Supplement to Draft

Environmental Impact Statement

Second Sydney Airport Proposal

Volume 3

Supplement

COMMONWEALTH DEPARTMENT OF
TRANSPORT AND
REGIONAL SERVICES

PPK
Environment&Infrastructure

Supplement to Draft

Environmental Impact Statement

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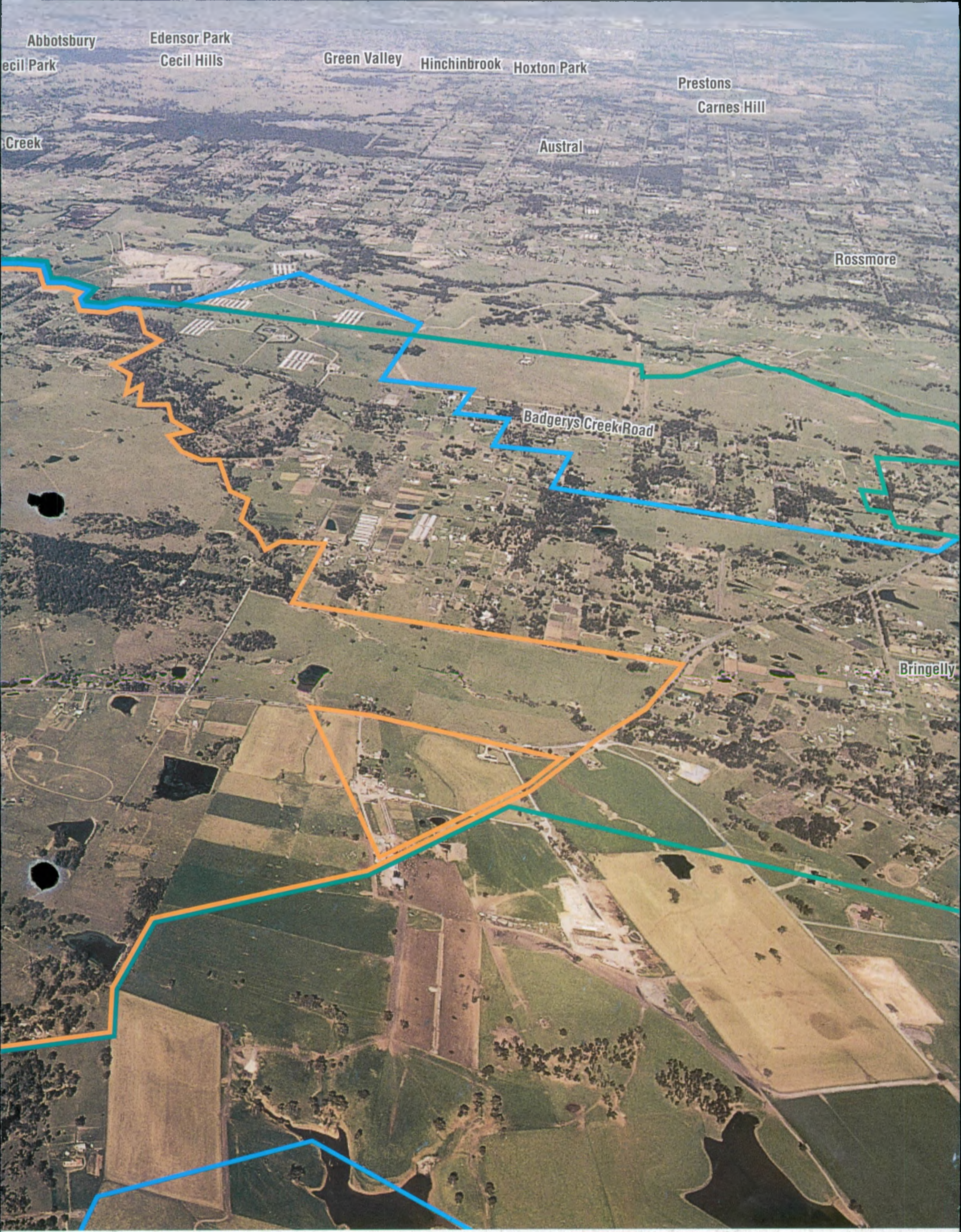
Approximate



Approximate Boundaries
Option A
Option B
Option C

Photograph 1
Sites of Badgerys Creek Airport Options (from south-west looking north-east)

Explanatory and Limitations Statements

This Supplement to the Draft Environmental Impact Statement (Supplement) has been prepared by PPK Environment & Infrastructure Pty Ltd (PPK) and the Commonwealth Department of Transport and Regional Services (DoTRS). The Supplement includes text, data, analyses and other material prepared by DoTRS (inclusive of information from Airservices Australia, Atech Group and Corporate Economics Australia Pty Limited) and other individuals and organisations, most of which are referenced in this Supplement. Except as otherwise stated in this Supplement, PPK has not verified the accuracy or completeness of the material prepared by DoTRS.

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To ensure clarity on some of the figures, names of some suburbs have been deleted from inner western, eastern, south-eastern and north-eastern areas of Sydney. On other figures, only 'Primary' and 'Secondary' centres identified by the Department of Urban Affairs and Planning's Metropolitan Strategy, in addition to Camden, Fairfield and Sutherland, have been shown.

Acknowledgments

The Department of Transport and Regional Services, as proponent of the proposal, would like to thank all members of the EIS team for their dedication to a large, complex and challenging project. The Department would also like to thank all those who took part in the community consultation program and those who lodged submissions on the Draft EIS.

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PART A

Introduction

Chapter 1

Background

Chapter 1
Background

1.1 Overview of the Proposal

Planning of and investigations into a site for a second Sydney airport have been conducted for more than 50 years. In 1986 the Commonwealth Government announced that Badgerys Creek had been selected as the site for Sydney's second major airport. This decision followed an examination of all possible locations for the second airport, conducted as part of the *Second Sydney Airport Site Selection Programme Environmental Impact Statement* (Kinhill Stearns, 1985a; 1985b).

