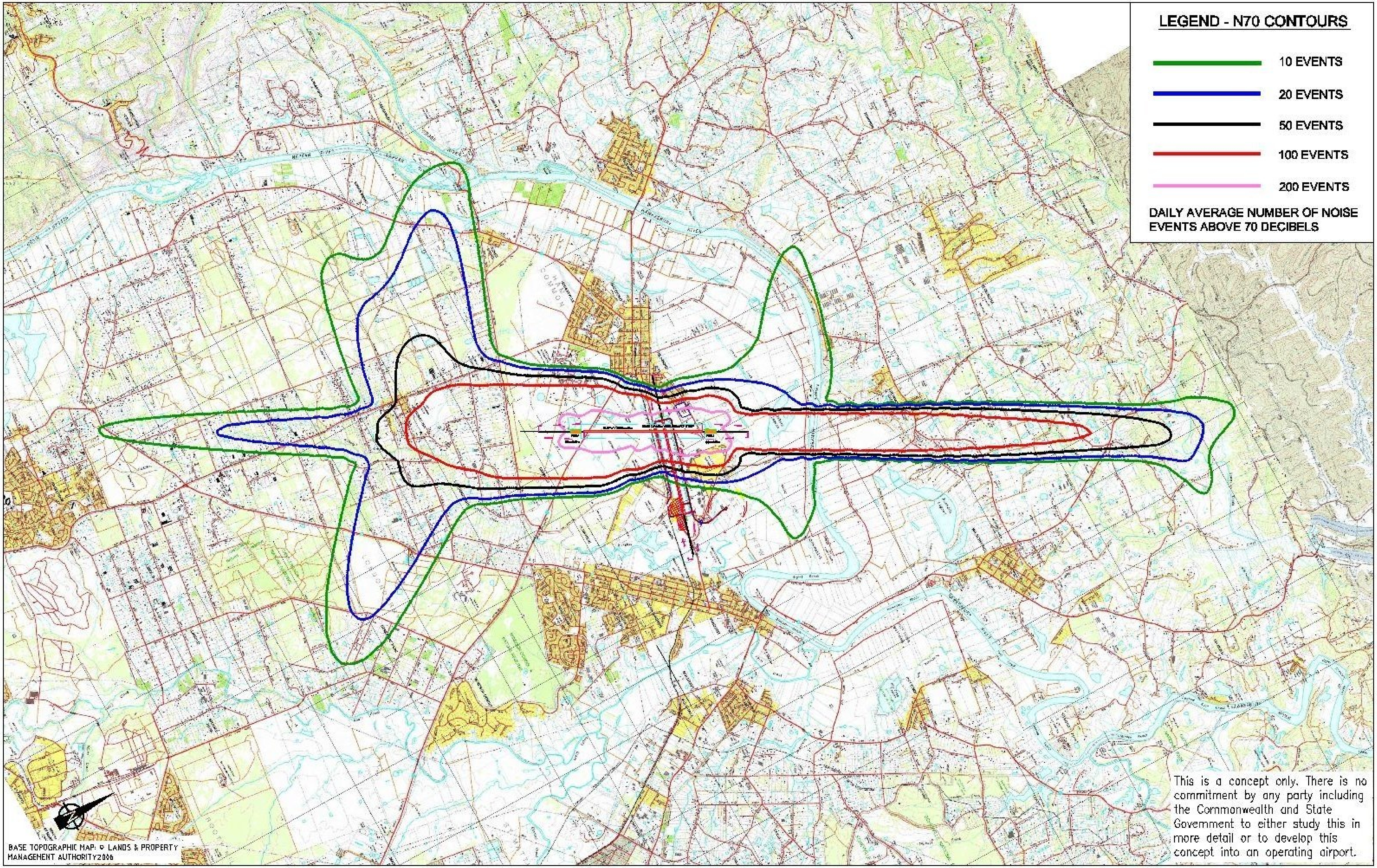
SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
OPTION D ANEC - 4000m RUNWAY 01/19



AMPC
Airport Master Planning Consultants
DATE: 22-12-10 SK116-A

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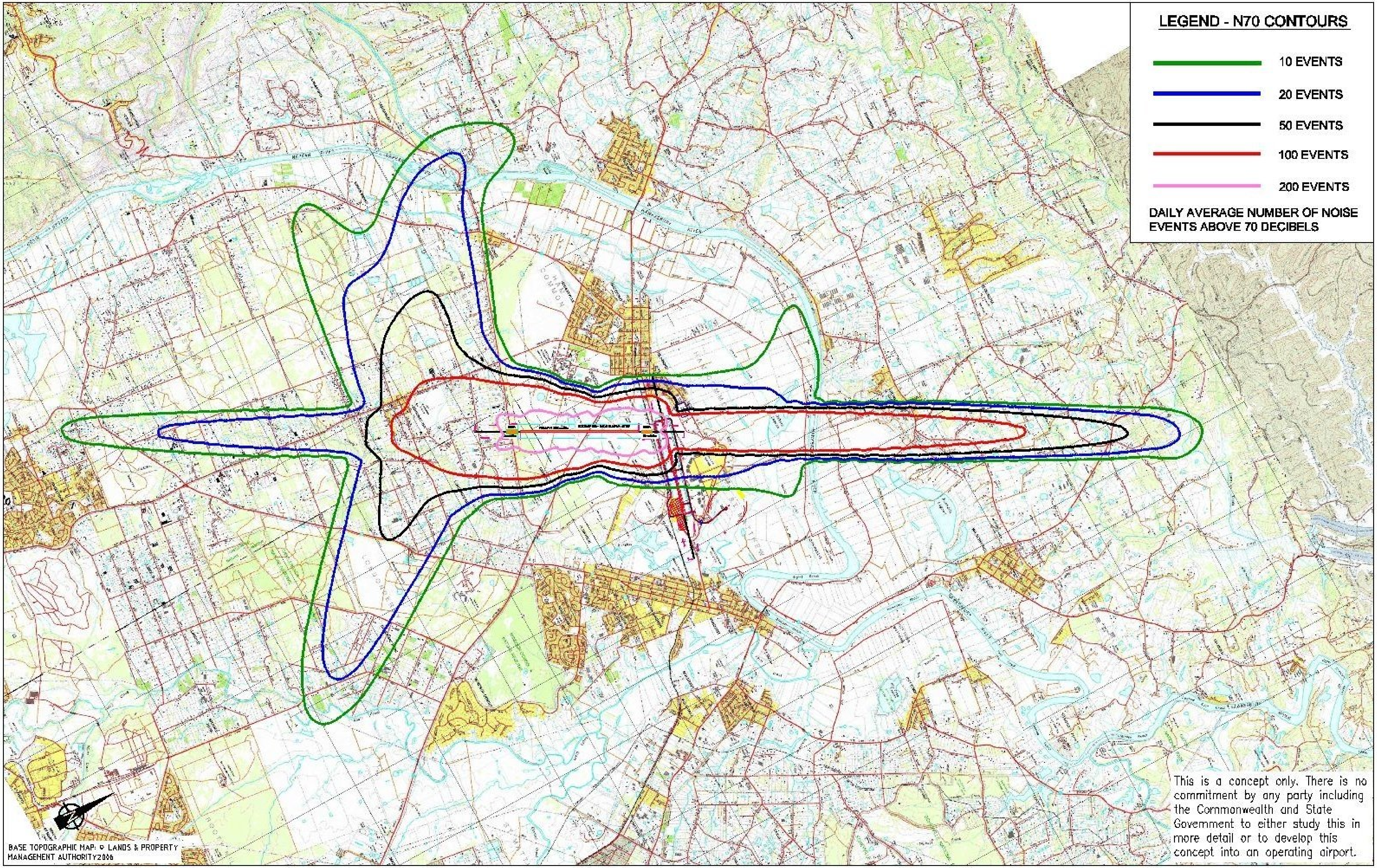
SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
OPTION A1 N70 - 2600m RUNWAY 01/19



