VOLUME 4

Appendix P3
Economic analysis

Western Sydney Airport

Draft Technical Report to the draft EIS

Draft Economic Analysis

September 2015

EY

Building a better working world

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Glossary of terms

Airport	The airport located at the Airport Site. Note: the airport is referred to in the Airports Act as Sydney West Airport and is also commonly known as Western Sydney Airport
Airport Site	The airport site for Sydney West Airport as defined in the Airports Act
Airport-lessee company	The company that is granted an airport lease over the airport site
ATMs	Annual Traffic Movements – a landing or departure constitutes one ATM
Aviation activity	Any activity for the arrival, departure, movement or operation of aircraft and includes aircraft aprons, helipads, heliports, runways, taxiways, navigational aids and the like
Base Case:	Scenario where the Western Sydney Airport is not developed – i.e. this represents the status quo
BTS	NSW Bureau of Transport Statistics
CGE	Computable general equilibrium (CGE) models are a class of economic models that use existing data to estimate how an economy might respond to changes in external factors
DPE	NSW Department of Planning and Environment
Earthworks	Means excavation or filling
Economic footprint	The total or gross contribution of an investment / expenditure / operations to employment or expenditure in the community (i.e. this does not account for substitution impacts)
Environmental Impact Statement	Means the environmental impact statement prepared in relation to the airport under the *Environment Protection and Biodiversity Conservation Act 1999* following a referral dated 4 December 2014.
FTE	Full time equivalent (FTE) is a standard unit of measurement of employee time
Greater Metropolitan Area (GMA) of Sydney	A wide classification of Sydney, stretching from Newcastle in the north to Kiama in the south and Blue Mountains in the west. Sydney GMA is broken into four catchments: the WSA catchment, KSA catchment, Marginal catchment and Other
Joint Study	*Joint study into aviation capacity in the Sydney region*, Report to the Australia and NSW Governments, 2012
KSA	Sydney (Kingsford-Smith) Airport or Sydney Airport
Land Side	That area of an airport and buildings to which the public normally has access, consistent with Section 9 of the *Aviation Transport Security Act 2004*.
MAP	Million annual passengers

Person years	A unit of measurement which accounts for the employment of one person in a full-time capacity for one year. It provides a consistent basis for accounting for employment where, for example, one person might be employed full time for five years or five different people working in different roles of one year each (both of which would be 5 person years).
Project Case:	Scenario where the Western Sydney Airport is developed and operating by 2025
SA3	Statistical Area Level 3. Statistical Areas Level 3 (SA3s) are built from aggregations of whole Statistical Area Level 2 (SA2) boundaries to represent regions of between approximately 30,000 people and 130,000 people to cover the whole of Australia. These boundaries reflect a combination of widely recognised informal regions as well as existing administrative regions such as State Government Regions in rural areas and local Government Areas in urban areas.
Sydney basin area	The Sydney basin is identified as the Sydney Greater Capital City Statistical Area, as defined by the ABS. It is bordered by Sutherland and Bargo in the south, Lake Macquarie and the Hawkesbury River in the north and Mt Victoria in the west.
Sydney West Airport	The Airport. Note: this is the name used in the Act. The airport is also commonly known as Western Sydney Airport
Terminal	Means services and facilities for passengers and freight of a kind usually provided within an airport terminal building including food and drink premises, kiosks, shops, airline lounges, medical centers, transfer corridors, business, premises, office premises, retail premises, passenger transport facility, public administration facility, vehicle hire premises and facilities for the conduct of events, functions, conferences and the like.
Transfer corridor	Means the provision of an area for the facilitation of inter- or intra terminal transfers of passengers or baggage
Up-gauging	An increase in the aircraft size (B737 to A340) by an airline to increase the number of available seats for a flight destination in lieu of adding an additional flight segment during the day. This will result in an increase in passengers per ATM.
Wilton-Richmond Study	The technical study commissioned by the Government in 2012 and completed in 2013 which considered Wilton's suitability as a second airport and explored the use of RAAF Base Richmond for limited civil operations.
Western Sydney Airport (WSA)	The Airport. Under the Act the airport is referred to as Sydney West Airport

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Section A
Introduction

1. Introduction

1.1 Background

Planning investigations to identify a site for a second Sydney airport first commenced in 1946 with a number of comprehensive studies—including two previous environmental impact statements for a site at Badgerys Creek—having been completed over the last 30 years.

More recently, the Joint Study on Aviation Capacity in the Sydney Region (Department of Infrastructure and Transport, 2012) and A Study of Wilton and RAAF Base Richmond for civil aviation operations (Department of Infrastructure and Transport, 2013) led to the Australian Government announcement on 15 April 2014 that Badgerys Creek will be the site of a new airport for Western Sydney. The airport is proposed to be developed on approximately 1,700 hectares of land acquired by the Commonwealth in the 1980s and 1990s. Construction could commence as early as 2016, with airport operations commencing in the mid-2020s.

The proposed airport would provide both domestic and international services, with development staged in response to demand. The initial development of the proposed airport would include a single, 3,700 metre runway coupled with landside and airside facilities such as passenger terminals, cargo and maintenance areas, car parks and navigational instrumentation capable of facilitating the safe and efficient movement of up to 10 million passengers per year. While the proposed Stage 1 development does not currently include a rail service, planning for the proposed airport preserves flexibility for several possible rail alignments including a potential express service. A final alignment will be determined in consultation with the New South Wales Government, with any enabling work required during Stage 1 subject to a separate approval and environmental assessment process.

In the longer term, approximately 40 years after operations commence and in accordance with relevant planning processes, the airport development could include parallel runways and additional passenger and transport facilities for around 82 million passenger movements per year. To maximise the potential of the site, the airport is proposed to operate on a 24 hour basis. Consistent with the practice at all federally leased airports, non-aeronautical commercial uses could be permitted on the airport site.

On 23 December 2014, the Australian Government Minister for the Environment determined that the construction and operation of the airport would require assessment in accordance with the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act). Guidelines for the content of an environmental impact statement (EIS) were issued in January 2015. Approval for the construction and operation of the proposed airport will be controlled by the Airports Act 1996 (Cth) (Airports Act). The Airports Act provides for the preparation of an Airport Plan which will serve as the authorisation for the development of the proposed airport.

The Australian Government Department of Infrastructure and Regional Development is undertaking detailed planning and investigations for the proposed airport, including the development of an Airport Plan. The draft Airport Plan is the primary source of reference for, and companion document to, the EIS. The draft Airport Plan identifies a staged development of the proposed airport. It provides details of the initial development being authorised, referred to as Stage 1, as well as a long-term vision of the airport's development. This enables preliminary consideration of the implications of longer term airport operations. Any stages of airport development beyond Stage 1 would be managed in accordance with the existing process in the Airports Act. This includes a requirement that for major developments (as defined in the Airports Act), a major development plan be approved by the Australian Government Minister for Infrastructure and Regional Development following a referral under the EPBC Act.

The Airport Plan will be required to include any conditions notified by the Environment Minister following this EIS. Any subsequent approvals for future stages of the development will form part of the airport lessee company's responsibilities in accordance with the relevant legislation.

1.2 Scope of works

This report has been prepared as part of the proposed Western Sydney Airport draft EIS, in accordance with Section 10 of the EIS Guidelines issued in January 2015 by the Department of the Environment. Section 10 of the Guidelines sets out the following requirements:

- The economic and social impacts of the action, both positive and negative, must be analysed. Matters of interest may include:
  - Details of any public consultation activities undertaken, and their outcomes
  - Details of any consultation with Indigenous stakeholders
  - Projected economic costs and benefits of the project, including the basis for their estimation through cost/benefit analysis or similar studies
  - Employment opportunities expected to be generated by the project (including construction and operational phases).
- The economic and social impacts must include impacts at the local, regional and national level.
- Details of the relevant cost and benefits of alternative options to the proposed action, as identified in section 3, should also be included.

This document specifically provides an assessment of economic and employment impacts of the project for construction of Stage 1, as well as operations of the proposed airport in the short term (2031) and the longer term (2063). Economic and employment impacts have included consideration of how impacts are distributed at the local, regional and national level.

Specifically the Draft Economic Analysis includes the following:

- **Airport construction land use impact assessment** – Considers the potential impacts of the construction of the proposed Stage 1 airport on employment in Western Sydney / Greater Sydney, as well as the value added implications of this investment
- **Operations land use impact assessment** –This considers how the proposed WSA development could potentially deliver jobs to Western Sydney in the form of direct employment, on-site business park employment, as well as off-site employment (due to flow-on impacts)
- **Computable General Equilibrium (CGE) economic impact assessment** – This considers the distribution of the economic benefits identified for the WSA project – in terms of household incomes, gross value added, jobs, etc.

This report has been prepared to detail the methodology and findings of each of the above and acts as a Technical Report to the draft EIS that has been prepared. This report should not be considered in isolation from the draft EIS.

1.3 Approach

In accordance with the study brief and accepted 'best practice' in the development of major transport project economic analyses, this analysis has been prepared to conform to the EIS guidelines.

More details on the approach to each of the three components of the Draft Economic Analysis is outlined in the relevant sections of this report.

1.4 Sources of data

A number of data sources have been utilised to undertake this analysis:

- **Aviation demand forecasts** – The changes in travel patterns as a result of an operational WSA. This analysis was undertaken by LEK Consulting

- **Airport proposed design** – The Reference Design of the proposed WSA development which informs the costs of the project as well as the scale of demand which can be accommodated.

- **Capital and maintenance costs** – WT Partnership have estimated the costs of construction (and maintenance costs) of the proposed airport and off-site supporting infrastructure.

- **Commercial analysis** – Revenues and operating costs have been estimated by LEK Consulting.

- **Ground transport demand** – An assessment of the change in ground transport demand (road and public transport) that will result from WSA – including workers and passengers to the airport and business park was developed by Transport for NSW's Bureau of Transport Statistics (BTS)[1]

- **Population, demographics and employment forecasts** – Long-term forecasts of population, demographics and employment in the Greater Metropolitan Area of Sydney have been provided by SGS Economics and Planning (SGS).

1.5 Assumptions

A number of assumptions were made to undertake this analysis:

- All value terms throughout this report are presented in real 2015 dollar terms unless clearly expressed otherwise

- All analysis of changes in employment as a result of the development of the proposed WSA assumes a net zero gain in employment across NSW. That is, the development of the proposed WSA is assumed to not change total employment in NSW, but to re-distribute it towards areas of increased activity (i.e. Western Sydney). This is a standard assumption in the economic appraisal of proposed transport infrastructure investments and is conservative

- As part of the land use impact assessment of the operations of the proposed airport, the employment impacts of a possible future business park has been included. The proposed development of a business park at the proposed airport site is consistent with the draft Airport Plan but outside of the scope of the Stage 1 airport development and would be subject to a future separate environmental assessment and approval regime under the Airports Act 1996.

- Results for 2031and 2063 have been presented. The year 2031 is used due to the traffic model outputs that have been provided by the NSW Bureau of Transport Statistics. The year 2063 is consistent with the definition of the long term scenario used for the purposes of the draft EIS

- All the data and calculations presented in this analysis are based on the concept design presented in the draft Airport Plan and may change following detailed design of the proposed airport.

Assumptions specific to each of the three components of the Draft Economic Analysis has been outlined in the remainder of the report.

1.6 Limitations of the analysis

The findings across the three components of the Draft Economic Analysis are subject to the following cross-cutting limitations:

- This work has not been prepared to inform decision making processes. Its sole purpose is to present potential employment and economic outcomes as a result of the development of the proposed WSA. Therefore, sensitivity testing around the results of the analysis has not been conducted

- Assumptions, forecasts and estimates underpinning the analysis are subject to further change and refinement (i.e. as part of the Final EIS process)

[1] Note that for the purposes of the evaluation, workers at WSA and their changing travel patterns are included as an externality impact of the airport

- Assumptions used to develop the forecasts may not be realised and unanticipated events and circumstances may occur. Therefore, there are likely to be differences between the forecast and the actual results, and these differences may be material

- This economic analysis is an input to the draft EIS for the WSA project only. Consequential infrastructure in the surrounding area (for example, new road links to the airport) is expected to be assessed by the NSW Government in separate decision making processes

- BTS traffic modelling is one of the inputs used to identify the scale of benefits from the WSA development to consumers of air services and the wider community. The BTS model is based on a planning horizon which is shorter than the long term planning period.[2] As a result, traffic modelling inputs from BTS (including travel times and generalised costs of access) were not provided for the full evaluation period, and therefore were assumed to remain constant for the remainder of the evaluation period.

Limitations specific to each of the three components of the Draft Economic Analysis has been outlined in the remainder of the report.