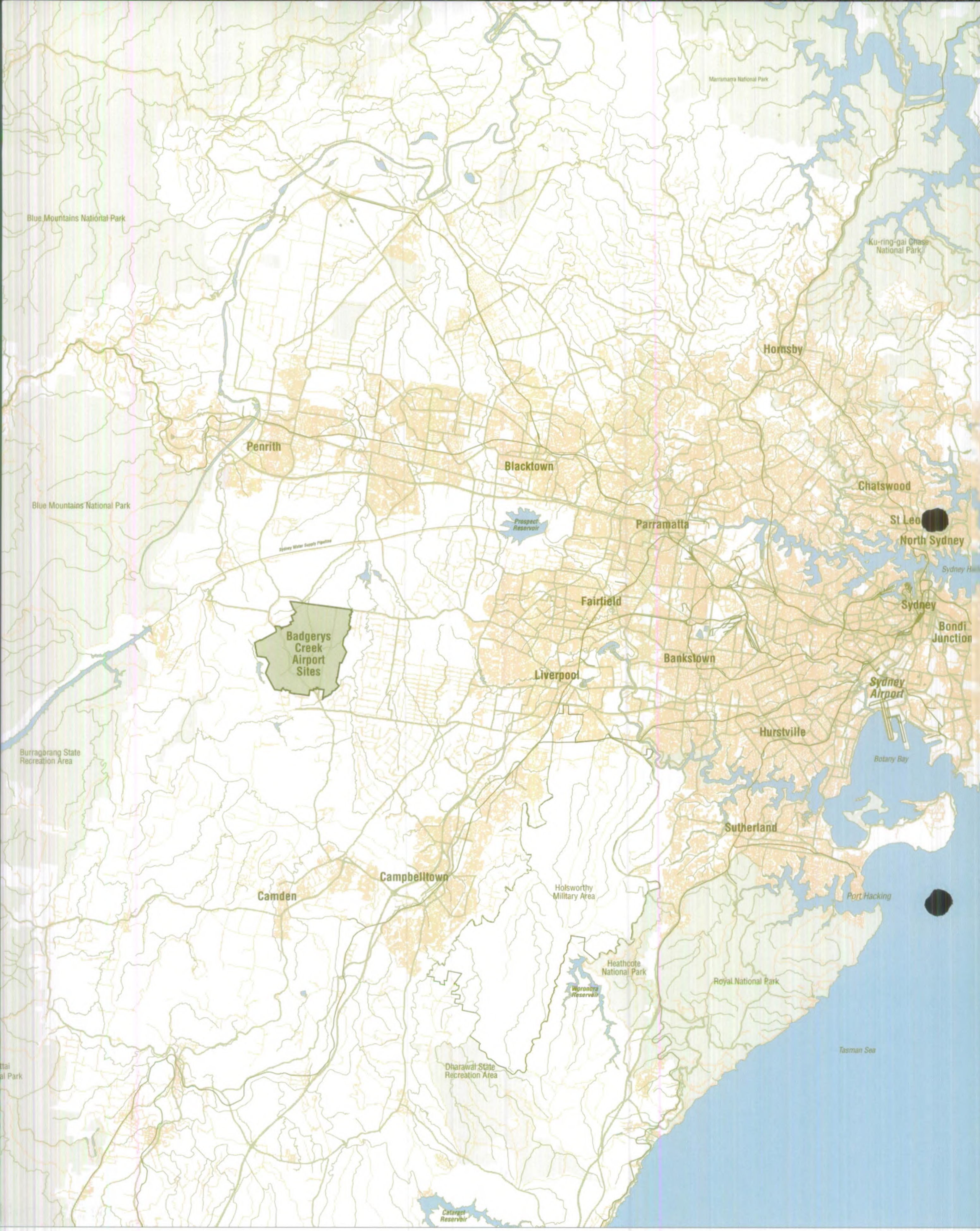
The Badgerys Creek site, which is about 46 kilometres west of Sydney's central business district and 1,700 hectares in area, was acquired by the Commonwealth between 1986 and 1991. In 1991 it was announced that the initial development of Badgerys Creek would be as a general aviation airport with a 1,800 metre runway. Development of a 2,900 metre runway for use by major aircraft was proposed by the Government in 1994 and 1995. This decision triggered the environmental assessment procedures in the *Environment Protection (Impact of Proposals) Act, 1974* and it was announced in January 1996 that an environmental impact statement (EIS) would be prepared on the proposal.

A new proposal was presented in May 1996 for the construction and operation of a second major international/domestic airport for Sydney either at Badgerys Creek or in the Holsworthy Military Area. The site was to be large enough for future expansion of the airport if required (Department of Transport and Regional Development, 1996). Holsworthy was subsequently discounted (on environmental grounds) as a potential site for Sydney's second major airport. Consequently, the Draft EIS (PPK Environment & Infrastructure, 1997) released for public exhibition in December 1997 examined only the Badgerys Creek site.

The Commonwealth Government has proposed the development of a second major airport for Sydney, capable of handling up to about 30 million domestic and international passengers and 360,000 aircraft movements per year (refer to Section 1.3 of the Draft EIS). Three airport options were considered in the Draft EIS:

- Option A developed the Badgerys Creek site in a form generally consistent with the planning undertaken since 1986, on land presently owned by the Commonwealth, with two parallel runways to be constructed on an alignment running approximately north-east to south-west;
- Option B adopted a runway alignment identical to Option A, but provided greater separation between the parallel runways and incorporated a cross wind runway; and
- Option C provided two main, parallel runways on an alignment approximately north to south, in addition to a cross wind runway.

Figure 1.1 illustrates the sites of the airport options in the context of the Sydney region.



Urban areas (indicated by local roads)

Figure 1.1

Location of Badgerys Creek Airport Sites

1.2 Overview of the Decision-Making Process

1.2.1 Legislation and Guidelines

The development of the proposed Second Sydney Airport requires a decision by the Commonwealth Government and is, therefore, subject to the *Environment Protection (Impact of Proposals) Act, 1974*, and its Administrative Procedures. The environmental assessment process established by this legislation is illustrated in *Figure 1.2*.