AMPC
Airport Master Planning Consultants
DATE: 23-12-10 SK117-A

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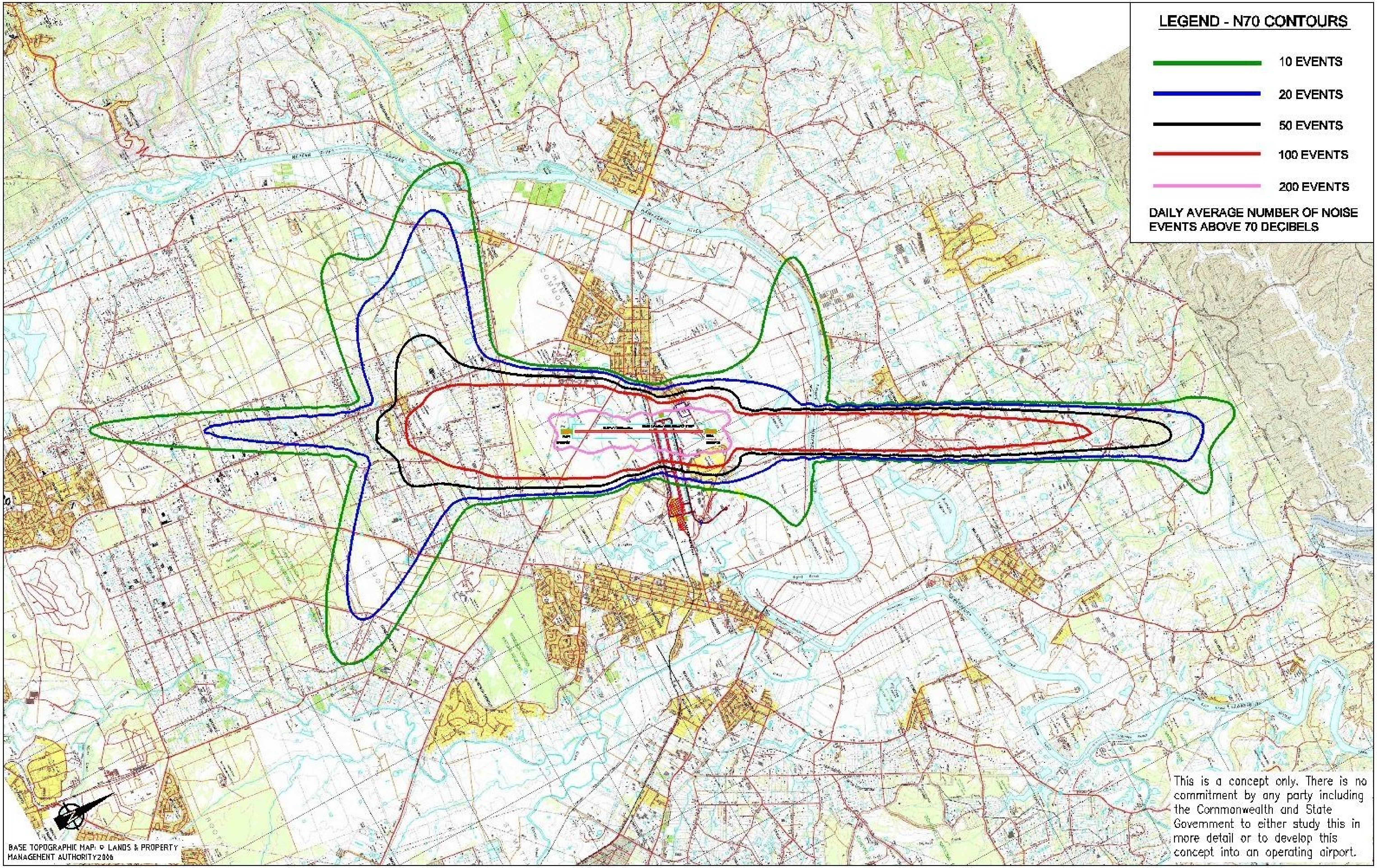
SCALE 1:75,000 (A3)

SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
OPTION A2 N70 - 2600m RUNWAY 01/19 (OFF BASE)

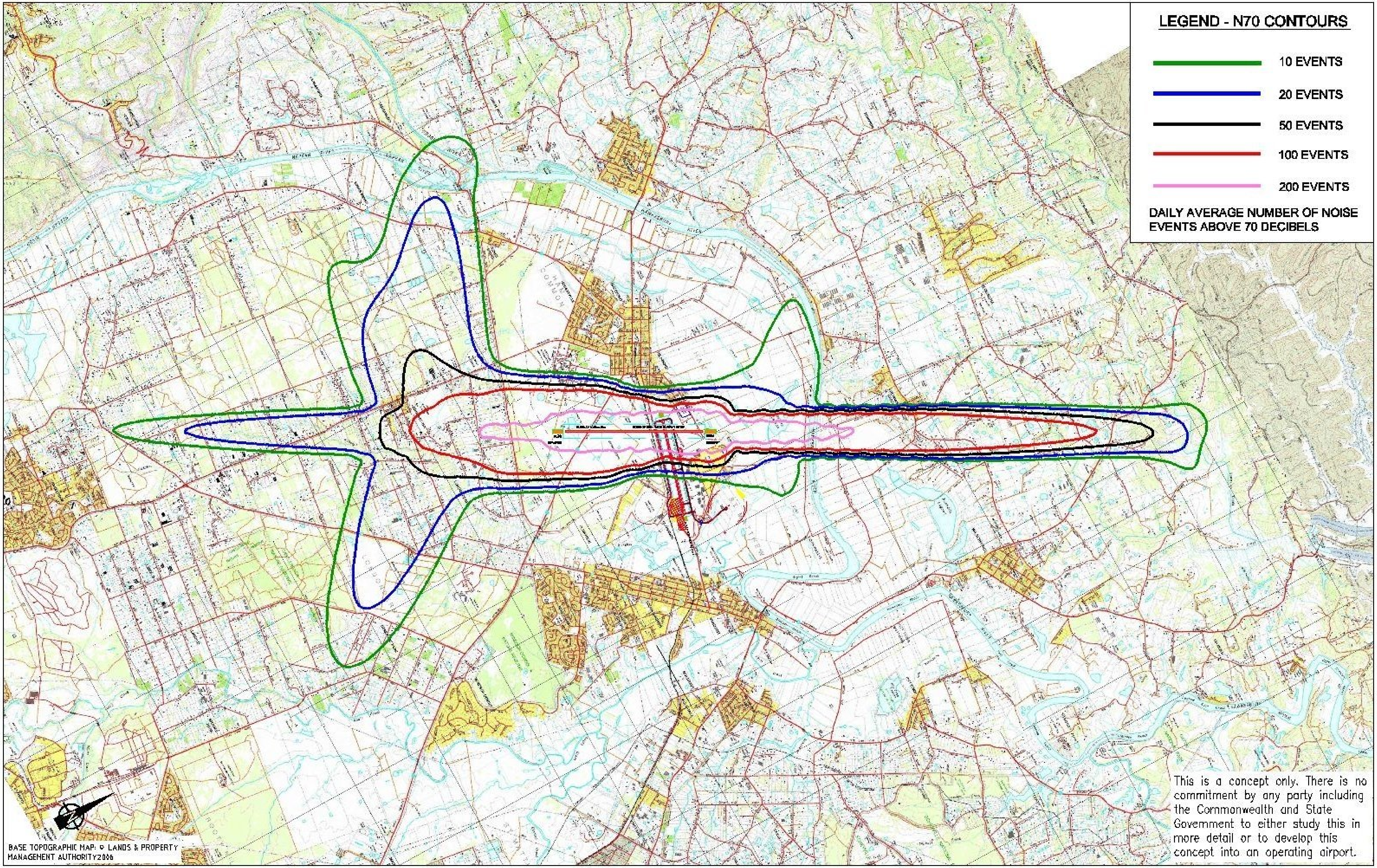


AMPC
Airport Master Planning Consultants
DATE: 23-12-10 SK118-A

0 1 2 3 4 5Km

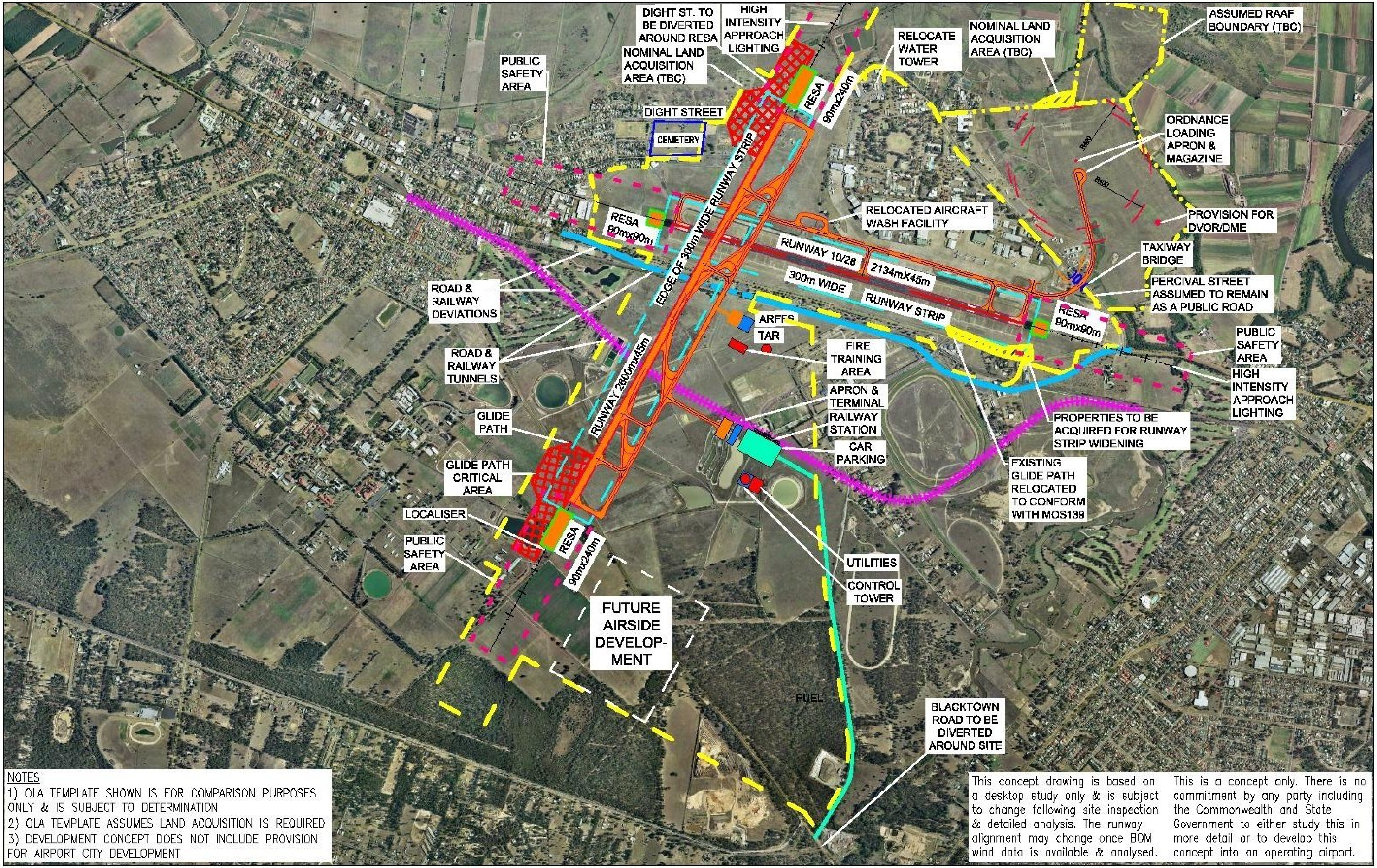
SCALE 1:75,000 (A3)

SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
OPTION B N70 - 2800m RUNWAY 01/19



AMPC
Airport Master Planning Consultants
DATE: 23-12-10 SK119-A

SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
OPTION C N70 - 3000m RUNWAY 01/19



NOTES
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2) OLA TEMPLATE ASSUMES LAND ACQUISITION IS REQUIRED
3) DEVELOPMENT CONCEPT DOES NOT INCLUDE PROVISION FOR AIRPORT CITY DEVELOPMENT

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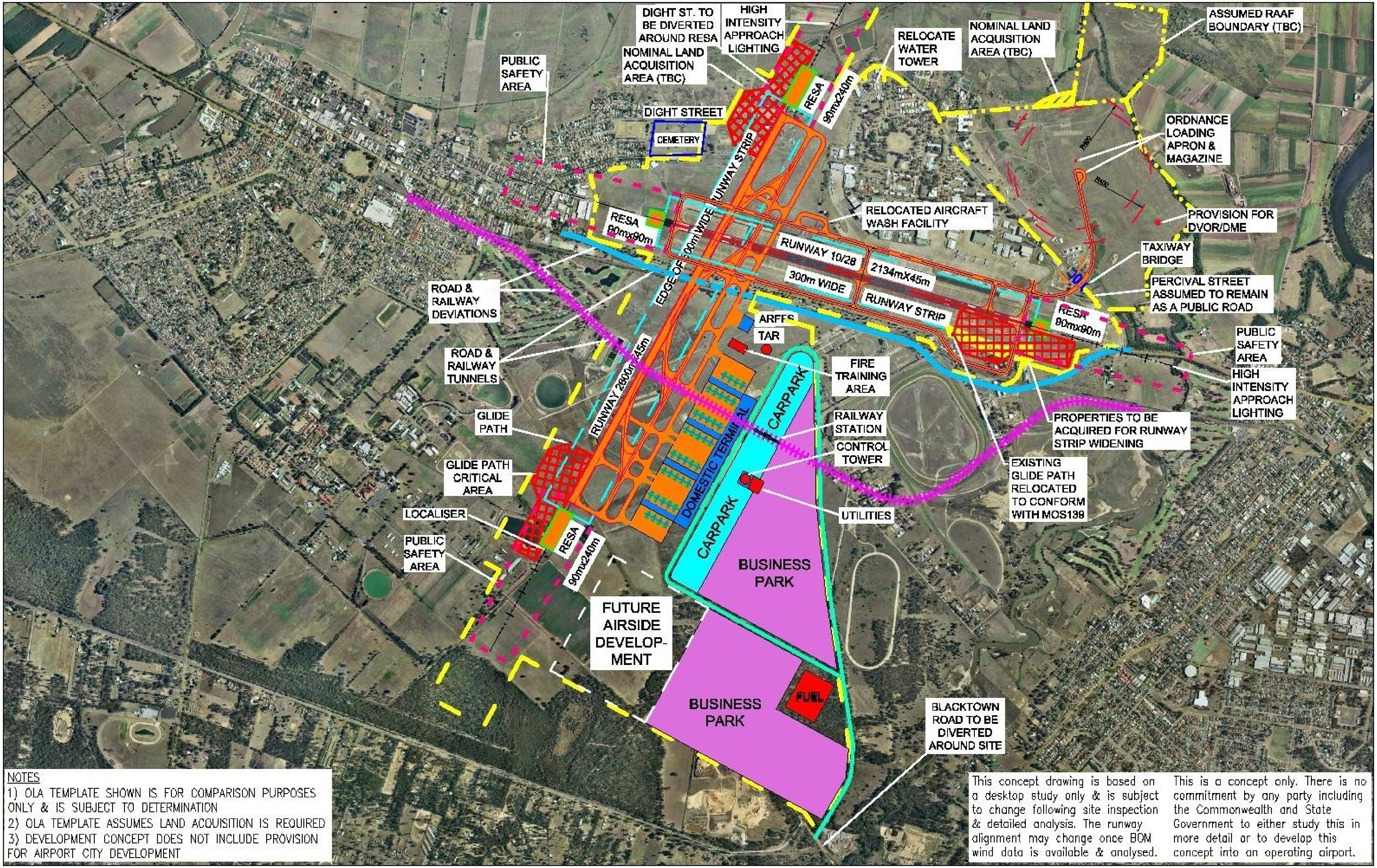
AMPC
Airport Master Planning Consultants
DATE: 11-05-11 SK130-A

0 250 500
SCALE 1:20,000 AT A3 APPROX.
SOURCE: BASE IMAGE GOOGLE EARTH PRO 2010

N

SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
DEVELOPMENT CONCEPT A1 - MINIMAL START-UP SCENARIO



NOTES
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2) OLA TEMPLATE ASSUMES LAND ACQUISITION IS REQUIRED
3) DEVELOPMENT CONCEPT DOES NOT INCLUDE PROVISION FOR AIRPORT CITY DEVELOPMENT

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AMPC Airport Master Planning Consultants

DATE: 18-04-11 SK125-B

0 250 500
SCALE 1:20,000 AT A3 APPROX.
SOURCE: BASE IMAGE GOOGLE EARTH PRO 2010

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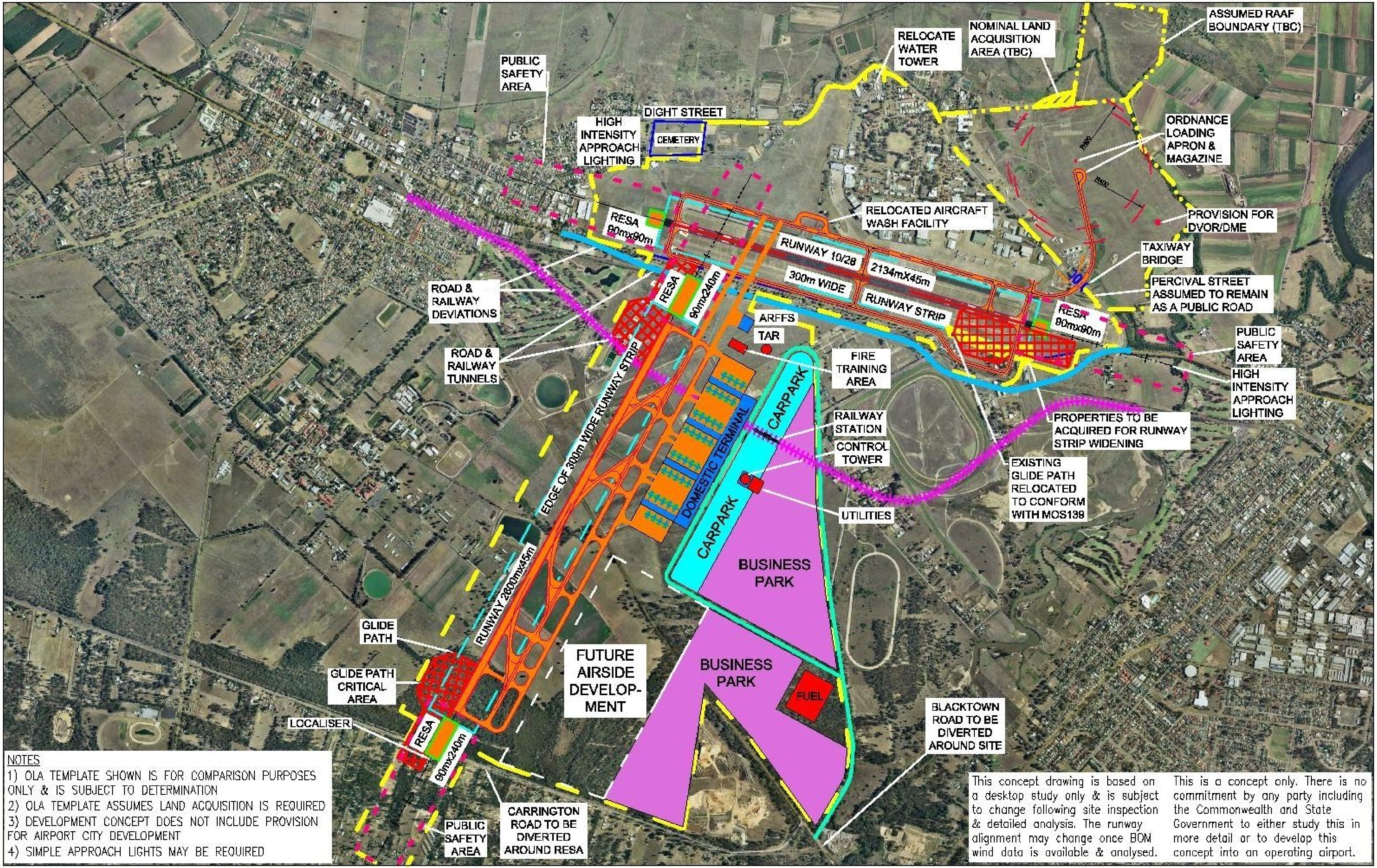
SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
DEVELOPMENT CONCEPT A1