1.7 Structure of the report

The report is structured as follows:

Table 1: Structure of the report

Section	Contents
Section A – Introduction	Chapter 1 – Introduction
Section B – Construction footprint	Chapter 2 – Construction footprint
Section C – Land use impacts of operations	Chapter 3 – Employment at WSA Chapter 4 - Land use impacts of operations
Section D – Economic impacts of operations	Chapter 5 - Spatial CGE modelling

Source: EY

[2] The BTS planning horizon is for the following 25 years, as opposed to the definition of the long term scenario used for the purposes of the Draft EIS (i.e. 2063)

Section B
Construction footprint

2. Construction footprint

2.1 Introduction

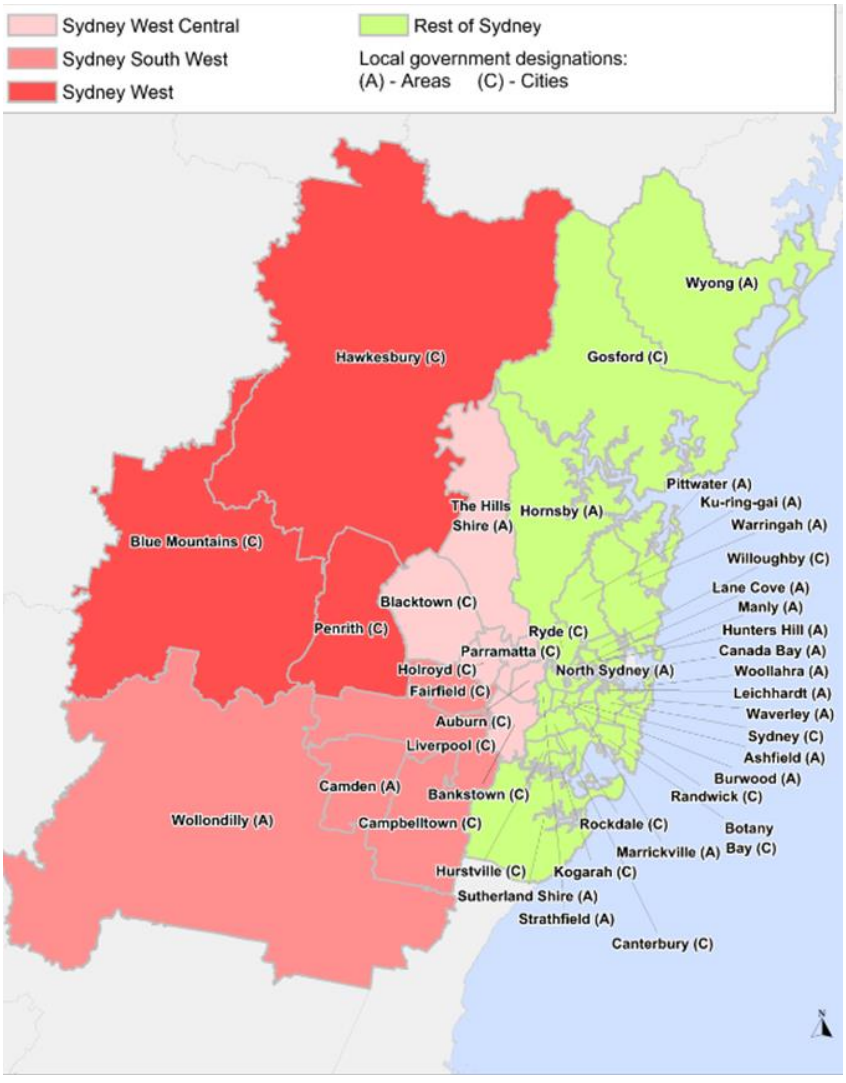
This section of the report presents results of an analysis of economic impacts of the construction of Stage 1 of the proposed Western Sydney Airport (the airport). Specifically, the analysis presents an economic contribution analysis covering the economic footprint of the construction phase of the Stage 1 development.

The results are presented for Western Sydney and 'Rest of Sydney'. Western Sydney comprises three subregions as defined by the NSW Government, with each subregion containing the following Local Government Areas (LGAs):

- **Sydney South West** - Liverpool, Fairfield, Camden, Campbelltown and Wollondilly LGAs
- **Sydney West** - Penrith, Hawkesbury and Blue Mountains LGAs
- **Sydney West Central** - Auburn, Bankstown, Blacktown, Holroyd, Parramatta and The Hills Shire LGAs

'Rest of Sydney' refers to the areas identified in Figure 1 not contained within the three Western Sydney subregions. The spatial areas are shown in the following map.

Figure 1: Spatial areas for reporting with Local Government Areas identified



2.2 Economic footprint of construction

The following section outlines:

- Direct and flow-on economic contributions
- Our approach to measuring economic contribution
- Economic footprint – employment
- Economic footprint – value-add

2.2.1 Direct and flow-on economic contributions

The direct and flow-on economic contributions presented in this report are based upon the following construction activities:

- Non-residential building construction
- Heavy and civil engineering construction
- Construction services

The analysis firstly identifies the direct jobs and the value-add of the proposed airport development in the above sectors. It then measures the flow-on impacts on jobs and value-add in other sectors along the supply chain, as well as consumption impacts through additional household expenditure.

The following definitions apply for the economic contribution analysis:

- Value-add: for each industry this is the value of production outputs (both direct and flow-on) less the value of inputs sourced from other sectors. The sum of value-add across all industry sectors in a specific region is known as the Gross Regional Product (GRP)
- "Direct" jobs and value-add: this is the number of jobs and amount of value-add directly related to the construction activities on-site. It includes the construction and fitting out of the airport, terminal buildings, the business park and associated infrastructure.
- "Flow-on" jobs and value-add: this is the number of jobs and amount of value-add generated in the supply chain of the on-site activities. This includes two components: the industrial effect and the consumption effect. The industrial effect is the impact on industries supplying the goods and services being used by the on-site activities. The consumption effect is the impact on sectors supplying goods and services being bought by households with the labour income they earned from the on-site activities.

For the purposes of the analysis, 'person years' has been used to express results. This term refers to the number of people employed, multiplied by the number of years that they are employed for. Therefore, 10 people employed for one year, or 1 person employed for 10 years, are both equivalent to 10 person years of employment. For the purposes of this economic contribution analysis, all employment totals over the construction period (i.e. from 2016 to 2024) are expressed in person years.

2.2.2 Approach to measuring economic contribution

In order to measure economic contribution, a two-step process was implemented:

- Initial inputs (sourced from GHD and REMPLAN) were collated; and

- Input-output modelling of direct and flow-on contributions was performed by EY (using GHD employment estimates and REMPLAN multipliers for the Western Sydney and Greater Sydney[3] regional economies).[4]

Employment assumptions

Table 2 presents the number of Full Time Equivalent (FTE) jobs involved in the construction sector by type of activity for each financial year during the construction phase of Stage 1 of the Project, based on GHD estimates.

Table 2: Construction FTE employment by category

GHD Category	REMPLAN Category	2017	2018	2019	2020	2021	2022	2023	2024	Total
Aviation Infrastr - Labour (Building)	Non-Residential Building Constr	-	-	-	74	124	256	217	82	**754**
Aviation Infrastr - Labour (Civil)	Heavy & Civil Engineering Constr	-	-	27	159	128	114	74	104	**605**
Aviation Infrastr - Superv and mangnt	Construction Services	-	-	4	55	135	157	148	84	**583**
Site Prep - Labour (civil)	Heavy & Civil Engineering Constr	52	141	103	15	26	61	28	-	**427**
Site Prep - Supervisory and mangnt	Construction Services	16	48	78	80	73	44	7	-	**346**
Aviation Infrastructure - Contract Admin	Construction Services	-	-	3	40	97	113	107	60	**419**
Site Prep - Contract	Construction Services	4	14	22	23	21	12	2	-	**97**
Total		**72**	**203**	**236**	**446**	**605**	**758**	**583**	**330**	**3,231**

Note: Construction is expected to end in FY2024, with development approval processes being required before the airport commences operations in July 2025.
Source: GHD

The number of jobs by type of work is mapped to the REMPLAN categories below, as shown in the above table:

- Non-Residential Building Construction – construction of non-residential buildings such as hotels, motels, hostels, hospitals, prisons or other buildings
- Heavy & Civil Engineering Construction – construction or general repair of roads, bridges, aerodrome runways or parking lots
- Construction Services – a range of services provided as part of construction activities, including installation, finishing, management, etc.

2.2.3 Economic footprint – Employment

This has been estimated for:

Western Sydney

Table 3 summarises the footprint of the construction activities on the Western Sydney economy in each financial year in terms of FTE jobs, based on REMPLAN multipliers and GHD job estimates for the project.

Table 3: Western Sydney FTE employment footprint (FTE)

Effects/Year	2017	2018	2019	2020	2021	2022	2023	2024	Total
Direct Effect	72	203	236	446	605	758	583	330	3,231
Industrial Effect	117	331	386	729	988	1,238	953	540	5,281
Consumption Effect	63	178	207	391	530	664	511	290	2,834
Total	251	712	828	1,565	2,123	2,660	2,047	1,160	11,346

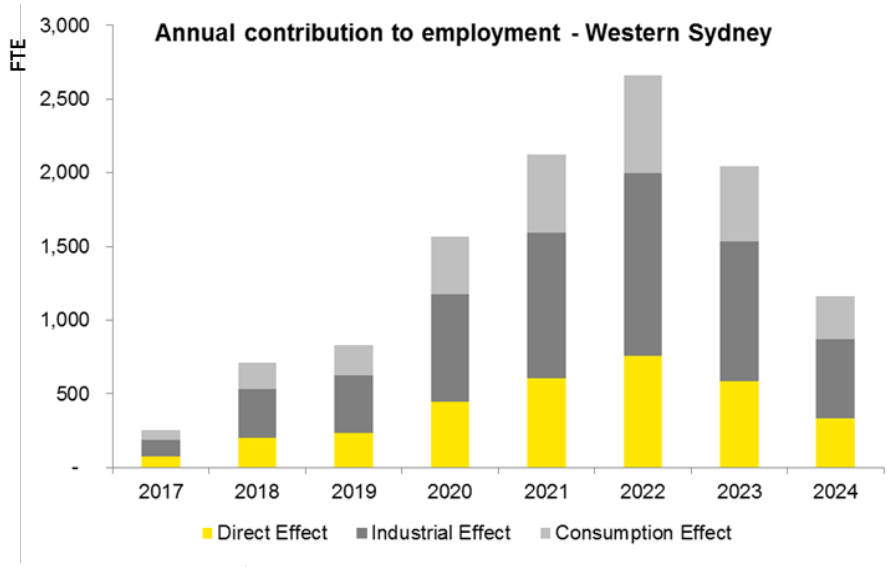
Source: REMPLAN, EY analysis

[3] This includes Western Sydney plus the rest of Sydney

[4] REMPLAN is an economic input-output model of regional economies which traces the revenue and expenditure 'multipliers' that link industries and workers within and outside economic regions based on ABS data.

Figure 2 shows the annual contribution to employment over time for Western Sydney:

Figure 2: Western Sydney FTE employment footprint



Source: REMPLAN, EY analysis

Direct on-site jobs reach 750 by 2022, generating a footprint that furthermore includes 1,200 jobs in the supply chain and a further 660 jobs through consumption effects. The total Western Sydney employment footprint reaches 2,700 jobs in 2022 and a total of 11,300 person-years over the construction period.

Greater Sydney

Table 4 summarises the footprint on the Greater Sydney economy in each financial year in terms of jobs, based on REMPLAN multipliers and GHD job estimates for the project.