The level of assessment applying to any individual proposal is a matter for Environment Australia or the Minister for the Environment to determine in accordance with the Administrative Procedures under the Act. In the case of the Second Sydney Airport proposal, the Minister determined that an EIS was the appropriate level of environmental impact assessment. Following the public review of the Draft EIS the Commonwealth Department of Transport and Regional Services is required to respond to the issues raised by preparing a Supplement to the Draft EIS. The Draft EIS and Supplement together constitute the Final EIS.

The preparation of EIS Guidelines is an important part of the environmental impact assessment process under the Act. These guidelines are based on the requirements of Paragraph 4.1 of the Administrative Procedures under the Act. The object of the Act is to ensure that matters affecting the environment to a significant extent are fully examined and taken into account in decisions made by the Commonwealth Government. The Administrative Procedures also set out the matters to be dealt with in an EIS.

The EIS Guidelines have also been subject to a process of public consultation. Draft guidelines were initially released in January 1996 for the then-proposed development of Sydney's second major airport at Badgerys Creek. Additional public input into the development of the guidelines was sought in July 1996, following the Government's decision to include the Holsworthy Military Area. All submissions received during the public consultation process were taken into account in preparing the revised guidelines, which were released in November 1996.

Following the elimination of Holsworthy, revised EIS Guidelines specific to Badgerys Creek were issued in October 1997. The October 1997 EIS Guidelines (Department of the Environment, Sport and Territories, 1997) are those on which the Draft EIS and this Supplement are based.

1.2.2 Public Review of the Draft Environmental Impact Statement

The Draft EIS was made available for public review and comment for a period of 14 weeks from 23 December 1997 until 30 March, 1998. A total of 15,650 submissions on the Draft EIS were received by Environment Australia from the NSW Government, local councils, community and other groups, and individuals.

Copies of all submissions were provided to the Department of Transport and Regional Services. Due to the large number of submissions, the Department, in consultation with Environment Australia, decided to use a common list of issues as the basis for summarising the issues raised in each submission. An overview of issues raised and the process used to summarise and address submissions is contained in *Chapter 2* of this Supplement.

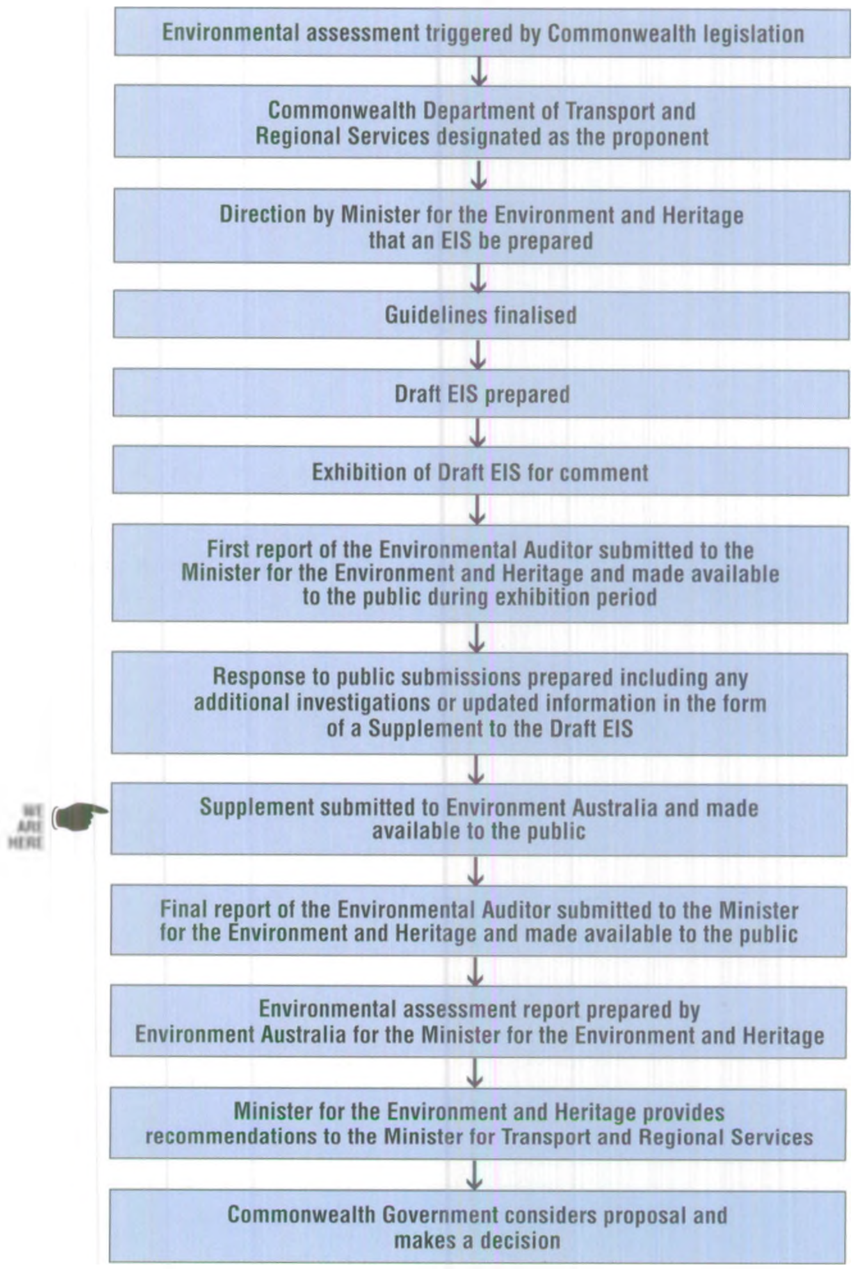


Figure 1.2
Environmental Assessment Process

The public review process for this proposal has been supplemented by the appointment of an Environmental Auditor. In broad terms, the role of the Auditor is to review the appropriateness and adequacy of the EIS, the Supplement and Technical Papers supporting the EIS, and to provide independent advice on the EIS to both the Government and the community. An audit report on the Draft EIS was released in January 1998 to coincide with the period of public review. A second audit report will review the adequacy of the Final EIS.