NOTES
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2) OLA TEMPLATE ASSUMES LAND ACQUISITION IS REQUIRED
3) DEVELOPMENT CONCEPT DOES NOT INCLUDE PROVISION FOR AIRPORT CITY DEVELOPMENT
4) SIMPLE APPROACH LIGHTS MAY BE REQUIRED

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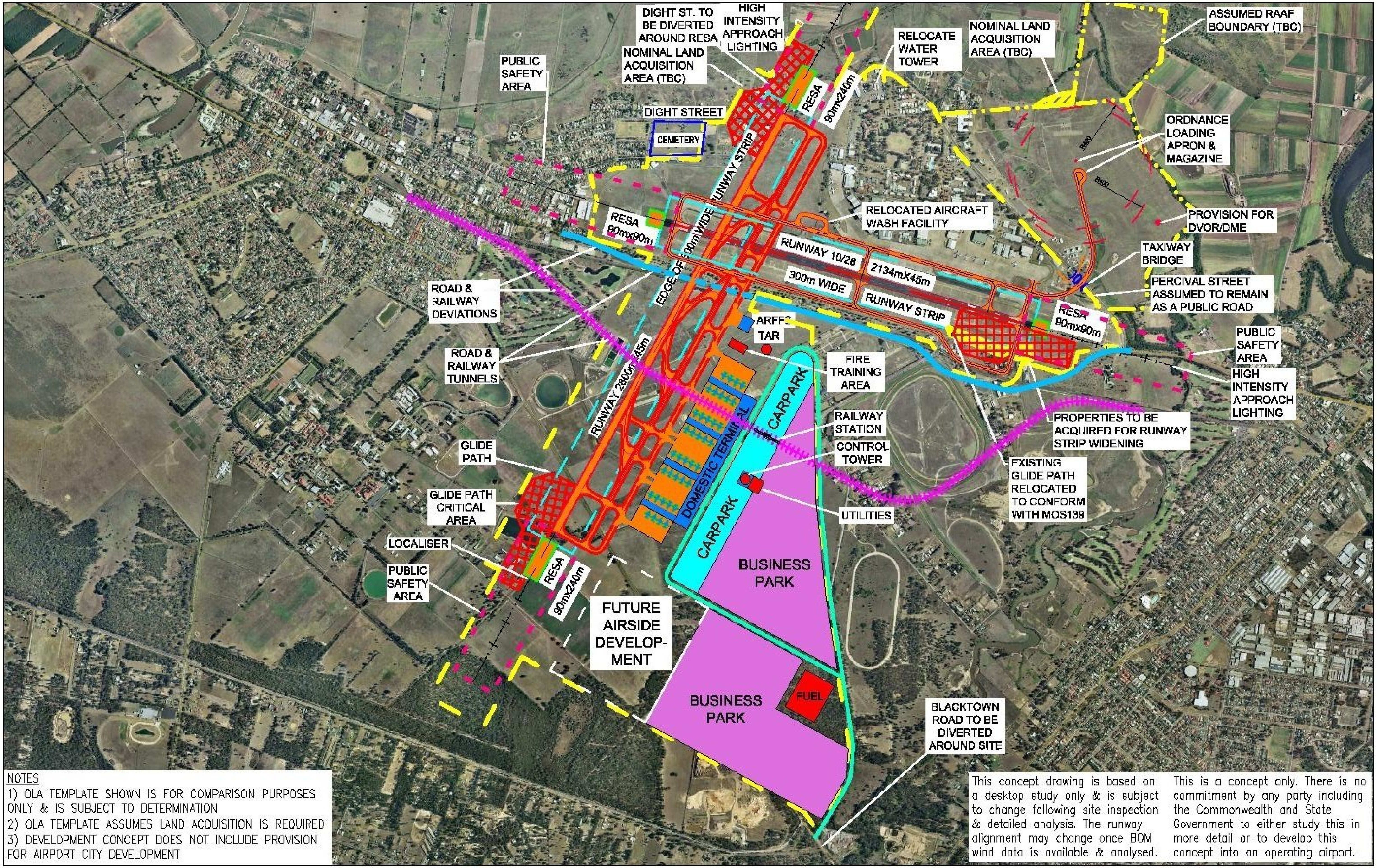
AMPC
Airport Master Planning Consultants
DATE: 18-04-11 SK126-B

0 250 500
SCALE 1:20,000 AT A3 APPROX.
SOURCE: BASE IMAGE GOOGLE EARTH PRO 2010

SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
DEVELOPMENT CONCEPT A2



AMPC
Airport Master Planning Consultants
DATE: 18-04-11 SK127-B

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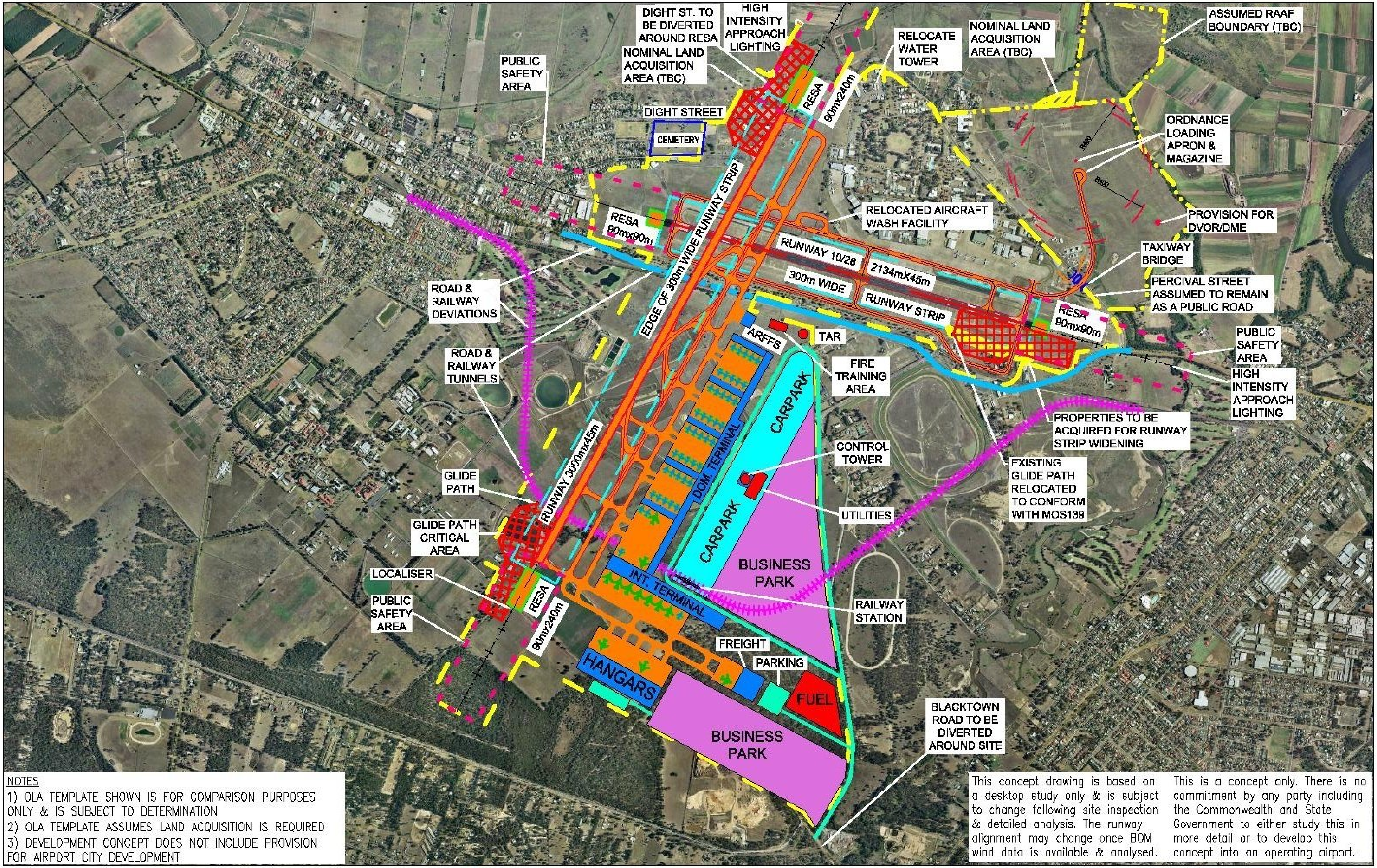
SOURCE: BASE IMAGE GOOGLE EARTH PRO 2010

SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
DEVELOPMENT CONCEPT B



AMPC
Airport Master Planning Consultants

DATE: 18-04-11 SK128-B

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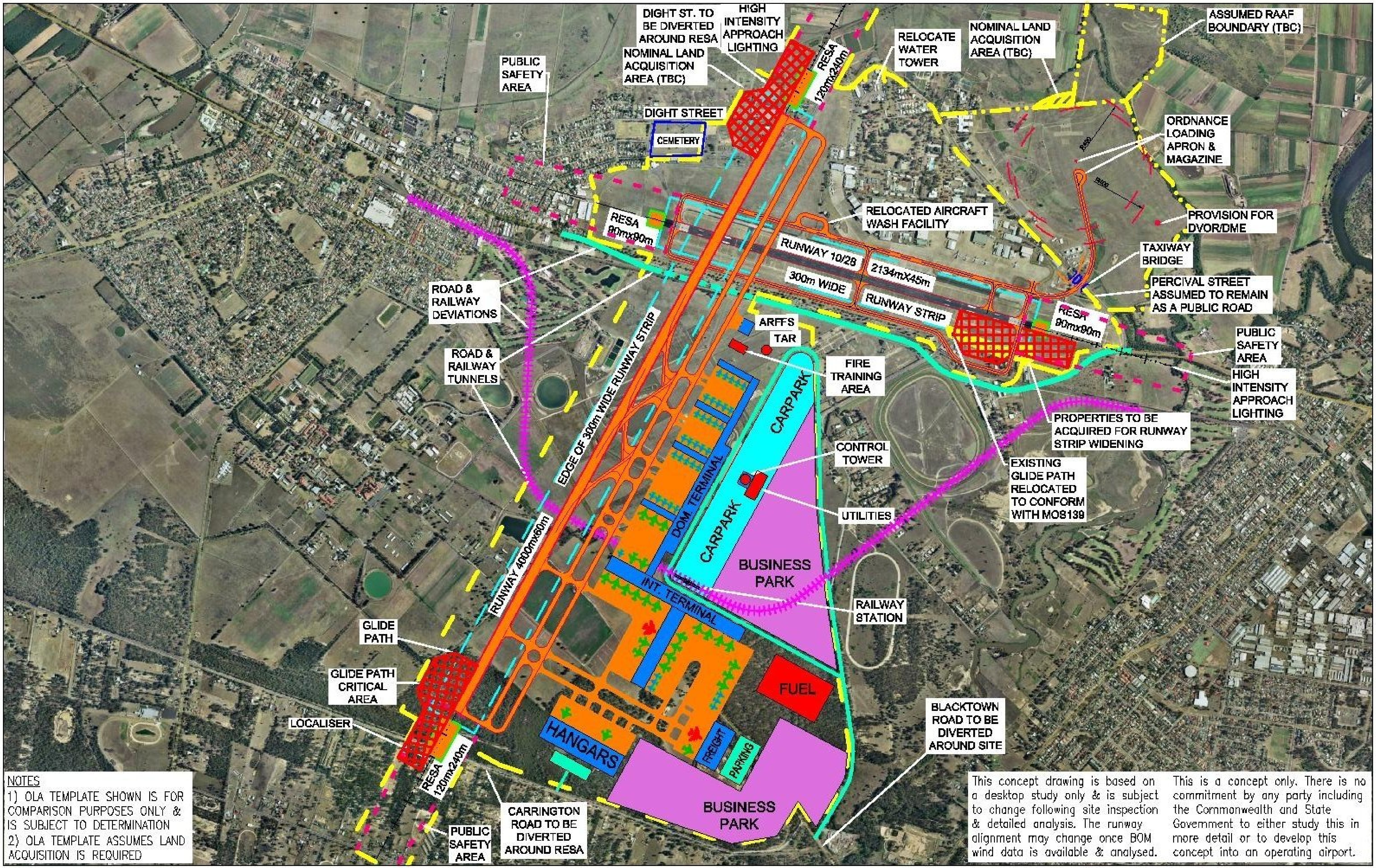
SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
DEVELOPMENT CONCEPT C



AMPC
Airport Master Planning Consultants

DATE: 27-04-11 SK129-C

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SOURCE: BASE IMAGE GOOGLE EARTH PRO 2010

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SYDNEY REGION AIRPORTS - RICHMOND RAAF BASE
DEVELOPMENT CONCEPT D

Appendix 4 Site Inspection Report

Airport Master Planning Consultants Pty Ltd

PO Box 6349
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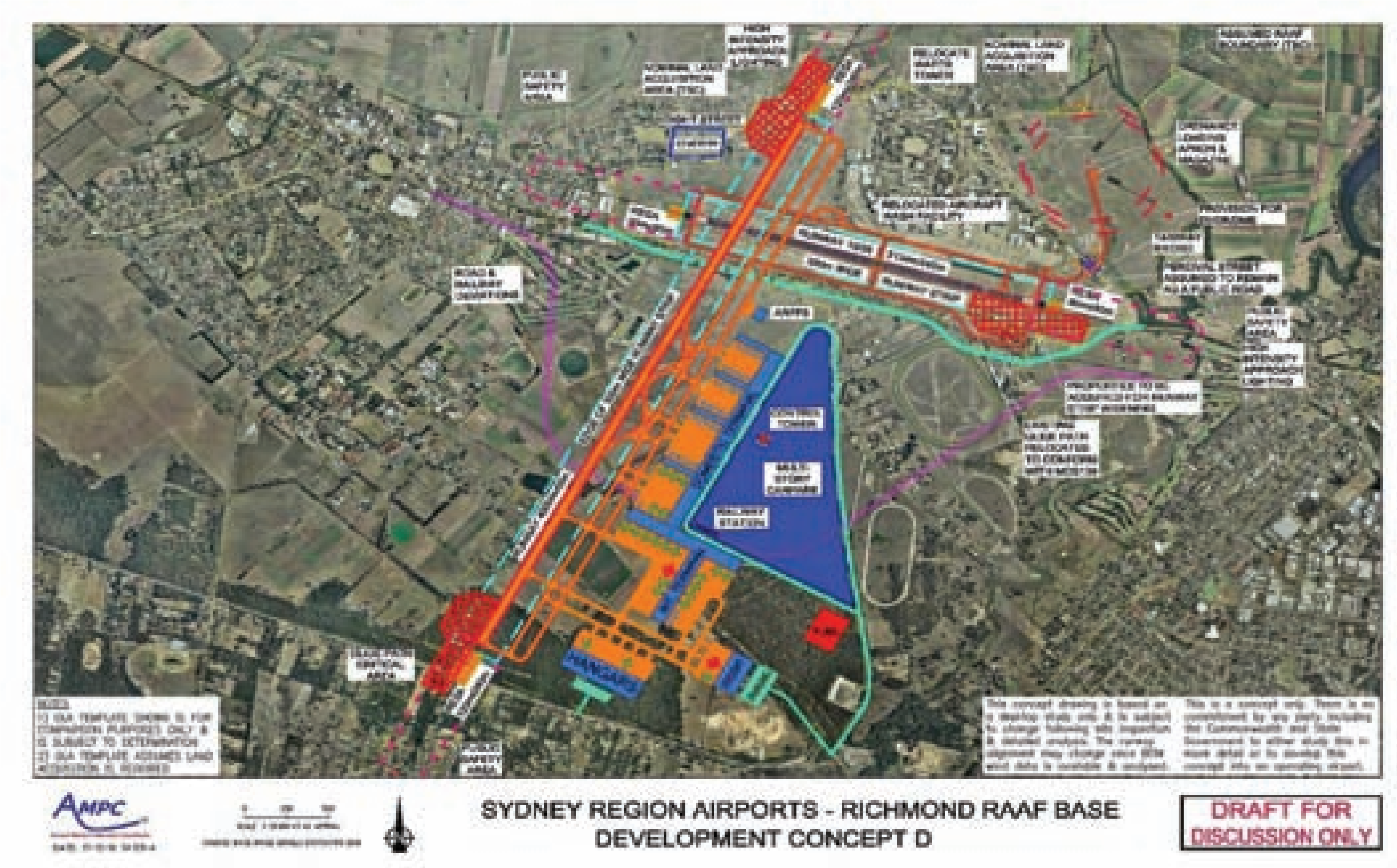
NSW 2113
Email:gmilner@ampc.net.au