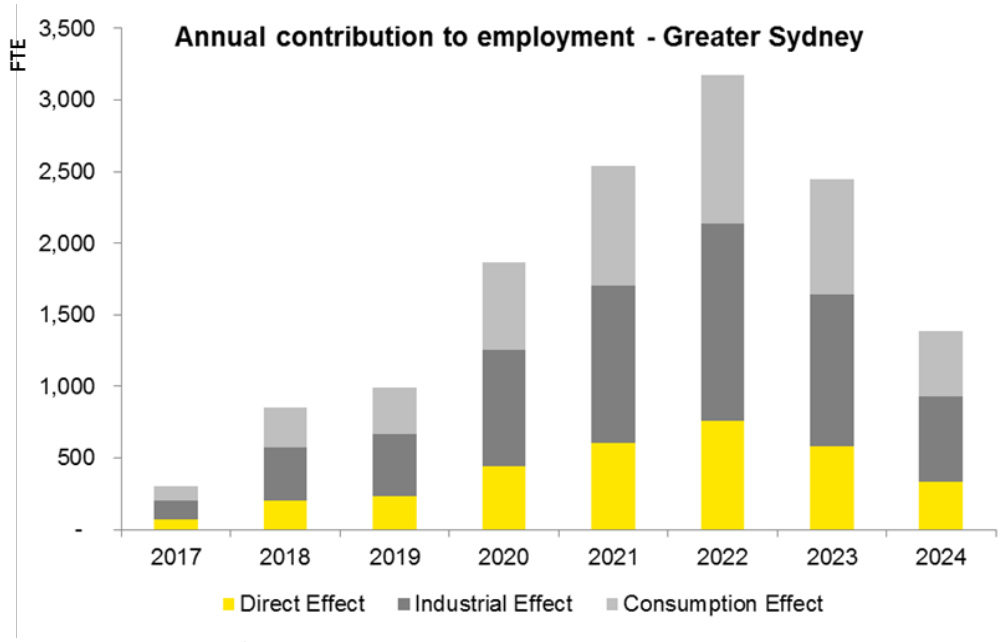
Table 4: Greater Sydney employment footprint (FTE)

Effects/Year	2017	2018	2019	2020	2021	2022	2023	2024	Total
Direct Effect	72	203	236	446	605	758	583	330	3,231
Industrial Effect	130	369	429	810	1,099	1,377	1,060	600	5,874
Consumption Effect	99	279	325	614	833	1,043	803	455	4,451
Total	300	850	990	1,870	2,537	3,178	2,446	1,386	13,556

Source: REMPLAN, EY analysis
Note that the Greater Sydney results outlined above are equal to Western Sydney plus the rest of Sydney

Figure 3 shows the annual contribution to employment over time for Greater Sydney:

Figure 3: Greater Sydney FTE employment footprint



Source: REMPLAN, EY analysis
Note that the Greater Sydney results outlined above are equal to Western Sydney plus the rest of Sydney

The Greater Sydney employment footprint is slightly larger, as a more of the flow-on impacts are captured within this larger geographical area. The Greater Sydney employment footprint reaches 3,200 jobs in 2022, and 13,600 person-years in total.

2.2.4 Economic contribution – Value-add

This has been estimated for:

Western Sydney

Table 5 summarises the economic footprint of the construction activities on the Western Sydney economy in each financial year in terms of value-add (in millions of dollars), based on REMPLAN multipliers and GHD job estimates for the project.

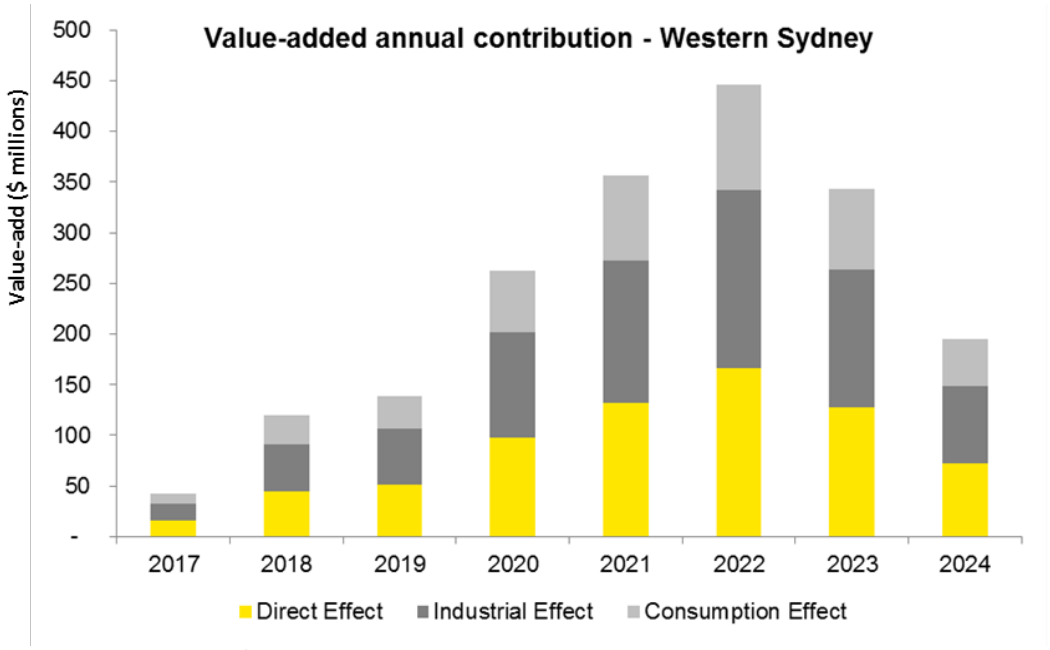
Table 5: Western Sydney value-add footprint ($ millions)

Effects/Year	2017	2018	2019	2020	2021	2022	2023	2024	Total
Direct Effect	16	44	52	98	132	166	128	72	707
Industrial Effect	17	47	55	104	141	176	136	77	751
Consumption Effect	10	28	33	62	84	105	81	46	446
Total	42	119	139	263	356	446	344	195	1,904

Source: REMPLAN, EY analysis

Figure 4 shows the annual contribution to value-add over time for Western Sydney:

Figure 4: Western Sydney value-add footprint



Source: REMPLAN, EY analysis

Direct on-site value-add reaches $170m by 2022, generating another $175m and $105m indirectly (through industrial and consumption effects). The total Western Sydney value-add footprint reaches $450m in 2022, summing up to $1,900m over the construction period (undiscounted).

Greater Sydney

The table below summarises the economic footprint on the Greater Sydney economy in each financial year in terms of value-add (in millions of dollar), based on REMPLAN multipliers and GHD job estimates for the project.

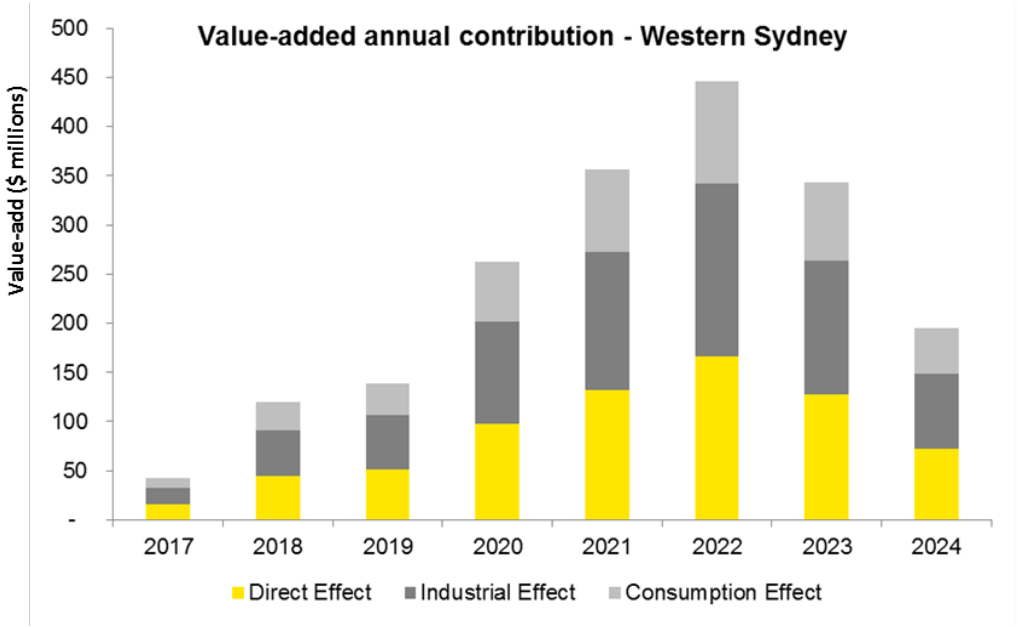
Table 6: Greater Sydney value-add footprint ($ millions)

Effects/Year	2017	2018	2019	2020	2021	2022	2023	2024	Total
Direct Effect	16	44	52	98	132	166	128	72	707
Industrial Effect	19	55	64	121	165	206	159	90	880
Consumption Effect	16	45	52	99	134	168	129	73	716
Total	51	145	168	318	431	540	416	235	2,304

Source: REMPLAN, EY analysis
Note that the Greater Sydney results outlined above are equal to Western Sydney plus the rest of Sydney

Figure 5 shows the annual contribution to value-add over time for Greater Sydney:

Figure 5: Greater Sydney value-add footprint



Source: REMPLAN, EY analysis
Note that the Greater Sydney results outlined above are equal to Western Sydney plus the rest of Sydney

As with employment impacts, the Greater Sydney value-add footprint is greater in magnitude than for Western Sydney, reaching $540m in 2022 and $2,300m over the construction period.

Limitations to this section

The findings that have been presented in this section are subject to the following limitations:

- The main limitation of economic contribution analysis is that it uses gross values rather than net values. This means it expresses the amount of economic activity that is directly and indirectly dependent on a project or an industry, but it does not explain whether the economic activity would be lost had the project not gone ahead or had the industry not existed. To understand the net impacts of a project, its economic contribution would have to be compared to that of an alternative use of resources.
- Furthermore, economic contribution analysis does not support conclusions as to whether the delivery of the project is 'better' for the economy than another project.
- Inputs have been sourced from GHD, BTS and a range of other organisations. EY has not undertaken any independent verification of the accuracy of any of these inputs.
- Assumptions, forecasts and estimates underpinning the analysis are subject to further change and refinement.
- Assumptions used to develop the forecasts may not be realised and unanticipated events and circumstances may occur. Therefore, there are likely to be differences between the forecast and the actual results, and these differences may be material.
- The results should be interpreted as being 'on average' estimates, and all else being equal. They should not be taken to reflect 'exact' and final impacts on population, employment, value-add or any other variable.
- The assessments focus on the economic outcomes resulting from the introduction of the airport. They do not consider any implications arising from any other policy changes or impacts, including how the airport is funded.
- The models do not explicitly take into account time, nor how preferences may change over time (between now and 2031 for example). Estimates should be thought of as a point in time cross sectional estimate for each of the modelled years.

Section C
Land use impacts of operations

3. Employment at WSA

Airports provide a mix of direct and indirect employment opportunities for communities, cities and regions.

3.1 Introduction

For the purposes of the technical report, the potential employment impacts that the operations of the proposed WSA can have on the Western Sydney (and wider) region has been considered in three categories:

- **Direct airport employment** (see Section 3.2) - Direct employment includes those persons that are employed at the airport to assist in the provision of its services. Direct employment at an airport typically includes administration and airport management staff, baggage handlers, airline staff, freight processing, retail operators, government operators, security and other services provided to customers
- **On-site business park employment** (see Section 3.3) – The airport site is expected to contain a business park, which can attract services directly supporting the operations of the airport (e.g. flight kitchens), services for airport employees and passengers (e.g. hotels, restaurants, tourism, car rental), as well as freight, high technology, manufacturing and finance / business related services
- **Off-site (flow-on) employment effects** (see Section 4) – The development of the proposed WSA is likely to have distributional effects on population and employment decisions in Sydney (and NSW), as businesses locate closer to the operating airport and people locate closer to employment opportunities.

3.2 Direct employment

Direct employment includes those persons that are employed at the airport to assist in the provision of its services.

In relation to direct employment, the three broad categories of employees in airports are: airline operation/service (such as ground handling, airline staff, fuel staff, freight operations staff and all maintenance staff), administration (such as airport company, police, immigration and customs employees) and commercial (such as duty free retail, restaurants and car hire companies).[5]

This section considers the approach used to estimate the total direct employees at the WSA site, and presents the results to the approach, and how they should be interpreted.

3.2.1 Approach

To identify the total number of direct airport jobs which could be supported by the proposed airport development, a benchmarking exercise was used to determine the relationship between the passenger throughput at domestic and international airports and the number of direct employees at each airport.

Table 7 presents the findings from this benchmarking exercise:

Table 7: Results from the benchmarking exercise

Airport	FTE's	pax in '000	FTE per MAP
London Airport	73000	76000	961
Schiphol Airport	60000	48000	1250
JFK NY	37000	53300	694
EWR NJ	21000	35600	590

[5] York Aviation (2004), The social and economic impact of airports in Europe

Airport	FTE's	pax in '000	FTE per MAP
LGA NY	12000	27000	444
Atlanta	58000	96000	604
Orlando	18000	34000	529
Hong Kong	40000	54000	741
Sydney	36882	32346	1140
Brisbane	14700	20300	724
Melbourne	12542	24448	513
Canberra	4900	3200	1531
Perth	5960	9359	637
Adelaide	5070	6784	747
Darwin	1641	1539	1066
Wellington	1361	5021	271
Sunshine Coast	900	917	981
Newcastle	383	1173	327
Launceston	319	1127	283
Hobart	250	1869	134
Total	403908	531983	759

Source: Publically available sources

The average employees per million annual passengers are a function of the airports considered in the analysis. Characteristics such as an airports scale (and resulting efficiencies), operating model and surrounding community can each have a significant effect on the direct employees required to service one million passenger movements.