1.2.3 Role and Objectives of the EIS Supplement

The objective of the *Environment Protection (Impact of Proposals) Act, 1974* is to ensure, to the greatest practicable extent, that matters significantly affecting the environment are both fully examined and thoroughly considered. With regard to this, it is intended that this Supplement to the Draft EIS will:

- comply with relevant legislative requirements for the environmental assessment of the second Sydney airport proposal;
- provide responses to issues raised in submissions on the Draft EIS;
- provide responses to issues raised in the first Auditor's Report on the Draft EIS;
- provide an additional source of information to the Commonwealth Government, the community and other stakeholders relevant to the consideration of the potential environmental impacts of the proposal;
- together with the Draft EIS provide a basis for Environment Australia to complete its assessment of the proposal; and
- provide, in conjunction with the Draft EIS, a framework within which the Commonwealth Government will consider the environmental impacts of the proposal, and community opinion of those impacts, in its decision making process.

1.2.4 Structure of the EIS Supplement

Comments were received relating to each chapter of the Draft EIS. As a consequence the ordering of chapters within the EIS Supplement generally follows the order of the Draft EIS. There are four exceptions: water; aviation; economics; and health issues. In terms of water issues, significant concerns were raised in submissions on various elements of this issue and responses have been incorporated into a separate chapter *(Chapter 13)*. The second relates to aviation issues; including airspace management, interaction with Sydney Airport and general aviation aerodromes, restricted airspace and fuel venting. These issues are addressed in a separate chapter *(Chapter 20)*. Additional assessment in the form of a benefit cost analysis has been undertaken and this is included as *Chapter 22*. Finally, health issues, owing to concerns raised in submissions, have been included as *Chapter 23*.

For consistency, each chapter has been structured in the same way. Chapters commence with a summary of the Draft EIS and a summary of the issues raised in submissions and by the Auditor on the Draft EIS. This is followed by any additional environmental assessment undertaken for the purpose of this EIS and responses to the issues raised in submissions. To conclude each chapter, an overview of each issue is provided that summarises the overall findings of the Draft EIS and EIS Supplement.

A total of 33 technical appendices accompany this Supplement. Their purpose is to provide more detailed technical responses, or clarification, where this has been required, to respond to a particular issue or issues. Additionally, a glossary of technical terms used in the EIS has also been prepared.

1.2.5 The Next Steps

Together, the Draft EIS and this Supplement form the Final EIS. A summary of the findings of the Final EIS has been prepared as a separate document.

Environment Australia is required to examine the Final EIS, taking into account any public comments received on the Draft EIS and the findings of the Auditor. Environment Australia will then provide an Assessment Report to the Minister for the Environment and Heritage, addressing the impacts of the proposal and the adequacy of measures proposed for the protection of the environment.

After examining the Assessment Report, the Minister for the Environment and Heritage may make any comments, suggestions or recommendations to the Minister for Transport and Regional Services that are considered necessary for the protection of the environment.

The Minister for Transport and Regional Services and the Commonwealth Government must take into account any such recommendations or advice in making a decision on the Second Sydney Airport proposal.

The report of the Environmental Auditor and the Assessment Report will be made available to the public.

Chapter 2

Overview of Comment on the Draft EIS

Chapter 2
Overview of Comment on the Draft EIS

2.1 Introduction

The Draft EIS on the Second Sydney Airport proposal was released on 21 December 1997 for public comment. When the public review period closed on 30 March 1998, a total of 15,650 submissions was received from 11,240 authors (some received after 30 March 1998).

The Administrative Procedures under the *Environment Protection (Impact of Proposals) Act 1974* require that all submissions received during the public review period must be taken into account in preparation of the Final EIS. The Final EIS for the proposed Second Sydney Airport also takes into account the matters raised in the report of the Environmental Auditor appointed by the Minister for the Environment and Heritage.

This chapter explains how comment on the Draft EIS was summarised, provides an overview of the issues raised by submissions, outlines the main themes raised in government submissions and the report of the Environmental Auditor, and discusses the approach taken in addressing these issues in this Supplement.

2.2 Summarising Comment on the Draft EIS

The Administrative Procedures under the *Environment Protection (Impact of Proposals) Act 1974* require that the proponent must summarise, or include in full, all submissions received during the public review period. The summary of submissions has been provided separately to public libraries.

The large number of submissions received made it impractical to include each submission in full in this Supplement. An alternative approach would have been to develop text which individually and uniquely summarised each submission. Apart from being extremely time-consuming and repetitive, such an approach would have produced a summary that was impractical to analyse for common themes for response in the Supplement. In consultation with Environment Australia, the approach adopted by the Proponent was to develop a comprehensive list of discrete issues raised in all submissions as the basis for summarising the issues raised in each submission. The summary of each submission was then entered into a database.

Copies of the database containing the summaries of each submission have been provided on CD to those libraries which received a copy of the Draft EIS. This distribution is used primarily because of the size of the database (more than 20 megabytes). This approach has been arrived at in agreement with Environment Australia.

The issues list used to categorise submissions was built up from the submissions and from the Auditor's Report. Where a submission raised an issue which could not be discretely categorised along with issues already in the list, a new issue was added to the list, or a better description of an existing issue was formulated.

The issues list is structured in three tiers. The first tier mirrors the chapter headings of the Draft EIS, the second tier breaks each issue down into its sub-parts, and the third tier is a more specific description of the issue raised by any particular submission. For example, issue 15 is air quality, issue 15.09 is health impacts, and issue 15.09.01 is "concern that the increase in air pollution will make asthma worse". All issues raised in submissions were categorised against third tier categories. The final list contains 585 third tier issues (see *Appendix A*). The higher order categories have proved a useful way of analysing the data.

The summarising process sought to make as little interpretation of comments made in submissions as possible. For example, only those authors who explicitly stated their opposition to the proposed airport were recorded against the issue 'no airport at Badgerys Creek' in the summary. By the same token, only those authors who explicitly stated their support for the proposed airport were recorded against the issue 'support for an airport at Badgerys Creek' in the summary.

Given the many issues of concern with the proposed development which are contained in the issues list, the number of authors who could be said to oppose the airport would be greater than the number who explicitly stated their opposition.

The benefits of this summarising technique have been that the Proponent has been able both to see the overall number of authors who raise particular issues, and to use the issues list as a reference point to return to individual submissions in order to clarify specific issues raised.