**PRELIMINARY SITE INSPECTION REPORT: RICHMOND



AUTHOR: BRIAN JACOBS
AMPC – AIRFIELD ENGINEER

SITE INSPECTION REPORT

DATE: 14 MARCH 2011

REFERENCE/NAME: RICHMOND (RAAF)

LOCATION: WINDSOR STREET / HAWKESBURY VALLEY WAY, RICHMOND

SITE DESCRIPTION: LIMITED TO GROUND VISUAL INSPECTION FROM SEVERAL LOCATIONS – A, B, C, D, E, F, G, H, I, J, K, L, M & N

A LARGE PROPORTION OF THE PROPOSED 4000M RUNWAY, SOUTH OF WINDSOR STREET/HAWKESBURY VALLEY WAY, WILL BE LOCATED ON LAND OWNED BY THE UNIVERSITY OF WESTERN SYDNEY – TO THE NORTH OF WINDSOR STREET THE RAAF BASE IS OWNED BY THE COMMONWEALTH.

GENERALLY THE LAND SOUTH OF THE RAAF BASE ALONG THE ROUTE OF THE PROPOSED RUNWAY IS LARGELY UNDEVELOPED FARMLAND / TREES

EXISTING LANDUSE ON SITE: GENERALLY - UNIVERSITY OF WESTERN SYDNEY /COMMONWEALTH / BUSINESS / FARMLAND / VIRGIN BUSH

RESIDENTIAL: MINIMAL

BUILDINGS/STRUCTURES: THERE ARE SOME BUSINESSES WITH SHEDS BUT NONE WITNESSED WITHIN THE PROPOSED RUNWAY ROUTE

AGRICULTURAL: FARMLAND

UNDEVELOPED: MAJORITY OF PROPOSED SITE IS UNDEVELOPED IN RELATION TO BUILDINGS/STRUCTURES DIRECTLY NORTH & SOUTH OF PROPOSED RUNWAY

OTHER: EXISTING RAILWAY LINE RUNNING PARALLEL TO WINDSOR STREET (WILL NEED RELOCATION)

TERRAIN DESCRIPTION ON SITE: GENERALLY RELATIVELY LEVEL TO UNDULATING

LEVEL: LEVEL TO UNDULATING

UNDULATING: VARIES

HILLS: NO MAJOR HILLS SIGHTED

RIVERS/WETLANDS: NOT SIGHTED

APPROACH/DEPARTURE DIRECTION 2 (HEADING)

OBSTACLES: TREES

TERRAIN/MASTS/POWER LINES: NONE SIGHTED ALTHOUGH THERE ARE MASTS IN THE VICINITY I.E AT LOCATIONS A, C, & N (Figure 2)

EXISTING LAND USE: UNVIVERSITY OF WESTERN SYDNEY / RAAF AIRFIELD BASE / COMMONWEALTH LAND / BUSINESSES / FARMLAND /ROAD RESERVE / VIRGIN BUSH / TREES

ROAD ACCESS: MAIN ACCESS TO SITE IS VIA WINDSOR STREET & LONDONDERRY ROAD RICHMOND

NUMBER/LANE: WINDSOR ROAD / HAWKESBURY VALLEY WAY IS ONE LANE EACH WAY (SEALED) WITH SEALED SHOULDERS

SEALED/UNSEALED: SEALED

SOIL: *UNKNOWN*

ALLUVIAL: *UNKNOWN*

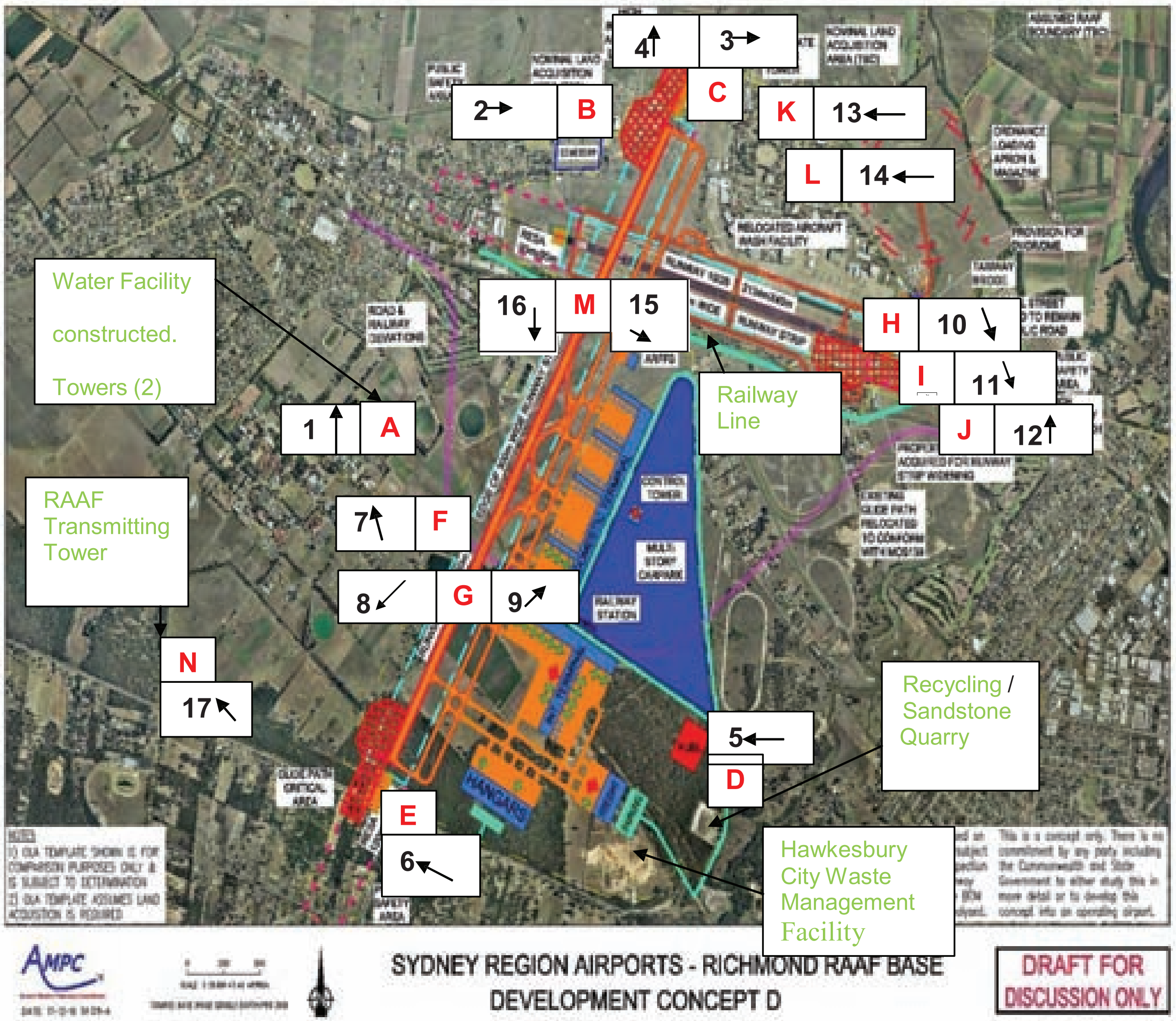
ROCK: *UNKNOWN*

UTILITIES: ABOVE GROUND TOWERS AT LONDERRY ROAD, DIGIT STREET, BLACKTOWN ROAD

OTHER COMMENTS / OBSERVATIONS: GENERALLY LEVEL / UNDULATING TERRAIN WHICH CONSISITS OF FARMLAND / UNIVERSITY OF WESTERN SYDNEY LAND / COMMONWEALTH LAND / VIRGIN BUSH / TREES

PHOTOGRAPHS

Refer Figure 1 below & Photos 1-17 inclusive
Refer Figure 2 for "Google Maps" - Plan view of Richmond RAAF & surrounds (www.googlemaps.com.au)