In light of this the results in the table above demonstrate that there is a wide range of variability in the number of employees per million annual passengers – results range from 134 FTE per million annual passengers at Hobart Airport, to 1,250 FTE per million passengers at Schiphol Airport (Amsterdam, Netherlands).

Recognising the high degree of variability in the analysis, it was found that the average results are broadly consistent with:

- The findings in A study of Wilton and RAAF Base Richmond for civil aviation operations (released in 2013) – 749 FTE per million annual passengers
- The technical advice provided by LEK Consulting (the demand modelling team) – 750 FTE per million annual passengers.

Therefore a ratio of 750 employees to one million annual passengers was applied to passenger demand forecasts to calculate expected direct employees at WSA.

3.2.2 Results and interpretation

Given the findings presented above and the draft demand forecasts delivered by LEK Consulting, the expected direct employees at the proposed WSA are:

- In 2031 – 8,730 direct employees
- In 2063 – 62,860 direct employees

Figure 6 highlights how employee numbers are expected to grow over the course of the demand modelling period (i.e. to 2075).

Figure 6: Direct employees at WSA to 2075

Source: EY

When interpreting these results it is important to note that:

- These are estimates of the gross contribution of employment to Western Sydney as a result of the delivery of the proposed WSA. It is not a net measure (i.e. it does not consider substitution effects; i.e. the likelihood that some people who will be employed by the airport may have already been employed in a different job in Western Sydney
- It is assumed that the airport does not deliver any new population or jobs to NSW (i.e. beyond that which is currently forecast by state planning etc.). Therefore, in 2031, 8,730 jobs have been re-distributed from the remainder of NSW – i.e. 8,730 people have moved from a previous job to work at the airport.

3.3 On-site business park employment

The Land Use Plan contained within the draft Airport Plan permits commercial and other activities to take place in other areas of the airport site. As part of this report, the employment impacts of a possible business park have been assessed. However, these developments are outside of the scope of the Stage 1 development and would be subject to a separate environmental assessment and approval regime under the Airports Act 1996.

As informed by our design consultant's Landrum & Brown, it is possible that an on-site business park at WSA will be delivered in stages alongside the airport development to 2063. The business park could potentially contain the following land uses:[6]

- Industrial
- Office
- Hotels
- Petrol station and food outlets
- Regional shopping centre

[6] It is important to note that for the purposes of the draft EIS, the impacts of the following land uses have not been considered.

- Bulky goods.

This section considers the approach used to estimate the total on-site business park employees at the WSA site, and presents the results of the approach, and how they should be interpreted.

3.3.1 Approach

The approach used to estimate the total number of on-site business park employees is based on the approach that was used to conduct the same analysis as part of the Wilton and Richmond Study released in 2013. This involved three stages of work:

1. Estimate the scale of the business park

The potential scale and land use at the proposed business park was a key driver of the expected number of employees. As part of the drafting process for the draft Airport Plan, the land envelope available for the on-site business park was identified. A market sounding and work from the EY Real Estate team then identified how the identified business park envelope could be divided between different land uses.

Table 8 provides the assumed allocation of land to different land uses to 2063, as of May 2015:

Table 8: Proposed land use at the on-site business park (all units in m2)

	2031	2063
Industrial	350,000	845,000
Office	10,000	100,000
Hotels	20,000	50,000
Petrol Station and Food Outlets	15,000	40,000
Regional shopping centre	-	200,000
Bulky goods	153,000	561,000
Total	548,000	1,796,000

Source: L&B / EY Real Estate Advisory

Therefore, the on-site business park was expected to grow from 548,000 m^2 in 2031 to 1,796,000 m^2 in 2063, with the largest portion of land being set aside for industrial use and bulky goods.

2. Apply floor space to site ratio

A floor space ratio is the ratio of a buildings total floor area (gross floor area) to the gross area of the plot of land on which it is constructed.

Different land uses have standard floor space to site ratios. These were provided by the EY Real Estate Advisory team and used to identify the total floor space available given the land use expectation outlined in the previous step of the approach.

Table 9 provides the ratios applied:

Table 9: Floor space to site ratios

Land use	Floor space to site ratio
Industrial	50%
Office	125%
Hotels	40%
Petrol Station and Food Outlets	40%
Regional shopping centre	100%
Bulky goods	50%

Source: EY Real Estate Advisory

3. Apply a m^2 per employee

Having identified the total floor space available for each land use, standards (defined by industry) which outline the number of employees per square metre of floor space were then applied to identify total employees at the proposed business park.

The square metres per employee, by land use are outlined in below.

Table 10: Square metres per employee, by land use[7]

Land use	M2 per employee
Industrial	50
Office	10
Hotels	54
Petrol Station and Food Outlets	20
Regional shopping centre	90
Bulky goods	100

Source: EY Real Estate Advisory

3.3.2 Results and interpretation

Using the approach outlined above, it was estimated that the on-site business park will support:

- In 2031 – 4,440 employees
- In 2063 – 27,150 employees.

Table 11 provides a breakdown of these employment estimates by land use:

Table 11: Business park employees

	2031	2063
Industrial	3,500	8,450
Office[8]	-	12,500
Hotels	74	370
Petrol Station and Food Outlets	200	800
Regional Shopping Centre	-	2,222
Bulky Goods	665	2,805
TOTAL	4,439	27,148

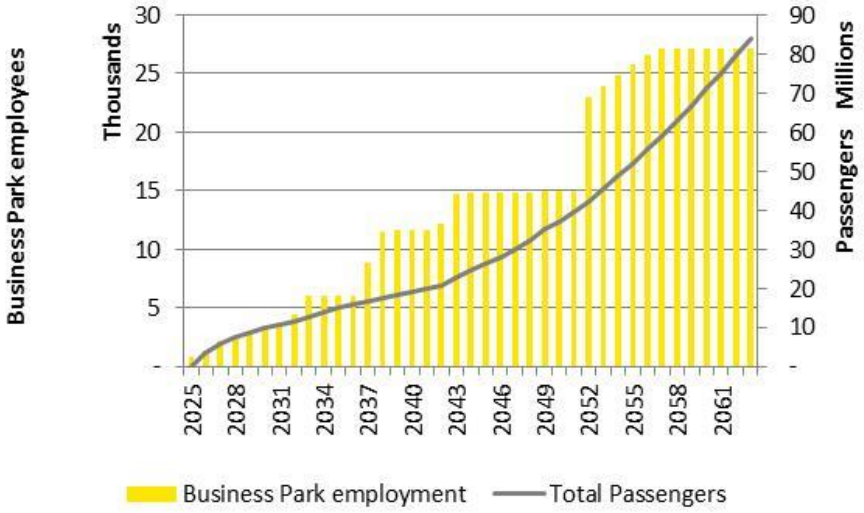
Source: EY
As noted previously, the business park development was not considered as part of the draft EIS process

Figure 7 illustrates expected growth in on-site business park employees (relative to total passenger growth):

[7] It should be noted that the square metres per hotel employee were not provided, and therefore, this was estimated as an average of the other land uses

[8] It is assumed that employees are hired one year after land is released. Therefore, while there are 10,000 m^2 of office space available in the business park in 2031, it has only just been released that year, and therefore, there is no employment expected

Figure 7: Business park employees to 2075



Source: EY

When interpreting these results it is important to note that:

- These are estimates of the gross contribution of employment to Western Sydney as a result of the delivery of the proposed WSA. It is not a net measure (i.e. it does not consider substitution effects: i.e. the likelihood that some people who will be employed by the airport may have already been employed in a different job in Western Sydney
- It is assumed that the airport does not deliver any new population or jobs to NSW (i.e. beyond that which is currently forecast by state planning etc.). Therefore, in 2031, 4,440 jobs have been re-distributed from the remainder of NSW – i.e. 4,440 people have moved from a previous job to work at the airport.

3.4 Conclusions

The combined direct employee and on-site business park employee estimates represent the total on-site employment anticipated over the planning horizon (i.e. to 2063) of the proposed WSA development.

Table 12 outlines the total employment that is expected to be redistributed to the WSA site.

Table 12: Total on-site employment

	2031	2063
Direct employees	8,730	62,860
On-site business park employees	4,439	27,148
TOTAL	13,169	90,008

Source: EY

Therefore, total on-site employment is anticipated to grow from approximately 13,000 in 2031, to approximately 90,000 in 2063.

These first distributional effects will have subsequent flow-on impacts onto the population growth and employment growth in the areas surrounding the proposed WSA. The next section considers these flow-on impacts in greater detail.

Limitations of this section

When considering the numbers that have been outlined in this section it is important to note that:

- The direct employment estimates that are presented are draft estimates. These are a function of the demand modelling which has been undertaken by LEK in February 2015 and are in the process of being updated. This will have direct impacts on the scale of the direct employment estimates identified for WSA
- The land use plans that have informed the on-site business park employee estimates was developed in May 2015 and has since been updated as part of the ongoing planning and design work for the Western Sydney Airport. Therefore the on-site business park employment results will be updated for the purposes of the Final EIS
- The employment estimates have been prepared for the purposes of the draft EIS, and will be prepared in line with updated demand and land use forecasts for the purposes of the final EIS process
- These numbers do not represent jobs which have been created in Western Sydney, but rather, these estimates represent the possible redistribution of existing employment to Western Sydney, which may be driven by the proposed WSA development. Therefore, the analysis assumes that no employment is created in NSW in the Project Case relative to the Base Case as a result of the WSA development. This is a standard assumption for economic analyses of transport infrastructure projects and we accept it is conservative.

4. Land use econometric model

WSA has the potential to impact jobs and population growth spatially throughout NSW, influencing where people will live and work. In particular, WSA is expected to significantly contribute to employment growth in and around the airport, which will provide improved job opportunities for residents in Western Sydney. In this way, WSA is a city-shaping investment that will contribute to a more balanced and sustainable growth for Sydney.

This section considers the econometric land use analysis of the Sydney economy which was used to predict, at a high level, the change in population and employment density as a result of WSA.

4.1 Land use econometric model

A project such as WSA has the potential to impact jobs and population growth in Sydney. In particular, WSA would be expected to redistribute population and employment towards Western Sydney, away from other parts of Sydney.

4.1.1 Accessibility and land use changes

To capture changes in land use (i.e. employment and population distributions) in surrounding areas due to the implementation of WSA, a land use econometric model was developed. This model was designed to measure the change in population and employment density as a result of a change in accessibility – driven by the delivery of an airport and its surrounding infrastructure. This includes:

Employment accessibility

One of many drivers of people's choice of where to live is the accessibility different locations provide to jobs and other attractions. WSA has the potential to improve accessibility to employment in Sydney's west which would be expected to attract people into the area from outside.

Population and firm accessibility

Similarly, one of many drivers of firms' location choice is the accessibility of different locations to workers and to other firms. WSA has the potential to improve accessibility for employers to both workers and other firms in Sydney's west which would be expected to attract more employers into the area from outside.

Airport

Airports themselves, independent of accessibility, also have an impact on population and employment density. In the case of population density, people may consider the distance they live from an airport. This includes:

- Effect of being within a 'threshold' distance whereby noise has an distinguishable negative impact
- Effect of distance from an airport outside of the threshold

Similarly, airports themselves also have an effect on where firms choose to locate. The effects on employment density include:

- Effect of being within an immediate airport zone – employment density within the zones that an airport is located
- Effect of distance from an airport
    i) within a 'threshold' distance (5km) which is attractive for firms in selected industries
    ii) the effect of distance outside of this threshold

4.1.2 Land use model

In order to measure the effect of accessibility on land use, both observed population and employment density is used in the econometric regression model. The model is therefore split into two parts:

- Model 1: Population density
- Model 2: Employment density

Model 1 builds a causal relationship between observed population density and accessibility to jobs in each area of Sydney to estimate the extent to which accessibility drives residential density. It does this by isolating accessibility to jobs from a number of other factors, such as distance or accessibility to other attractions or the physical characteristics of the area.

Model 2 builds a causal relationship between observed employment density and accessibility to population and other firms in each area of Sydney to estimate the extent to which accessibility drives employment density. It does this by isolating accessibility to people and firms from a number of other factors, such as proximity to other enabling pieces of infrastructure such as a port or an airport.

Outputs from the population density model (Model 1) are used as an input for population accessibility in Model 2. In this way, Model 1 and Model 2 are iterative.

Econometric techniques are used to correct for a number of confounding relationships that often prevents robust causal relationships from being identified. One such relationship is 'reverse causality'. Reverse causality occur if we estimate the impact of accessibility on density and there is a simultaneous causal impact of density on accessibility – which would be the case if transport investment and services tend to be provided in locations where density is already high.