2.3 Overview of Issues Raised in Submissions

A total of 15,645 submissions was summarised (five submissions received were later withdrawn at the request of the authors). The large difference between the number of authors and the number of submissions reflects the fact that some authors made more than one submission, and some authors made the same submission more than once (for example by mail, by facsimile, or through their local Member of Parliament). For this reason, the database that contains the summaries is referenced by authors rather than submissions to avoid double counting of issues raised in identical submissions by the same author. Where different issues were raised in separate and distinguishable submissions by the same author, these were counted against the author.

The 15,650 submissions received contained a total of 21,475 pages. Approximately 1.2 percent of the submissions contained more than five pages (totalling 4,408 pages), 7.5 percent contained two to four pages (totalling 2,775 pages), and the remainder were single page submissions.

The primary purpose of this Supplement is to address specific comment on the Draft EIS. All submissions were taken into account in preparation of the Supplement. As with other major development proposals, the public review of the Draft EIS was used as a forum to register a protest against the proposal, and this is reflected in the issues raised. It was also evident from the prevalence of standard submissions (both identical submissions from different authors and those which used pro forma documents as a base), that a large number of submissions formed part of several major campaigns opposing the proposed airport.

A relatively small number of authors addressed their comments directly to the content of the Draft EIS or its supporting documents.

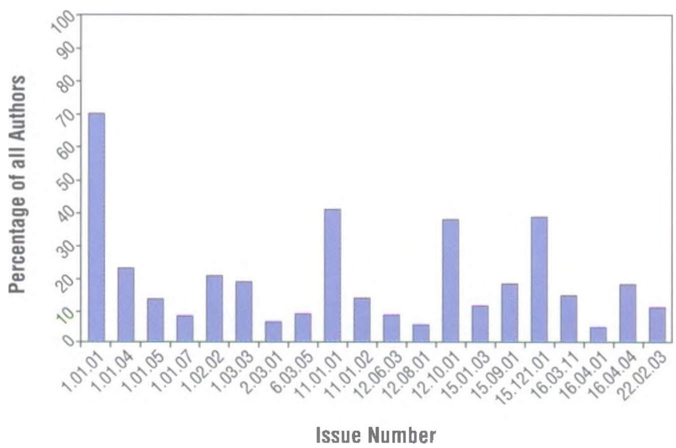
The proportion of authors who raised less than three issues was 20 percent, and 50 percent of authors raised less than five issues. Authors raised 7.6 issues on average.

Many issues raised in submissions have been characterised in the issues list as an 'unspecified concern' about a matter; for example, '[u]nspecified concern about the effects of the proposal on health' (issue 1.03.03). The use of the term 'unspecified' is simply meant to characterise general comments made about a matter, where little or no further detailed comment has been supplied on the issue by the author.

There were 38 authors categorised as arising from Government (including State and local governments and their agencies), 89 as representing community organisations (including political parties, schools, and community groups organised to oppose the proposed airport), and 35 authors categorised as business and industry representative groups. The remaining authors were individuals. There were four confidential submissions and ten petitions received.

The number of authors who explicitly stated their objection to the development of an airport at Badgerys Creek was 7,838 (70 percent of all authors). Most of the remaining authors made comments implicitly opposed to the proposed airport. This was reflected in the high frequency that other issues of concern with the proposed airport were raised (for example, issues such as 'unspecified concern about the impacts of, or objection to, aircraft overflight noise'). There were 61 authors (0.5 of one percent of all authors) who explicitly stated their support for the proposal.

The 20 (third tier) issues raised most frequently by authors are presented in *Figure 2.1*.



1.01.01	No airport at Badgerys Creek
1.01.04	Concerned about adverse impacts of the airport on quality life
1.01.05	General political comment, eg Government decision on the 'Second Sydney Airport' issue will influence voting behaviour
1.01.07	Unspecified concern about the proposal
1.02.02	Unspecified concern about environmental impacts of the proposal
1.03.03	Unspecified concern about the effects of the proposal on health
2.03.01	The Draft Environmental Impact Statement is inadequate or flawed
6.03.05	Objects to any site within the Sydney Basin
11.01.01	Concerned about impact on schools and students
11.01.02	Concerned about sleep disturbance
12.06.03	Unspecified concerns about, or objection to reduction in, property values
12.08.01	Concern that the airport will not be subject to a curfew
12.10.01	Unspecified concern about the impacts of, or objection to, aircraft overflight noise
15.01.03	Unspecified concern or complaint about existing air quality
15.09.01	Concern that the increase in air pollution will make asthma worse
15.12.01	Unspecified concern about, or objection to, air pollution
16.03.11	Unspecified concern about, or objection to, increase in, water pollution
16.04.01	Concerned about the impact of aircraft emissions and fuel venting on water supply
16.04.04	Unspecified concern about, or objection to, adverse impacts on water supplies
22.02.03	Unspecified concern about, or objection to, increase in, road congestion

Figure 2.1
Twenty (third tier) Issues Raised Most Frequently by Authors

To place these individual issues in some context, it is also useful to identify the most frequently raised issues based on the highest level of aggregation in the issues list (that is, first tier issues). On this basis, the major issues raised by authors were those relating to:

- *Overview of the Proposal* (88 percent of all authors), with the most frequently raised point being that there should be no airport at Badgerys Creek (70 percent of all authors), concern about adverse impacts of the airport on quality of life (24 percent), unspecified concern about environmental impacts of the proposal (20 percent), and unspecified concern about the effects of the proposal on health (18 percent);
- *Air Quality* (56 percent of all authors), with 39 percent of all authors raising an unspecified concern about, or objection to, air pollution, and 18 percent raising concern that the increase in air pollution would make individuals' asthma worse;
- *Effects of Aircraft Noise and Impacts of Aircraft Overflight Noise* (48 percent of all authors for each), with most authors raising concerns about the impact on schools and students (41 percent of all authors), unspecified concern about the impacts of, or objection to, aircraft overflight noise (37 percent), and concerns about sleep disturbance (14 percent);
- *Geology, Soils and Water* (36 percent of all authors), with most authors raising an unspecified concern about, or objection to, adverse impacts on water supplies, or water pollution (18 percent and 16 percent of all authors respectively); and
- *Strategic Alternatives* (25 percent of all authors), with 11 percent of all authors supporting an alternative site outside the Sydney Basin

The next highest ranked first tier issues were transport-related; they account for 15 percent of authors (most authors expressing a concern about, or objection to an increase in road congestion), and the decision-making process, raised by 14 percent of authors (where most suggested that the EIS process and/or the Draft EIS were flawed). All remaining first tier issues attracted comment from less than 10 percent of authors.