LOCATION FOR PHOTOS: A, B, C, D, E, F, G, H, I, J, K, L, M & N

FIGURE 1: RICHMOND - PHOTOGRAPHS – LOCATION & ORIENTATION

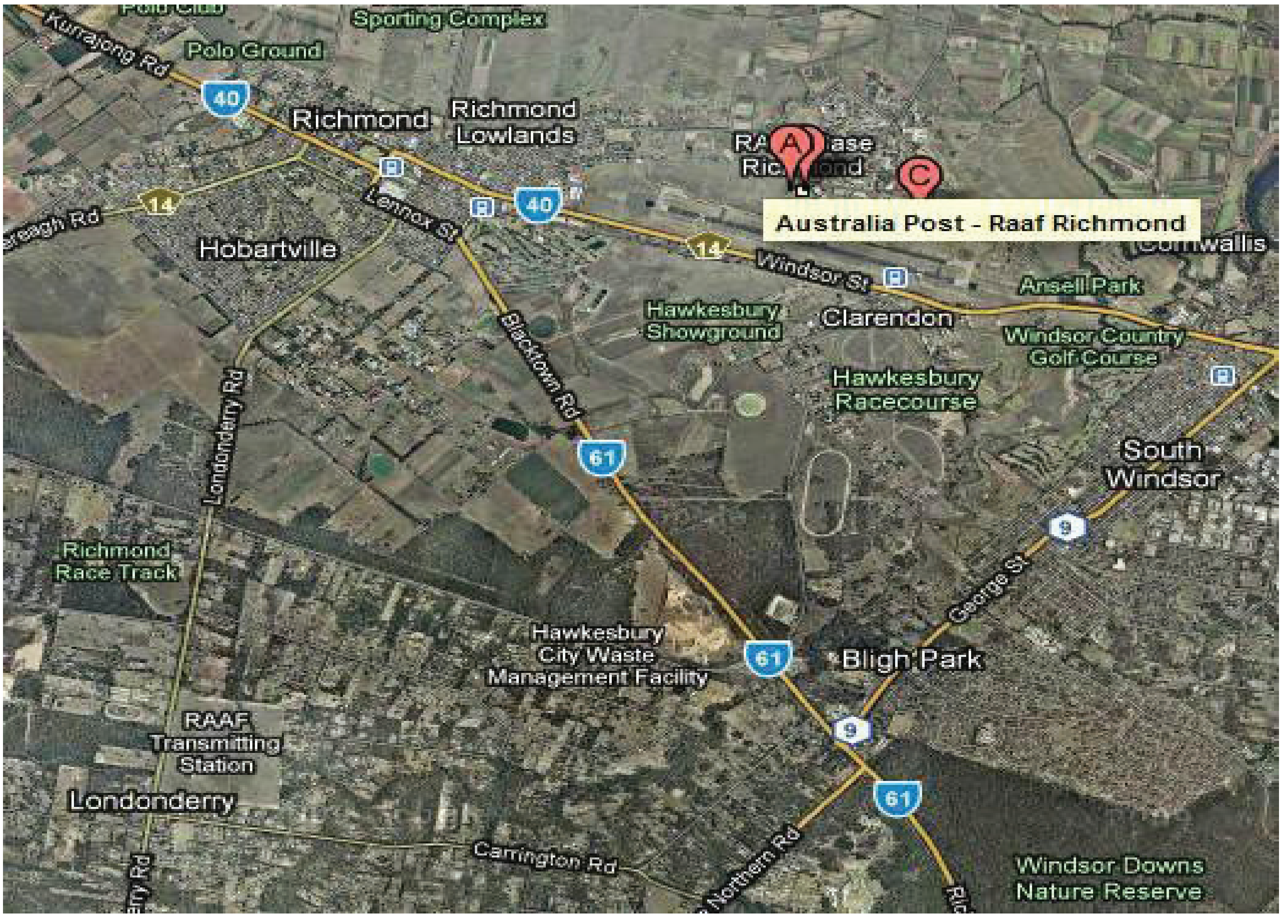


FIGURE 2: RICHMOND – GOOGLE MAPS AERIAL (www.googlemaps.com.au)

PHOTO 1: LOCATION A – Campus Drive (at Blacktown Road intersection) looking north showing existing tower. A new Water Facility is being constructed near an existing tower.

PHOTO 2: LOCATION B – Digit Street looking east (just east of the Cemetery) at the northern end of proposed 4000m Runway

PHOTO 3: LOCATION C – Digit Street looking east - Commonwealth Land signage advising of Commonwealth land ownership

PHOTO 4: LOCATION C – Digit Street looking north just east of the Cemetery towards northern end of proposed 4000m Runway

PHOTO 5: LOCATION D – Racecourse Road facing west towards proposed Fuel facility

PHOTO 6: LOCATION E- Carrington Road facing north west at intersection with the proposed 4000m Runway at southern end RESA

PHOTO 7: LOCATION F – Blacktown Road just south of Campus Drive looking NNW

PHOTO 8: LOCATION G – Blacktown Road at approx. location of proposed Runway (4000m) at intersection – facing south west

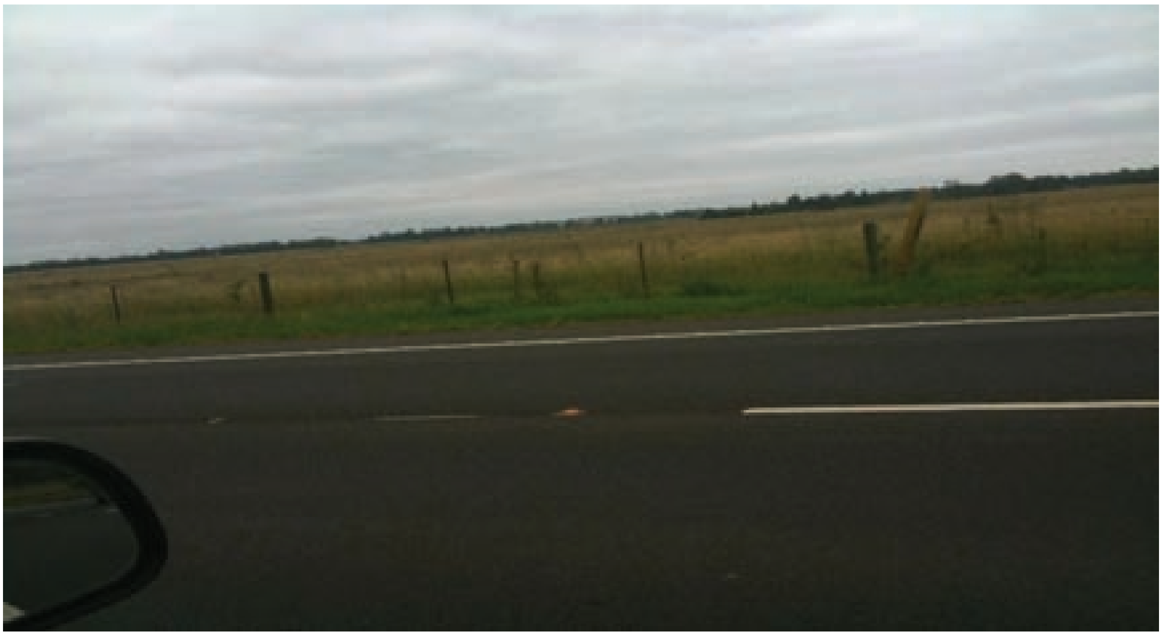


PHOTO 9: LOCATION G – Blacktown Road at approx. location of proposed Runway (4000m) intersection – facing north east

PHOTO 10: LOCATION H – Percival Street facing south east– the RAAF Base is to the right of the photo (south west)

PHOTO 11: LOCATION I – Percival Street facing south east at proposed Taxiway Bridge – the RAAF Airfield Base is to the right of the photo

PHOTO 12: LOCATION J – Percival Street facing NNW towards proposed Loading Apron

PHOTO 13: LOCATION K – Cupitts Lane (NE off Digit Street) - facing west

PHOTO 14: LOCATION L – Digit Street – facing west towards RAAF Airfield - Water Tower identified

PHOTO 15: LOCATION M – Hawkesbury Valley Way (Windsor Street) facing south east – this is the approx. location where the proposed 4000m Runway crosses this road