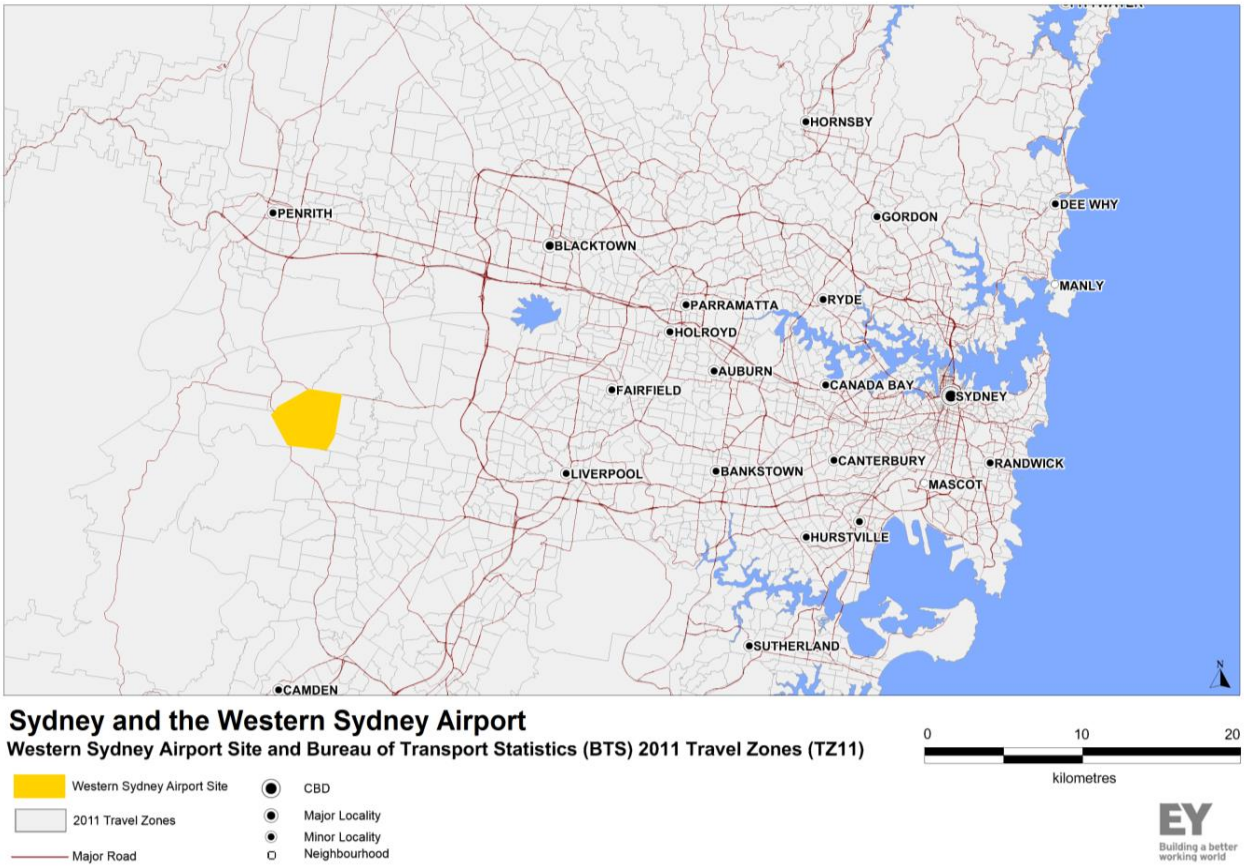
The models developed for WSA explicitly account and correct for reverse causality using techniques that are discussed the methodology below.

4.2 Land use model methodology

4.2.1 Geography

Data for density, accessibility and all of the other explanatory variables in the model was obtained for each TZ11 zone in the Sydney Greater Metropolitan Area (GMA). Figure 8 depicts the TZ11s zones and the WSA Airport site.

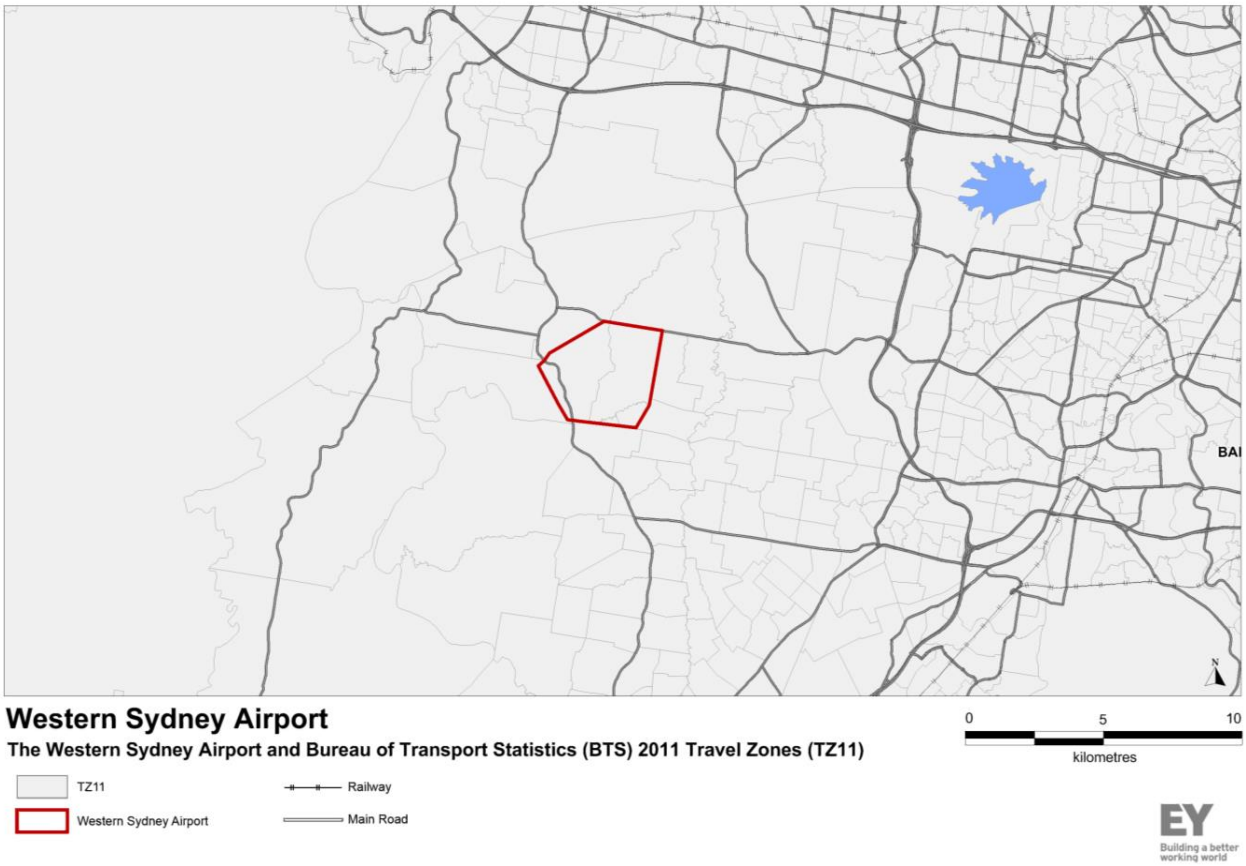
Figure 8: TZ11s and the Western Sydney Airport[9]



Travel zones are defined by NSW Bureau of Transport Statistics

[9] Note that the site marked is not the same as the proposed airport site

Figure 9: Western Sydney Airport and its immediate surrounds[10]



Travel zones are defined by NSW Bureau of Transport Statistics

4.2.2 Dependent Variable

Population model - Population density

The dependent variable in the population density model is residential density. Residential density is defined as the number of residents per hectare in each TZ11, i:

$$Pop\ density_i = Total\ pop_i / ha_i$$

Employment model - Employment density

The dependent variable in the employment density model is work-place based employment density. Employment density is defined as the number of jobs per hectare in each TZ11.

$$Emp\ density_i = Total\ emp_i / ha_i$$

4.2.3 Accessibility Variable

Population model – residents' accessibility to jobs

Accessibility for residents to jobs is measured by car, bus and rail. Job accessibility for residents in each TZ11 is the number of jobs in that TZ11 plus the number of jobs in every other TZ11 divided by the average cost of getting to these TZ11s:

[10] Note that the site marked is not the same as the proposed airport site

$$Access_i^J = \sum_{i=1}^{N} \frac{jobs_i}{avg\ cost_i^J}$$

Where the average cost of accessing jobs in the TZ11; avg cost_i^J, is across all available modes (i.e. car, bus and rail).

Average journey costs to jobs in the TZ11 where people live have been set to zero.

Employment model – employers' accessibility to workers and firms

Firms' access to workers and to other firms is measured in a similar way. Worker accessibility for each TZ11 is the number of workers living in that TZ11 plus the sum of the workers in every other of the TZ11s divided by the cost of access to these TZ11. The same logic applies to access to other firms:

$$Access_i^W = \sum_{i=1}^{N} \frac{workers_i}{avg\ cost_i^W}$$

$$Access_i^F = \sum_{i=1}^{N} \frac{firms_i}{avg\ cost_i^F}$$

Where:

- The average cost of accessing workers, avg cost_i^W, uses average journey costs across public transport modes.
- The average cost of accessing firms, avg cost_i^F, uses car journey costs.

The reason for using different modes as a basis for the two different access calculations is to avoid multicollinearity – that two explanatory variables that both have causal impact have too similar variability, prevents both of them from being identified at the same time.

The cost of accessing workers and firms in the TZ11 where employers are located is zero.

4.2.4 Regression Model

Building a regression found that there was a clear log relationship between job accessibility and population density. This relationship helps determine the specification for the regression model.

Other explanatory variables

A number of variables were collected in order to test and determine whether they had a statistically significant effect on population and employment density. These included accessibility (as outlined above), attractiveness factors, location quality, population and employment characteristics and 'control variables'. These variables were included to be able to isolate the effect of accessibility from all other factors influencing density.

A number of factors were tested for the **population model**:

- 15 attractiveness factors including distance to the nearest primary school, distance to nearest beach and distance to nearest shopping centre
- 10 control variables including distance to the nearest 'peak' elevation and distance to the nearest rail station.

A number of factors were tested for the **employment model**:

- 12 attractiveness factors including distance to major hospital, distance to nearest intermodal terminal and distance to nearest motorway access
- 2 employment and employment characteristics including the share of employment in 'higher density' occupations (i.e. jobs that are based amongst agglomeration, like financial services)
- 8 control variables including distance to the sea.

4.3 Population model results

Results for the population regression can be seen below. A number of variables are significant at the 1%, 5% and 10% statistical significance level, making them useful explanatory variables for describing population density. Statistical significance at the 5% level means that there is less than a 5% probability of the explanatory variable having a coefficient of zero (and therefore not found to affect density) given the observed coefficient.

4.3.1 Population impacts

The relevant elasticities that are estimated in the population model are used to find the change in population (and therefore population density) by travel zone. That is:

- Employment accessibility elasticity is applied to the change in employment accessibility as a result of the implementation of WSA
- The elasticity on the distance to nearest airport is applied to those travel zones that are now closer to a major airport with the introduction of WSA
- The effect of being within 5km of the airport is applied to those travel zones that will lie within 5km of the new WSA airport

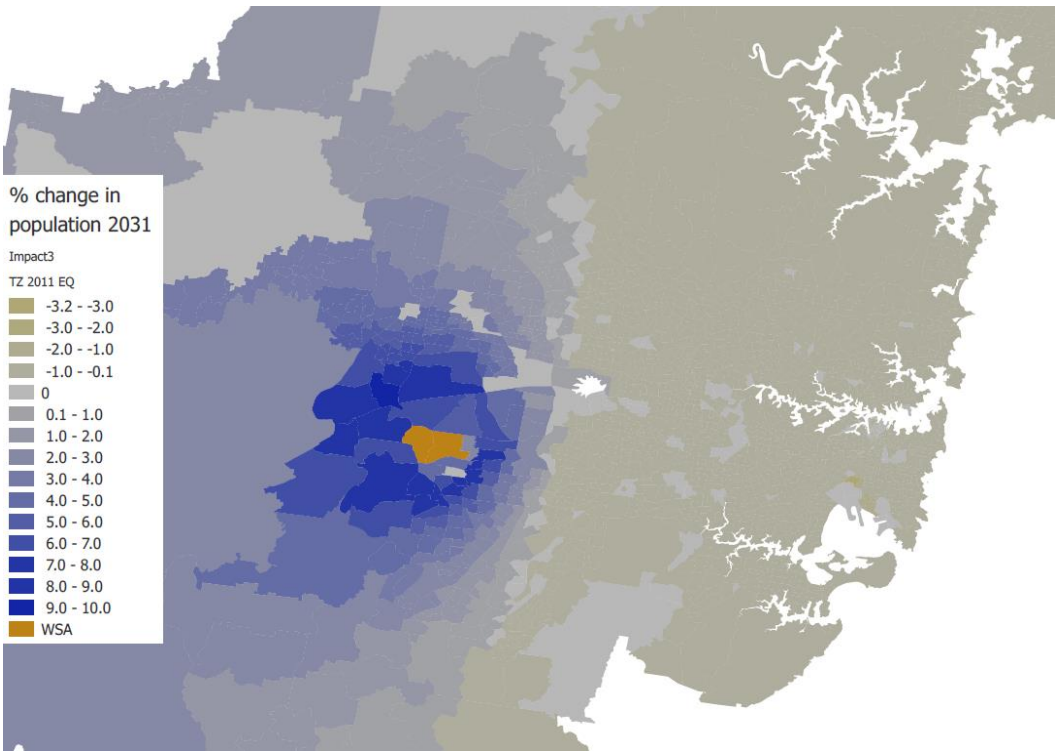
For the purposes of this land use analysis, it is assumed that there will be no net new population in Sydney as a result of WSA. Instead, population is redistributed across Sydney after the implementation of WSA and the associated changes in accessibility. The estimated change in population is incremental on the Base Case of no WSA, therefore areas that see a reduction in population in the analysis do not necessarily decline in absolute terms, rather they do not grow by as much as they otherwise would have without WSA.