Figure 2.2 shows those suburbs (by postcode area) with the highest proportion of submission authors in the population in that area (as at the 1996 census). *Table 2.1* shows the suburbs within those postcode areas from which submissions were received.

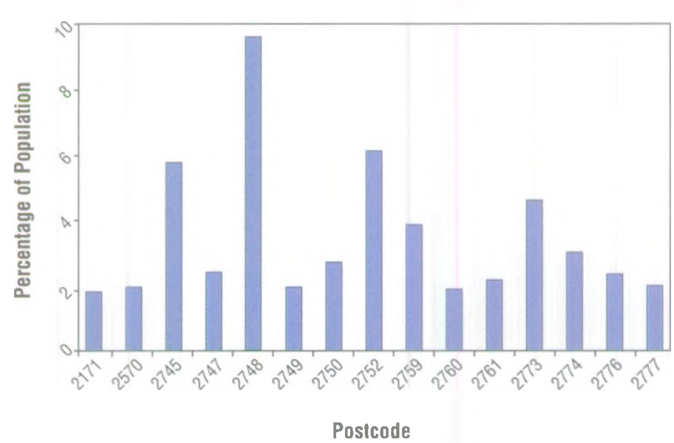


Figure 2.2

Number of Authors as a Percentage of Population - Top 15 Postcode Areas

Table 2.1 Suburbs within the Top 15 Postcode Areas from which Submissions were Received

Postcode	Suburbs within Postcode
2171	Austral, Badgerys Creek, Bringelly, Catherine Field, Cecil Hills, Cecil Park, Hoxton Park, Kemps Creek, Leppington, Pleasure Point, Rossmore, West Hoxton
2570	Bickley Vale, Cobbitty, Camden South, Ellis Lane, Elderslie, Mount Hunter, Glenmore, Orangeville, Oakdale, Theresa Park, The Oaks, Werombi
2745	Glenmore Park, Greendale, Luddenham, Mulgoa, Regentville, Wallacia
2747	Cambridge Gardens, Cambridge Park, Claremont Meadows, Kingswood, Llandilo, Werrington, Werrington County, Werrington Downs
2748	Orchard Hills
2749	Castlereagh, Cranebrook
2750	Emu Heights, Emu Plains, Jamisontown, Leonay, Penrith, Penrith South
2752	Silverdale, Warragamba
2759	Erskine Park, Mount Vernon, St Clair
2760	Colyton, Oxley Park, St Marys
2761	Dean Park, Glendenning, Hassal Grove, Oakhurst, Plumpton
2773	Glenbrook, Lapstone
2774	Blaxland, Blaxland East, Mount Riverview, Warrimoo
2776	Faulconbridge
2777	Hawkesbury Heights, Springwood, Valley Heights, Winmalee, Yellow Rock

The postcode areas registering the highest proportion of authors included suburbs which were in close proximity to the Badgerys Creek site (postcodes 2748, 2752, 2745 and 2773). It should be noted, however, that these postcode areas have relatively small populations compared with some of the others which feature in *Figure 2.2*. For example, the largest number of authors in absolute terms live in the Penrith area (postcode 2750).

Appendix A contains the full list of issues used to summarise submissions, and the number of authors who raised each issue.

2.4 Key Issues Raised in Government Submissions

2.4.1 NSW Government Submission

At the outset, the NSW Government states that it cannot support any of the airport options that have been proposed for Badgerys Creek. The covering letter for the submission from the Premier of NSW, the Hon. Bob Carr, states that "the Draft EIS, and the process of its preparation, are seriously flawed". The summary of the key concerns provided in the covering letter are that the Draft EIS:

- does not adequately integrate minimisation of environmental impacts into project planning;
- is deficient in its consideration of air quality, noise, health, flora and fauna, ground and surface water, heritage and hazards and risks impacts;

- ignores the issue of funding for off-site infrastructure;
- fails to assess the cumulative impacts of the airport and related off-site infrastructure; and
- does not provide a comprehensive analysis of the costs and benefits of the proposed airport development.

2.4.2 Local Government Submissions

Submissions were received from 31 local councils. The councils fell into four broad categories, covered below.

Western Sydney Alliance Councils

The Western Sydney Alliance consists of the councils of Baulkham Hills, Blacktown, Blue Mountains, Campbelltown, Camden, Fairfield, Holroyd, Parramatta, Penrith and Wollondilly. The Western Sydney Alliance submission made extensive comment on most aspects of the Draft EIS and expressed strong opposition to an airport at Badgerys Creek. Its overall conclusion was that the Badgerys Creek proposal is "seriously flawed in concept; and that the proposed airport would have dire consequences across a raft of social, environmental and community health issues". Many of the Western Sydney Alliance member councils made individual submissions containing additional comment in support of the joint Western Sydney Alliance submission.

Other Western Sydney Councils

The Hawkesbury City Council submission did not support the proposed airport development due to environmental concerns and the possible impact on operations at RAAF Base Richmond. The Liverpool City Council submission supported the proposed airport development on the basis that the project would result in significant economic benefit to the community. The submission noted that support is conditional, however, on a number of land use and environmental concerns being addressed.

Other Sydney Councils

These councils were: Ashfield, Botany Bay, Canterbury, Drummoyne, Hornsby, Hunters Hill, Hurstville, Ku-ring-gai, Lane Cove, Manly, Marrickville, North Sydney, Rockdale, Ryde, South Sydney, Sutherland, and Waverley.