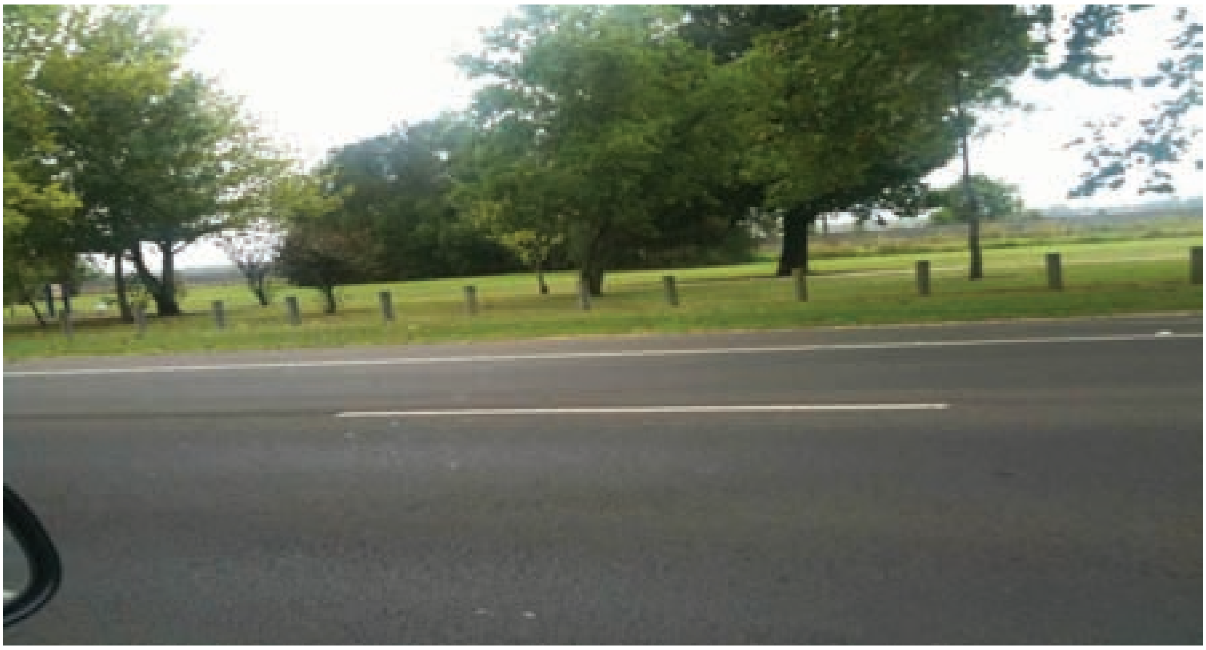


PHOTO 16: LOCATION M – Hawkesbury Valley Way (Windsor Street) facing south showing existing Railway line (which will need to be diverted to accommodate the proposed Runway) – this is the approx. location where the proposed 4000m Runway crosses this road

PHOTO 17: LOCATION N – Namatjira Avenue facing NW to RAAF Transmitting Station Tower (off Londonderry Road, near Carrington Road)

Appendix 5 Airspace reviews

Richmond North-South Airspace Considerations

This concept is based on locating a new runway from 2,600 m up to 4,000m length on a 01/19 alignment at the existing RAAF Base Richmond. The current Runway 10/28 is assumed to be retained as a cross-wind and tactical resource, but the majority of traffic (including RAAF operations) would utilise the new Runway 01/19.

As an existing airport, military Air Traffic Control (ATC) is applicable within the Richmond Control Zone (CTR) which is a trapezoidal shaped area extending approximately 16 nautical miles (nm) to the north-west and 20 nm to the south-east. It extends from the surface to an altitude of 2,500 feet and is active during the tower's hours of operation which are 0800-2300 hours local. The tower may be vacated and the CTR deactivated during these hours when long breaks between scheduled movements occur.

In terms of the new runway it is assumed the airport would be operated under Class C ATC civil procedures. A nominal 8.5 nm radius has been assumed for the CTR (noting the location of the existing Richmond Military CTR). This is based on a conservative application of the design principles contained in the Civil Aviation Safety Authority's (CASA) Advisory Circular AC 2-5-1(0) *Guidance for Controlled Airspace Design March 2010.* The associated control area (CTA) steps would be assumed to be delineated so as to encompass sufficient airspace to contain the flight paths of those Instrument Flight Rules (IFR) flights or portions thereof to which it is desireable to provide the applicable parts of the ATC service, taking into account the navigation aids provided for the airport. In practical terms, it is assumed the CTA steps would generally be oriented as for the runway alignment i.e. 01/19 (again noting the location of the existing Richmond Military CTR). The CTR is assumed to extend upwards from the surface to the lower limit of the CTA. The lateral and vertical design of the CTA steps will be dependent on the types of navigation aids proposed for the airport and their respective operating tolerances.

Figure A5.1 depicts the current immediate airspace environment for Richmond, overlaid in dark blue with the nominal CTR and CTA information.

Figure A5.1 – Airspace Considerations (Not to Scale)

Source: Base Image Airservices Australia 2010

Notable airspace issues are as follows:

- The nominal civil CTR boundary falls within the existing Richmond Military CTR which has an upper limit of 2,500ft;
- Restricted Areas R468 and R493 overlay the Richmond Military CTR and have lower limits of 2,500ft and 4,500ft respectively. They are activated by NOTAM and have conditional status of RA1;

EcoNomics

- Restricted Areas R559A and R559F adjoin the north-western edge of the Richmond Military CTR. They are associated with military flying training, operate from 10,000ft and FL260 respectively, are both activated by NOTAM and have conditional status of RA2;
- Danger Area 538A adjoins the north-western edge of the Richmond Military CTR. It is associated with military flying training and operates from the surface to 7,500ft. Hours of operation are by NOTAM;
- The existing Richmond Military CTR boundary lies about 9nm from the edge of the Sydney CTR, which has an upper limit of 2,500ft. Sydney (Kingsford-Smith) Airport itself is situated approximately 18nm from the edge of the existing CTR boundary;
- The exiting Richmond Military CTR is overlaid by the Sydney CTA and 25 DME CTA steps with lower limits of 2,500ft and 4,500ft respectively;
- The Class D CTR boundary associated with Bankstown Airport lies about 8nm to the south- east of the existing Richmond Military CTR boundary;
- Restricted Areas R536A and 536B lie about 4nm to the south of the existing Richmond Military CTR boundary. R536A and 536B are associated with explosives demolition at Orchard Hills and operate from the surface to an altitude of 1,500 feet and 4,500 feet respectively. R536A is active from daylight to sunset, and R536B is active Monday to Friday 0900-1200 hours and 1300-1600 hours local. Both areas have a conditional status of RA3;
- Danger Area D556A (upper limit 2,500ft) lies approximately 3nm south of the existing Richmond Military CTR boundary. This area is associated with Bankstown flying training and operates during daylight hours;
- Danger Area D556B (upper limit 4,500ft) lies approximately 4nm south of the existing Richmond Military CTR boundary. This area is associated with Bankstown flying training and operates during daylight hours;
- Palm Beach Water Aerodrome (not certified or registered) lies approximately 13nm to the east of the existing Richmond Military CTR boundary;
- Mangrove Mountain Aerodrome (not certified or registered) lies approximately 15nm to the north-east of the existing Richmond Military CTR boundary. Winch launched gliding activities are undertaken;
- The existing aerodrome at Somersby (not certified or registered) lies approximately 17nm to the north-east of the existing Richmond Military CTR boundary. Powered hang gliding activities are undertaken;
- The existing water aerodrome at Gosford (not certified or registered) lies about 15nm to the east of the existing Richmond Military CTR boundary;
- Danger Areas D539A (upper limit 2,000ft) lies approximately 6nm south-east of the existing Richmond Military CTR boundary and D539B (upper limit 2,500ft) abuts the existing Richmond Military CTR on the south-east. These areas provide the Bankstown Lane of Entry for VFR traffic;
- The Class D CTR boundary associated with Camden Airport lies about 17nm to the south of the existing Richmond Military CTR boundary;

- Danger Area D552 (upper limit 4,500ft) lies approximately 17nm south of the existing Richmond Military CTR boundary. This area is associated with Camden flying training and operates during daylight hours;
- Restricted Areas R555A and R555B lie about 14nm to the south of the existing Richmond Military CTR boundary. Both areas are associated with firing. R555A operates from the surface to 1,500ft, is operational 24 hours and has a conditional status of RA3. R555B operates from 1,500ft to NOTAM altitude, is activated by NOTAM and has a conditional status of RA2; and
- Restricted Areas R555C (upper limit 3,000ft) and R555D (upper limit NOTAM) lie approximately 19nm to the south of the existing Richmond Military CTR boundary. Both areas are associated with firing. R555C has a conditional status of RA3 and that of R555D is RA2.

The following preliminary observations can be made in relation to the new runway. They assume that civil and RAAF operations would be able to be integrated:

- Airspace management associated with the new runway would need to be integrated into the complex airspace arrangements which characterise the Sydney Basin;
- Only minor modifications to the existing Richmond Military CTR may be required to accommodate the new runway;
- CTA steps, particularly to the south, would probably need to be modified and this may have an impact on D556B and/or VFR east-west traffic;
- The proposed runway alignment of 01/19 appears to avoid conflicts with Restricted/Danger Areas to the north-west of the existing Richmond Military CTR;
- The proposed runway alignment of 01/19 may be reasonably compatible with Sydney's 16/34 operations;
- The proposed runway alignment appears to be clear of R536A/B. However, this issue is of high importance and will need to be checked by Airservices Australia/Defence and/or the OAR. If a conflict is found, runway rotation and/or modification/closure of R536A/B may need to be considered; and
- Potential conflicts or dependencies with Richmond and Sydney (Kingsford-Smith) Airport's operations would require more detailed analysis by Defence, Airservices Australia and/or the OAR.

These preliminary observations will need further consideration by Airservices Australia/Defence and/or the OAR. Note only aerodrome facilities that are depicted on aeronautical charts have been considered. The possibility always exists there could be other aerodrome facilities not shown on these charts.

In terms of its potential airspace interaction with Sydney (Kingsford-Smith) Airport, a Richmond North-South Airport is rated "Major".