4.3.2 Change in population density

By applying the job accessibility elasticity found above, to the change in job accessibility in 2031 and 2063 that results from the introduction of the WSA, the change in population density in each TZ11 is found. This can be seen visually, for 2031, in Figure 10.[11]

[11] Note that the orange area illustrates the two TZ11 which best correspond to the location of the airport. The actual airport area is different.

Figure 10: Population redistribution in 2031



Source: EY analysis

4.3.3 Change in population

The analysis found that by 2031 WSA will result in an additional population of 17,800 in Western Sydney. Figure 11 shows the areas in which population growth to 2031 will be higher and lower with WSA. The WSA site occupies the two travel zones coloured orange.

Table 13 provides a summary of the effects of the WSA on population in Western Sydney. As can be seen, Sydney West is anticipated to see the largest increase in population in Western Sydney in 2031 and beyond. Sydney South West is also anticipated to experience strong growth relative to the Base Case, particularly in 2063. This population will be redistributed away from the Rest of Sydney, the Rest of NSW and Sydney West Central.

Table 13: Population changes in Western Sydney as a result of WSA

Region	2031	2063
Sydney South West	4,900	31,100
Sydney West	16,200	63,400
Sydney West Central	-3,200	-18,200
Rest of Sydney	-14,000	-59,500
Rest of NSW	-3,900	-16,800

Source: EY

When considering the results outlined above, it is important to note that while Rest of Sydney and Rest of NSW have a negative result over the course of the planning period, this is not to say that the population of these areas will decrease. Rather, the populations of these areas will continue to grow; however, this growth will be slower relative to a case where the proposed WSA had not been developed.

In Western Sydney, the strongest growth is estimated to occur in the following LGAs:

- Penrith
- The Blue Mountains.
- Blacktown
- Wollondilly
- Camden

Growth in these LGAs is expected to be supported by slowing growth in other LGAs further from the proposed WSA development.

Table 14 outlines how the population of each LGA is expected to change in 2031 and 2063 relative to a case where there was no airport development. Table 14 also presents the expected percentage change in population, by LGA, relative to a scenario without the proposed WSA development (in 2031).

Table 14: Population change by LGA Region

LGA – population change	2031	2063	2031 %
Wollondilly	1,063	4,033	1.9%
Camden	4,152	22,474	2.6%
Penrith	12,176	48,777	4.7%
Blacktown	1,734	5,443	0.4%
Blue Mountains	3,277	12,232	3.4%

Source: EY analysis

4.4 Employment model results

A number of variables are significant at the 10% statistical significance level in the employment density model, making them useful explanatory variables for describing employment density.

4.4.1 Employment impacts

The relevant estimated elasticities and coefficients in the employment model regression are used to find the change in employment (and therefore employment density) by travel zone. That is:

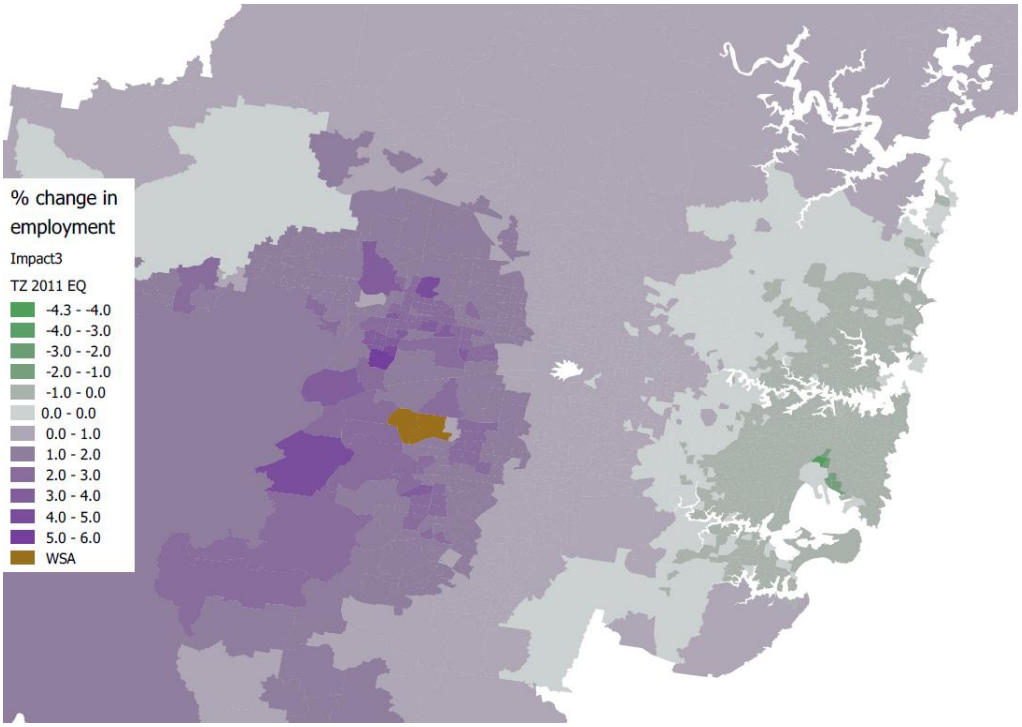
- Employment (firm) accessibility elasticity is applied to the change in employment accessibility resulting from the implementation of WSA
- Population (worker) accessibility elasticity is applied to the change in population accessibility resulting from the implementation of WSA
- The effect of being within an airport zone is applied to those travel zones containing the WSA
- The effect of being within 5km of the airport is applied to those travel zones that are to be within 5km of the new WSA airport.

Just like in the population model, for the purposes of this land use analysis it is assumed that there is no net new employment in Sydney as a result of WSA. Instead, employment is redistributed across Sydney after the implementation of WSA and the associated changes in accessibility. The estimated change in employment is incremental on the Base Case of no WSA, therefore areas that see a reduction in employment in the analysis do not necessarily decline in absolute terms, rather they do not grow by as much as they otherwise would have without WSA.

4.4.2 Change in employment density

By applying the population and employment accessibility elasticities found above, to the change in job accessibility in 2031 and 2063 that results from the introduction of the WSA, the change in employment density in each TZ11 is found. This can be seen visually, for 2031, in Figure 11.[12]

Figure 11: Employment density change as a result of WSA[13]



EY analysis

4.4.3 Change in employment

The analysis found that by 2031 WSA will enable an additional job growth of 6,930 in Western Sydney.

Table 15 provides a summary of the effects of the WSA on employment in Western Sydney. As can be seen, the Sydney West region is anticipated to see the largest increase in population in Western Sydney in 2031 and beyond. Sydney South West will see a large increase, particularly in 2063. These jobs will be distributed away from the Rest of Sydney.

[12] Note that the orange area illustrates the two TZ11 which best correspond to the location of the airport. The actual airport area is different.

[13] Note that the site marked is not the proposed airport site – the area marked is the travel zones that the proposed Badgerys Creek site falls within

Table 15: Change in Western Sydney employment in 2031 as a result of WSA[14]

Region	2031	2063
Sydney South West	2,000	10,600
Sydney West	3,000	14,300
Sydney West Central	1,900	4,300
Rest of Sydney	-7,200	-29,800
Rest of NSW	300	600

Source: EY

When considering the results outlined above, it is important to note that while Rest of Sydney and Rest of NSW have a negative result over the course of the planning period, this is not to say that the employment of these areas will decrease. Rather, the employment of these areas will continue to grow; however, this growth will be slower relative to a case where the proposed WSA had not been developed.

In Western Sydney, the strongest growth is estimated to occur in the following LGAs:

- Penrith
- The Blue Mountains.
- Wollondilly.

Growth in these LGAs is expected to be supported by slowing growth in other LGAs further from the proposed WSA development.

Table 16 outlines how the employment of each LGA is expected to change in 2031 and 2063 relative to a case where there was no airport development. Table 16 also presents the expected percentage change in employment, by LGA, relative to a scenario without the proposed WSA development (in 2031).

Table 16: Employment change by LGA Region as a result of WSA

LGA – employment change	2031	2063	2031 %
Wollondilly	244	1,080	1.6%
Penrith	2,345	11,672	2.0%
Blue Mountains	373	1,539	1.5%

EY analysis

4.5 Conclusions

As anticipated, the building of the new WSA airport will have a significant impact on both worker and job accessibility in Sydney which will lead to changes in population and employment density in the future, relative to if WSA were not built.

WSA will make it more attractive for people to live in Western Sydney by virtue of people having a greater access to jobs and wanting to be closer to an airport. This will lead to a relatively higher population density in areas like Penrith, the Blue Mountains, Blacktown, Wollondilly and Camden. These people would otherwise have continued living in the rest of Sydney, in places like Randwick, Hornsby and Canterbury, and also other parts of Sydney West Central such as Parramatta and Bankstown.

WSA will also make it more attractive for firms to set up in Western Sydney as they will have access to a greater number of workers and also be closer to other firms, enabling knowledge spill-over. Therefore,

[14] Note that this does not include the employment that will be taken up directly on-site at WSA

relative to natural 'Base Case' growth (i.e. without WSA), there will be relatively higher employment densities in Western Sydney, particularly in areas like Penrith and Blacktown, but also in Liverpool, Fairfield and Camden and across the rest of Sydney's West.

4.5.1 Value of working closer to home in Western Sydney

While Western Sydney has almost half (47 per cent) of Sydney's residents, the region has just over one third (36 per cent) of the city's jobs. This means that many Western Sydney residents must travel outside the region for work, particularly for well-paid professional and tertiary level jobs.

Around 30 per cent of the resident workforce travel to other parts of the city to get to work,[15] underscoring the importance of creating more jobs in the city's west. This dispersed employment has placed significant pressure on Sydney's transport infrastructure and generated many economic costs, including those associated with traffic congestion and disruption.[16]

The majority of employment growth in the next 20 years is expected to occur in the Sydney central business district, away from the majority of Sydney's population growth in Western Sydney. As a result, the region's job shortage ('job deficit') is expected to grow to 300,000 by 2036, with an estimated 450,000 extra jobs needed in the next 25 years to prevent the job deficit worsening.

Increased employment in the region as a result of the proposed WSA would reduce the need for residents to travel outside Western Sydney for work. In turn, this has the potential to reduce the costs of travel incurred by Western Sydney residents, increase the accessibility and efficiency of the wider transport network, and reduce unemployment in the region. This in turn can deliver a series of benefits:

- **Potentially reducing commuter times for individuals** and thereby reducing energy use, cutting carbon emissions, raising the overall productivity of the workforce and increasing people's quality of life
- **Generating higher levels of social cohesion and a greater sense of community**, with new and diverse employment opportunities offering psychological benefits associated with having a job and additional career choices, without the need to relocate. This feeds into other social benefits including increased social inclusion, good mental health and greater life satisfaction.

[15] Bureau of Transport Statistics, *2011 Journey to Work datasets,* NSW Government, Sydney, 2013

[16] Dispersed employment also contributes to residents in Western Sydney being more dependent on their cars for transport than other parts of the city. For example, the average vehicle kilometres travelled per person in Campbelltown and Liverpool is twice that of residents in inner Sydney or the eastern suburbs, while just four per cent of Camden's workforce travels to work by bus or train, compared to 20 per cent in Burwood.

Limitations

A number of limitations apply to the numbers that have been presented in this section. Furthermore, a number of simplifying assumptions were made to undertake the analysis.