Most councils (Ashfield, Botany Bay, Canterbury, Drummoyne, Hurstville, Ku-ring-gai, Lane Cove, Marrickville, Rockdale, Ryde, South Sydney, Waverley) in this category made submissions supporting a Badgerys Creek airport as a means of either avoiding further expansion of Sydney Airport or downgrading its role. These submissions typically criticised the Draft EIS for failing to adequately address the impacts of not constructing a Second Sydney Airport. Several councils (Hornsby, Hunters Hill, Manly) made submissions opposing Badgerys Creek in favour of alternative airport sites (including those outside the Sydney basin), including as a replacement airport for Sydney Airport. Submissions by two councils (North Sydney and Sutherland) primarily commented on the EIS process.

Councils Outside the Sydney Basin

The Goulburn and Greater Lithgow councils each made a submission supporting alternative airport sites to Badgerys Creek, namely Goulburn and Newnes Plateau respectively.

2.5 Report of the Environmental Auditor

SMEC Australia Pty Ltd was appointed by the Minister for the Environment and Heritage as the Auditor of the EIS process. The Auditor's role was to report on the appropriateness and adequacy of the data and methodologies used by the proponent and its consultants in the preparation of the EIS. On the basis of the data presented, the Auditor was also to report on the correctness or reasonableness of any assumptions made, or conclusions reached, in the Draft EIS and Supplement.

The Auditor provided its report on the Draft EIS to the Minister for the Environment and Heritage, who tabled it in Parliament in January 1998. The audit process was uniquely established for this proposal, and is not prescribed by the *Environment Protection (Impact of Proposals) Act 1974* or its Administrative Procedures. Therefore, while the report forms part of the material which has been considered in the preparation of this Supplement, it did not constitute a 'submission' under the Administrative Procedures.

The Auditor's Report covers all aspects of the Draft EIS. Its overall assessment was that the "Draft EIS generally does not go into the degree of detail that could reasonably be expected for such a major proposal". While the Auditor considered the Draft EIS 'adequate or well done' in a number of areas, the main deficiencies or concerns highlighted in the report's summary were that:

- the proposal's objectives were not clearly stated and the project definition was too broad;
- there was inadequate assessment of alternatives, in particular the environmental consequences of not proceeding with the proposal;
- more detailed flight path planning should have been undertaken;
- further work should have been undertaken to identify noise impacts and measures for ameliorating the impacts;
- better meteorological data and modelling techniques should have been used to assess air quality impacts;
- there were a number of gaps in the assessment of hazards and risks;
- further work should be undertaken on the various health impacts, such as air pollutants and ozone, and impacts on vulnerable groups;
- the assessment of planning, land use and community impacts could be improved by further work on the impact of cross-wind runways and on employment lands;
- the social assessment was very general and heavily qualified;
- further work should be undertaken on impacts on flooding, creek stability, surface water quality, rainwater tanks, the treatment of run-off and the ground water system;
- there were shortcomings of the flora and fauna analysis, including the lack of a clear assessment of the impact of construction on the Cumberland Plain Woodland, inconsistent approaches to plant and animal studies, and that further work was required on comparative assessment of the airport options, cumulative impacts and environmental management;
- while the significance of Aboriginal heritage at Badgerys Creek was low, a Cultural Heritage Management Plan should be prepared before any project approval;

- additional information on erosion potential and control, chemical properties of the soil, soil contamination, fill material and land monitoring programs was required;
- the assessment of visual impacts had some key weaknesses;
- waste and energy issues received inadequate coverage;
- further significant work was required on the range of cumulative impacts associated with the proposal and related developments;
- the economic analysis was inadequate;
- further work should be undertaken to better describe proposed mitigation and monitoring for the impacts of construction and operation of the airport; and
- while the community consultation program generally alerted large numbers of people likely to be affected by the proposal, overall the consultation did not build community confidence in the EIS process.

The Auditor's role has continued during preparation of the EIS Supplement, including assessing the scope of further work to be undertaken for this Supplement, monitoring the process used to summarise submissions, and ensuring the effectiveness with which issues raised in public comment on the Draft EIS have been taken into account in the Final EIS. The Auditor's report will be released by the Minister for the Environment and Heritage following release of this Supplement.

2.6 Approach to Responding to Issues Raised

As noted above, the summaries of submissions have been used by the Proponent to take into account in the preparation of this Supplement the comments raised in submissions.

The EIS Supplement does not provide separate responses to each issue raised in submissions. Using the summary issues list as a basis, similar issues have been aggregated to provide a more coherent and better flowing response to the issues raised. For example, the Draft EIS (and the issues list used for summarising submissions) covered aircraft noise impacts in two chapters, and health impacts of the proposed airport in several chapters. In contrast, this Supplement contains a single chapter dealing with each issue, for example, one on aircraft noise and another on health, so that issues that are alike can, under broad headings, be systematically addressed.

As noted above, the report of the Auditor formed part of the comment on the Draft EIS, but was not a submission. Responding to its comments is an important part of the purpose of this Supplement. The Supplement refers primarily to the negative comment made by the Auditor rather than to its positive comment on the Draft EIS, as it is the former which needs to be addressed. Where the Auditor raised a particular issue, this is, in general, noted in the text.

Chapter 3

The Decision-Making Process and Consultation

Chapter 3
The Decision-Making Process and Consultation

3.1 Summary of the Draft Environmental Impact Statement

The decision on whether to proceed with the Second Sydney Airport at Badgerys Creek will be made by the Commonwealth Government. Commonwealth environmental legislation requires that several steps be taken before that decision is made. Consultation, both with the community and stakeholders, is an important part of the process.

Extensive consultation was undertaken during the preparation of environmental studies for the Draft EIS. The consultation program targeted areas likely to be affected by the proposal, including suburbs surrounding the proposed airport sites at Holsworthy Military Area and Badgerys Creek. The program included identifying the interests of communities, developing appropriate information, communicating that information and consulting with the community. Ten separate information newsletters and brochures were released during this period and over 400,000 copies distributed. More than 140 advertisements were placed in metropolitan and local newspapers. In addition, this material was produced in 16 languages and over 20,000 copies of the translations distributed. Direct contact and exchanges of information with the community occurred at the Liverpool Community Access Centre, meetings, information days, displays at shopping centres, a telephone information line, the internet and by responses to written submissions.