- The estimates outlined in the land use analysis assume a net zero gain to employment across NSW. Therefore, all jobs that are redistributed to Western Sydney as a result of the proposed WSA would have existed elsewhere in NSW had WSA not been developed. Therefore, the land use assessment considers the relocation of population and employment, and holds total employment and population in NSW fixed whether WSA is developed or not

- This work is demand driven (i.e. where people want to move to) and does not consider existing or potential future plans for land use in NSW. For example, there is currently no intention from the NSW Government to have the Western Sydney Employment Area support any of the employment impacts of Stage 1. However, this has not been taken into consideration as part of the land use modelling

- The land use modelling is undertaken to provide a richer picture of how the WSA project impacts on firms and residents across Sydney. It represents a simplified model of the drivers of land use and is designed to provide an understanding of the general impacts on densities caused by these drivers. The model is not designed to provide an accurate prediction of impacts at a detailed level.

- The elasticity estimates produced by the land use models should be interpreted as being an 'on average' estimate, and all else being equal. They should not be taken to be 'exact' population and employment density responses to accessibility.

- The model does not take into account time and how preferences may change over time (between now and 2063). Estimates should be thought of as a point in time cross sectional estimate.

- The model only estimates population and employment redistribution as a result of a change in accessibility. Results should therefore be treated as separate from CGE results, which takes into account a number of additional changes as a result of WSA, such as travel time savings and productivity.

Section D
Economic impacts of operations

5. CGE analysis

WSA will deliver significant economic benefits. This section considers the final incidence of the economic gains, both in terms of the 'who' and 'where' of the benefits.

5.1 Data Sources

Raw data inputs underpinning the economy, such as output, consumption, labour, capital, imports and exports are sourced from REMPLAN Economy 2015 Input-Output tables. Input-Output tables are used for the four areas making up the model – Western Sydney, Rest of Sydney, Rest of NSW and Rest of Australia.

Elasticity parameters used in the model, such as for the household utility function and the firm production function, are sourced externally, but where necessary are adjusted to reflect the Australian economy.

5.2 CGE Models

CGE models are used to measure the full set of impacts of a change in economic conditions in an economy. These changes can include Government or consumer spending, population, workforce, industry (such as an increase/decrease in wages), the building of infrastructure, or any other policy change. These changes will all flow through the economy subject to the inter-relationships between various agents that participate in it. These inter-relationships exist for any number of spatial units (regions) in the economy. For example, if the economy is made up of four regions, each region would contain its own set of flows between agents, whilst it would import/export to each of the other regions making up the economy.

The purpose of the CGE modelling for the proposed WSA development is to provide a richer picture of how the proposed WSA will affect individuals and business across Sydney, NSW and Australia. The CGE model applied is a high-level model with significant simplifying assumptions and results should be interpreted with this in mind.

5.2.1 Flows and relationships between agents in the economy

Inter-relationships between economic agents, which result in the various flows of output, capital and labour in the economy, include:

Demand-side

- Households maximise utility from consumption subject to their budget constraint
- Government - Government demands and consumes output produced by firms across all industries
- The 'rest of the world' – The 'rest of the world' demands and consumes output produced by firms across all industries.
- Firms – firms demand output for use as intermediate inputs in their own production

Supply-side

- Firms – Firms across a number of industries produce output that is demanded in the economy by combining intermediate inputs produced by other firms and adding their own value-add
- Households – households provide the capital and labour that is needed by firms to produce value-add
- The 'rest of the world' – The 'rest of the world' supplies the output that is demanded by the economy that is not sourced domestically.

5.2.2 General equilibrium

Given the set of inter-relationships and flows as outlined above, an economy is said to be in 'general equilibrium' when a set of conditions are met. These are:

- Demand equals supply of output in all industries
- Labour supply equals labour demand
- Capital supply equals capital demand
- Income in any industry equals its expenditure (this implies that the economy is perfectly competitive, i.e. no supernormal profits).

Because of the interconnectedness of the economy and the set of flows between agents, any change that affects an agent in the economy is going to shift the economy out of general equilibrium. In order to move back into equilibrium, a series of 'indirect' changes, or effects, take place through the economy. CGE models find the new equilibrium, thereby capturing the direct and indirect effects of the initial change in the economy. General equilibrium is reached through a series of behavioural relationships on both the production and consumption sides of the economy.

5.2.3 How general equilibrium is reached - behavioural relationships of firms and households

In order to measure the total impact as a result of a direct change to the economy, agent behaviour must be modelled. CGE models therefore incorporate a series of behavioural rules which govern how these various agents act and respond to changes in the conditions they face.

Firms

- Firms choose production so as to maximise profits subject to their budget constraint
- Once a level of production has been chosen, firms decide how to produce it. This can be thought of as comprising six steps:
    - Determine the share of production sourced from intermediate inputs and value-add (e.g. how much of production is sourced externally and how much is produced in-house)
    - Determine the share of value-add from labour and capital (e.g. whether to invest in more machines to reduce labour need)
    - Of the labour share, determine the optimal mix of labour type (across various occupations)
    - Of the capital share, determine the optimal mix between physical capital (e.g. machines, plant equipment) and land
    - Determine the optimal intermediate input mix (across the various industries/ products available in the economy) (e.g. whether to purchase raw materials directly from the agricultural sector or processed materials from the wholesale sector)
    - Determine the share of the intermediate inputs sourced from own region (termed 'domestic region') vs. imports from each of the other modelled areas (inter-region or international imports).

These firm decisions are governed by firm technology as well as relative prices of intermediate inputs, capital and labour (domestic, inter region and international).

Households

- Households maximise utility from consumption subject to their budget constraint
- Given the total budget available, households decide the optimal consumption mix in two steps:
    - Determine the consumption mix across the products available in the economy (e.g. to consume more leisure services at the expense of housing)
    - Determine the share of consumption sourced domestically vs. imports

These household decisions are governed by household preferences as well as the relative prices of products (domestic, inter region and international).

Labour Supply

Households in each modelled area supply labour to firms in each of the model areas:

- Households supply different types of labour ranging from labourers to managers (there are eight types of occupations offered, subject to ABS OCCP 1 digit level)
- Households supply this labour subject to relative real perceived wages (i.e. higher real wages in a location increases labour supply to that location).
- Relative perceived wages are a function of salaries and also commuting travel time (e.g. lower commuting costs from A to B increases the 'perceived' relative wage in location B for residents in A)

5.2.4 What CGE models capture

CGE models are able to capture and report a series of macroeconomic and social indicators for each region that makes up the economy, before and after the exogenous change runs through it. These include:

- Value-add for every modelled industry in the economy
- Productivity for every industry in the economy
- Employment and labour income in the economy
- Business profits
- Net imports/exports

This therefore makes CGE models a good tool for capturing the economy-wide spatial impacts of a change in infrastructure. By translating some of the benefits / impacts that can accrue to users and producers of an infrastructure asset, CGE makes them identifiable from a macro perspective which demonstrates how new infrastructure can improve the economy in an aggregate sense.

5.2.5 Approach to this assessment - Spatial general equilibrium model

To develop evidence on these flow-on impacts of WSA on the wider economy, a spatial economic impact model (i.e. a Spatial General Equilibrium Model, SCGE) was used. A SCGE can assist in the translation of the potential benefits from an infrastructure investment into real economic impacts accrued to people 'on the ground'. In other words, an SCGE translates potential time and cost savings to individuals and businesses and accessibility gains (as a result of the new airport development) into area-specific changes in wages, productivity, incomes, value add and prices.

Again, it is important to note that the CGE model that has been prepared to consider the proposed WSA development is not intended to be a macro-economic exercise to understand the net outcomes of the

proposed WSA development, operations and financing. Instead it considers the final incidence of potential benefits of the proposed development amongst businesses, workers and individuals.

Metrics to describe the impact of the WSA through use of the SCGE include (all in real values):

- **Increased value add** – value add is the value of output produced less the cost of intermediate inputs used in the production of that output and expresses the net wealth generated by the activity. WSA will result in higher value-add per year by supporting productivity and growth, delivering benefits to businesses and workers alike.
- **Gross business profits** – the share of an increase in value-add that is retained as real returns to owners, investors and others who finance businesses.
- **Gross household labour incomes** – the share of an increase in value-add that is enjoyed by households through an increase in real wages.
- **Enhanced productivity per worker** – this is change in real value-add per worker per year. WSA enables workers in Western Sydney, and indeed the Rest of Sydney to be more productive due to a reduction in the cost of aviation services.
- **Net imports** – the balance of the real value of exports and imports in a region, representing both domestic, inter-regional trade and international trade.

5.3 WSA CGE methodology

5.3.1 Geography

The WSA SCGE model is set up to represent transactions taking place between individuals, businesses and governments, in terms of consumption, labour, capital, real estate and trade. Households provide labour and capital to firms and use the income to purchase goods and services. Firms use inputs sourced from other firms, as well as labour and capital, to produce goods and services, which are in turn sold to households and to other firms. These transactions are represented for four spatial areas (termed 'regions', which are:

- Western Sydney (WS) = r_1
- Rest of Sydney (RoS) = r_2
- Rest of NSW (RoNSW) = r_3
- Rest of Australia (RoAus) = r_4
- Rest of world (ROW) = e

Transactions happen both within regions and between them – that is, all parties can decide to purchase goods, services, labour and capital either from within a region or 'import' from any of the other regions.

Western Sydney

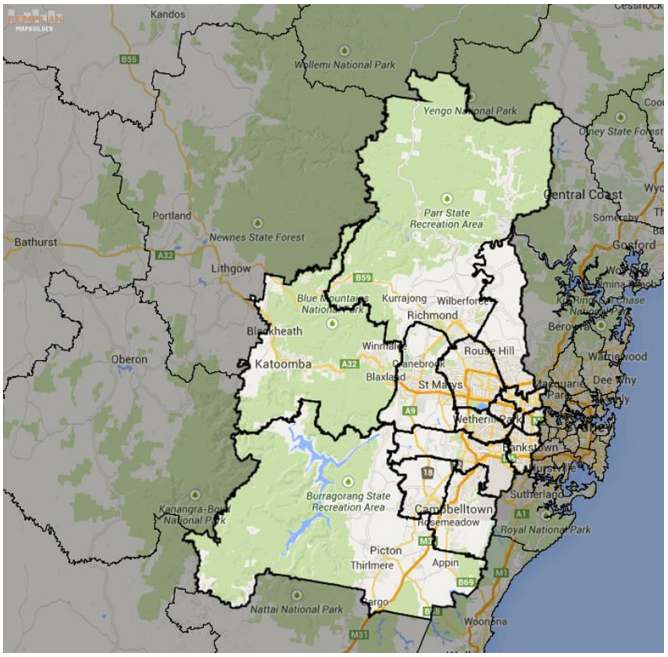
Western Sydney is made up of the following LGA areas:

- Parramatta (C)
- Bankstown (C)
- Liverpool (C)
- Fairfield (C)
- Holroyd (C)
- Penrith (C)
- Blacktown (C)
- Campbelltown (C)
- Camden (A)
- Hawkesbury (C)
- Wollondilly (A)

- The Hills Shire (A)
- Blue Mountains (C)
- Auburn (C)

Figure 12 illustrates how Western Sydney has been defined.

Figure 12: Western Sydney



Rest of Sydney

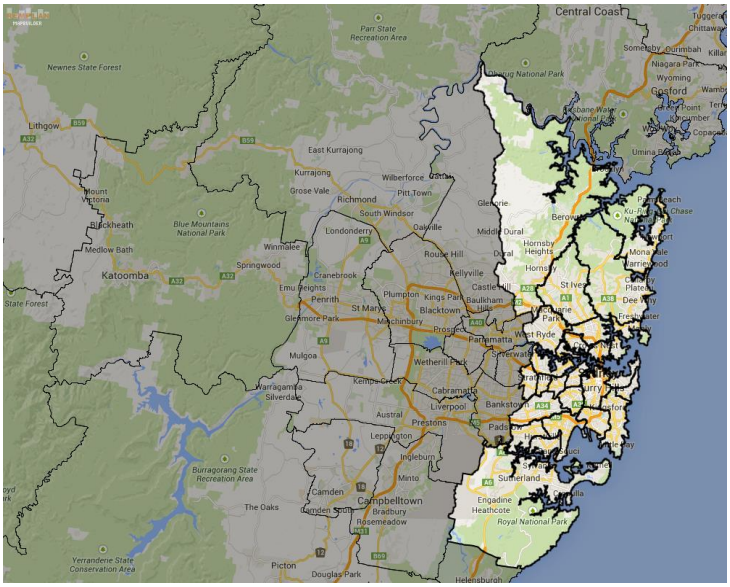
The 'Rest of Sydney' is made up of the following LGA areas:

- Sydney (C)
- Botany Bay (C)
- Rockdale (C)
- Marrickville (A)
- Canterbury (C)
- Strathfield (A)
- Burwood (A)
- Canada Bay (A)
- Ashfield (A)
- Leichhardt (A)
- Woollahra (A)
- Waverley (A)
- Randwick (C)
- Manly (A)
- Kogarah (C)
- Hurstville (C)
- North Sydney (A)
- Mosman (A)
- Willoughby (C)
- Lane Cove (A)
- Hunters Hill (A)
- Ryde (C)
- Ku-ring-gai (A)
- Hornsby (A)

- Sutherland Shire (A)
- Warringah (A)
- Pittwater (A)

Figure 13 shows how Rest of Sydney region is defined.

Figure 13: Rest of Sydney



Other spatial areas

The two other spatial areas informing the model are Rest of NSW and Rest of Australia.

The model is calibrated based on observed patterns of transactions, including intra and interregional trade and commuting.

5.3.2 Industries

Each region contains 9 industries. These are produced by grouping the REMPLAN transactions table data for each region into the following industries:

- Primary
- Manufacturing and Construction
- Utilities
- Food and trade
- Transport
- Technology
- Financial and Advisory
- Public and Social
- Other Services

5.4 Consumption

5.4.1 Households

Each of the locations in the model includes a representative household which demands and consumes goods.

Each good can be thought of as a generic good produced by each of the 9 industries. Households must first choose their consumption good mix which forms the first stage of the household consumption decision.

After choosing the consumption good mix, households must then decide from what region to source these goods.

5.4.2 Government

In the model, it is assumed that the Government acts as a consumer in much the same way as a typical household described above. Governments must firstly determine their optimal consumption good mix, before deciding where to source this consumption mix from. In this way, the Government is just another consumer.

5.4.3 Exports for consumption

While the 'rest of world' also imports products from the modelled regions, it is not explicitly modelled. The 'rest of world' is therefore represented as another consumer purchasing goods from each of the modelled regions and treated in the same fashion as households and Government (i.e. with the use of a CES utility function).

The addition of household and Government consumption as well as inter-region and rest of world consumption of a region's goods gives total consumption demand in that region.

5.5 Production

Output in the economy is produced by a representative firm in each of the 9 industries, and each of the four regions. Of this output, a proportion is made up of intermediate inputs sourced from other industries (or its own), with the remainder generated as value-add.

To create the value-add, a combination of primary inputs (in this model labour and capital) are used. Labour and capital is provided by households. While overall labour supply is relatively inelastic, it can be sourced from any of the four regions in the economy (see below). Capital supply, on the other hand, is elastic.

Once firms choose the amount of labour they need, they then choose what type of labour they need. They choose between eight different occupations. Similarly, firms must choose what type of capital they need in production – either physical capital (such as machinery or plant equipment) or land.

The intermediate inputs used in production are chosen by each firm and made up of a combination of each of the other industry's output. For each of these inputs, a proportion is sourced locally and a proportion is sourced from other regions and the rest of the world.

Choosing the mix of labour and capital

After determining the level of value-add to be produced, firms then decide the optimal combination of labour and capital to produce that value-add.

5.6 Labour

5.6.1 Choosing the occupation mix

Firms choose the occupational mix of labour which optimises the labour component of the value-add of their production.

The different occupations that firms are able to choose in their production are:

- Managers
- Professionals
- Technicians and Trades Workers

- Community and Personal Service Workers
- Clerical and Administrative Workers
- Sales Workers
- Machinery Operators and Drivers
- Labourers

5.6.2 Journey to work

Regardless of where workers in households live, workers may decide to commute to work in any of the regions.

The decision on where to work is a function of the relative wage of workers (perceived wage in region of residence versus perceived wage in region of work) and travel time to get to work. A higher wage at home relative to the other regions makes it more attractive for workers to not travel out of the region; likewise a higher travel time also makes it less attractive to workers to travel outside their region of residence to work.

Perceived Salary

The perceived salary faced by workers in a region is a function of the wage in that region and the commuting time to reach that region.

Labour Supply

The labour supply in any origin-destination pair is a function of the ratio of perceived wage to the average perceived wage faced by workers living in a certain origin and the elasticity of labour supply. The labour supply elasticity represents the responsiveness (or willingness) of labour to move into different regions to work as the relative perceived wage in that region changes (holding place of residence constant). A labour supply of 0.15 has been selected for the model.[17]

Migration

One of the effects of WSA can be to attract residents into Western Sydney and the Rest of Sydney. Household's location decisions are determined based on relative real perceived wage levels between locations. If workers living in a certain location see lower prices, higher wages or lower cost of accessing jobs, there will be an inflow of residents to that location.

5.7 The Australian economy – initial sectoral structure

Before introducing the effects of WSA on the four region Australian economy, the model is in its initial equilibrium. That is, all of the conditions previously outlined (labour demand = labour supply etc.) are true. Prices of goods, capital and labour are normalized and taken to be 1.

For all regions, the labour, capital and goods market all clear:

- Wages are such that the labour market clears
- Capital rents are such that the capital market clears
- The price of output is such that the goods market clears

[17] Fullerton, Shoven and Whalley - Dynamic General Equilibrium Impacts of Replacing the US Income Tax with a Progressive Consumption Tax

5.8 The Implementation of Western Sydney Airport

The potential benefits that result from the construction of WSA can be translated into impacts on the macro economy in Sydney. The SCGE model is able to take potential benefits and use them as 'shocks' or exogenous changes to the Australian economy.

Specific benefits which have been considered as 'shocks' to the economy in the SCGE model are:

- Willingness to pay benefits accruing to consumers
- Producer surplus benefits accruing to airlines.

This means that, as previously identified, the SCGE model that has been prepared to consider the proposed WSA development is not intended to be a macro-economic exercise to understand the net outcomes of the proposed WSA development, operations and financing. Instead it considers the final incidence of potential benefits of the proposed development amongst businesses, workers and individuals.

Willingness to pay benefits to consumers

WSA will result in a set of benefits to aviation users, including the reduced costs of accessing aviation services and reduced passenger delays. It will also result in benefits accruing to new passengers who otherwise would not access aviation services from Sydney. These savings enter the labour production function in the form of labour productivity, representing an increase in productivity of each type of occupation and in each sector for that particular region.

Therefore the higher the willingness to pay benefits, the higher is the increase in productivity per worker and value-add that is attributed to labour. By helping workers become more productive, WSA is helping increase the level of value-add per unit of labour, increasing wages and overall value-add in the Sydney and NSW economies.

Producer surplus accruing to airlines

The introduction of WSA will also result in an increase in total factor productivity in the aviation sector. This is attributed to the operational savings (producer surplus) that will be made to airlines. In the CGE model, this increase in total factor productivity is captured in the firm's value-add production process.

By enabling a total factor productivity gain, WSA is increasing the amount of value-add that results from a given level of capital and labour in the aviation sector.

5.9 Results

The increase in labour and total factor productivity results in increased efficiency and, initially, a reduction in the prices businesses charge for their products. This increases demand for these products, through increased consumption and increased demand for each region's product from other regions and from overseas.

As these impacts ripple through the economy, households and firms keep responding until prices adjust to ensure demand equals supply in all markets. The difference between the new 'equilibrium' outcome and the initial situation represent the changes caused by the introduction of WSA.

It should be noted that summing changes in labour income and business profits will not add up to change in total value-add due to these using different price indexes to bring the figures into 'real' terms. Business profits and labour income are converted using CPI, whereas total value-add is converted into real terms using an RPI (retail price index).

Table 17 reports selected outputs from the model. These include changes in value-add ($m), productivity ($/worker), business profits ($m), household income ($/worker) and exports ($m).

Table 17: Summary results – 2031 – change on Base Case as a result of WSA

Revised Label	Unit	Western Sydney	Rest of Sydney	Rest of NSW	Rest of Australia	Total
value add	$	$77m	$145m	$23m	-$39m	$205m
Business profits	$	$27m	$42m	$11m	-$8m	$73m
productivity per worker	$	$90	$95	$20	-$4	$17
Labour income	$	$44m	$50m	$15m	$32m	$140m
Net imports	$	$23m	-$36m	$5m	$55m	$47m

Source: EY CGE model

The project generates an additional $205m in value-add per year across Australia, the majority of which in Sydney. There is a reduction in value-add in the Rest of Australia (outside NSW), reflecting economic activity that is attracted to Sydney / NSW. The increase in value-add is supported by increases in productivity per worker, averaging $23 across the country, but reaching $90 per worker in Western Sydney and $95 per worker in Rest of Sydney.

$73m is earned annually as additional profits by businesses, again with the majority of the benefits accruing to Sydney. There are smaller positive benefits to the Rest of NSW and a negative impact on the Rest of Australia, again reflecting activity that is diverted to Sydney.

The impact on household incomes is $140m per year. Here significant regional spillovers are apparent, with a substantial share of the total gains falling to Rest of Australia, mainly through lower prices on imports from NSW. In this way it can be seen how WSA will also have a positive impact on households outside of NSW. Still, the largest benefit also here accrues to residents in Sydney.

Patterns of trade differ between the regions. There are two main opposing effects - additional incomes results in an increase in imports, while impact of lower prices mean improved competitiveness generates an increase in exports. For Western Sydney and the Rest of Australia the balance favours additional imports. For Rest of Sydney, the increased competitiveness dominates. The reason for these differences is primarily the sectoral composition – Rest of Sydney includes the Sydney CBD which contains a significant amount of export oriented service sectors.

Table 18 show the same set of impacts in 2063. The patterns are very similar, although the impacts are much larger, reflecting the larger productivity gains in those years.

Table 18: Summary results – 2063 – change on Base Case as a result of WSA

Revised Label	Unit	Western Sydney	Rest of Sydney	Rest of NSW	Rest of Australia	Total
value add	$	$1507m	$4640m	$506m	-$815m	$5838m
Business profits	$	$541m	$1372m	$248m	-$138m	$2023m
productivity per worker	$	$941	$1613	$225	-$42	$252
Labour income	$	$869m	$1580m	$333m	$670m	$3452m
Net imports	$	$660m	-$1015m	$372m	$1389m	$1406m

Source: EY CGE model

By 2063, WSA is expected to increase value-add in the Australian economy by $5.8bn, of which the majority is enjoyed by the Rest of Sydney. About $800m of value-add is diverted from Rest of Australia to NSW.

Worker productivity increases significantly, by $940 per worker in Western Sydney and $1,600 in Rest of Sydney. A smaller negative impact to Rest of Australia is caused by a compositional impact – as the activity that is attracted to NSW is on balance of higher-than-average productivity per worker.

Business profits increase by $2bn per year, the vast majority to NSW. Household incomes increase across all the regions, from $333m per year in Rest of NSW to $1.6bn per year in Rest of Sydney. All regions also now see an increase in net imports.

5.10 Conclusion

The economic modelling in this section investigates the final incidence of these gains after they have rippled through the Australian economy. The modelling finds that in response to the introduction of WSA, Sydney is better able to attract economic activity away from the Rest of Australia, leading to increased business profits reaching $2bn per year by 2063. Household incomes, however, increase across Australia, with $2.5bn enjoyed by Sydney residents and a further $1bn shared between Rest of NSW and the Rest of Australia. On average, Australian value-add per worker increases by $250 per year.

Limitations of the analysis

A number of limitations were identified to the scope of the analysis presented above. Furthermore, a number of simplifying assumptions were made to undertake the analysis.

- The purpose of the CGE modelling is to provide a richer picture of how the proposed WSA will affect individuals and business across Sydney, NSW and Australia. The CGE model applied is a high-level model with significant simplifying assumptions and results should be interpreted with this in mind.
- The CGE model, although built on accepted microeconomic foundations, presents a simplified and highly aggregated version of the Australian economy. All industries and households are assumed to be homogenous in that the same production and utility function represents all agents. In reality, individual preferences and firm structures are going to differ across various agents.
- The CGE model captures increases in household expenditure and gross value add in the economy as a result of the proposed WSA. However, it is important to note that the CGE model that has been prepared to consider the proposed WSA development is not intended to be a macro-economic exercise to understand the net outcomes of the proposed WSA development, operations and financing. Instead it considers the final incidence of potential benefits of the proposed development amongst businesses, workers and individuals.
- It is assumed that the economy achieves Pareto optimality, that is, no individual can become better off without another becoming worse off. In reality, it would be expected that there are inefficiencies in the economy that can be overcome to make some agents better off without making other agents worse off.
- It is assumed that there is perfect competition amongst firms in the economy. In reality there are sectors in the economy that are not perfectly competitive, where firms are able to earn a supernormal profit. In this way the CGE model of the Australian economy presents a simplified market structure which is not fully representative of the economy.
- The Constant elasticity of substitution function was assumed for firms and households in the model. Elasticities underpinning these functions were sourced from external sources or based on economic theory. They were not estimated using econometric methods.

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