The Draft EIS was placed on exhibition for 14 weeks. In agreement with Environment Australia, 69 exhibition locations at which the Draft EIS could be examined by the public were chosen, which included State and Territory libraries, government offices, councils and local libraries. In addition to these, the Draft EIS was also exhibited at displays set up in shopping centres, and, on request, at additional council offices and libraries. The Draft EIS was also available for reference at the Second Sydney Airport Mobile Access Centre, and for sale through the Australian Government Information Service.

A range of consultation activities was also conducted during the exhibition period. The objectives of these consultation activities were to provide information concerning the EIS process and the results of the studies, distribute summaries of the Draft EIS and other written information, answer questions and advise people on how to make submissions. In addition to provision of the Mobile Access Centre, there were briefings for local council and community group representatives, five day-long information sessions and a telephone information line operating throughout the exhibition period.

3.2 Summary of Issues Related to the Decision-Making Process

3.2.1 Issues Raised in Submissions

Compliance with Legislation and Guidelines

The environmental assessment process is administered by Environment Australia under the *Environment Protection (Impact of Proposals) Act, 1974*. It was suggested in submissions from the NSW State Government, the Western Sydney Alliance and others that the EIS process was flawed. Some submissions further suggested that the Draft EIS was deficient because the Administrative Procedures under the Act had not been followed. Other suggestions were that the EIS Guidelines were inadequate and that the Act should be updated. It was also suggested that certain issues outlined in the EIS Guidelines were either not discussed or were not discussed in adequate detail. These included the consideration of alternative airport sites and the "do nothing" option; the proposed role of the airport and how airspace management would be co-ordinated with existing airports; and adherence to the principles of ecologically sustainable development. The view was expressed that the EIS process was flawed to such an extent that unresolved issues could not be salvaged through the preparation of a Supplement.

Other submissions suggested that the Commonwealth environmental impact assessment process would not provide a reliable prediction of the impact of the proposals on the environment and communities as too many assumptions and disclaimers appeared in the Draft EIS. Reasons cited to support this view included the use of insufficient primary research, a lack of scientific data and the arrival at unsupportable conclusions.

Additional investigations and further public exhibition were called for, and in one submission, a Commission of Inquiry was requested, to ensure the production of a document on which an informed decision can be made. It was also suggested that the Department of Transport and Regional Services' response to all issues raised by the Auditor should be subject to public scrutiny before finalisation of the EIS. In some submissions it was requested that the EIS process be abandoned and that Badgerys Creek no longer be considered as a potential site for Sydney's second airport.

Scope of the Draft Environmental Impact Statement

The Royal Australian Planning Institute concluded that the scope of the Draft EIS was too broad, resulting in a document both too long and too complex for a general reader; others, contrastingly, suggested that the scope should be considered as having been too narrow. It was suggested that a specific airport option and its role should have been defined prior to detailed environmental assessment, thereby allowing studies to be more clearly focussed, and reducing the amount of technical information. Others requested that the EIS process be reopened to include all feasible and prudent alternatives to an airport at Badgerys Creek.

The Western Sydney Alliance, Communities Against an Airport in Western Sydney, The University of Western Sydney, amongst others, suggested that insufficient time and resources were provided for the preparation of the Draft EIS. Submissions stated that more recent data and superior techniques would have been more appropriate, for example, in the assessment of air quality. The suggestion was also made that impacts on a wider area should have been addressed, including an assessment of impacts on Baulkham Hills local government area, Hawkesbury local government area, the Blue Mountains, inner city suburbs and eastern Sydney. In particular, submissions from people living in the Blue Mountains indicated a feeling that they had not been considered in the Draft EIS. Submissions from others suggested that as far as they were concerned the EIS process had been a waste of time and money.

Concern was also expressed in submissions that the impacts of only 245,000 aircraft movements a year were considered in the Draft EIS despite the Commonwealth Government's proposal for an airport capable of handling 360,000 aircraft movements. The omission of detailed assessment of off-site infrastructure needed to support the airport in EIS studies was also challenged. Some comments suggested that the cumulative impacts of infrastructure, such as fuel pipelines, transport infrastructure and waste management facilities, could not be addressed without considering the environmental impacts of such facilities. The possibility was also raised that the airport itself could potentially be approved by the Commonwealth Government and off-site infrastructure needed to support the airport rejected by the NSW State Government.

Scope and Effectiveness of the Consultation

The scope and effectiveness of the consultation process have been questioned in several ways. Some organisations, such as Telstra, have specifically requested further consultation. Concern has been expressed by Communities Against an Airport in Western Sydney and Fairfield Residents Against Airport Noise, amongst other community groups, about the adequacy of consultation for people not fluent in English and by the Western Sydney Alliance and Western Sydney Regional Organisation of Councils over the adequacy of consultation with Aboriginal people. Other criticisms included the lack of consultation activities in eastern Sydney and with the Campbelltown community after the Holsworthy option was abandoned, and that although residents of Parramatta and Holroyd were provided with a schedule of consultation activities in the local media, no activities were listed for their area.

Complaints were made that staff at the access centre, mobile access centre and mobile displays were unable to answer detailed questions concerning the proposal. It was suggested that the consultation team understated impacts through the use of outdated or incorrect information. Comment was also made that residents were denied the right to be heard at public forums and that PPK representatives declined invitations to attend certain public meetings.

The difference between community consultation and community information was the subject of some comments, with the suggestion that the consultation strategy used was an attempt at providing information only, rather than receiving feedback.

The release of the Draft EIS during the week before Christmas (that is, December 1997) aroused suspicion. A number of comments suggested that further extensions to the exhibition period should have been made, because of the timing of the release of the Draft EIS.

Other Issues Related to the Decision-Making Process

A variety of other issues related to the decision-making process were also raised. These issues generally related to the Auditor's Report and the transparency of the study process.

Comments were made in submissions either supporting or critical of the audit process. Generally, those submissions expressing support for the audit process reiterated specific issues raised in the Auditor's Report, and, as outlined above, concluded that the Draft EIS was flawed. An alternative view put forward by the Royal Australian Planning Institute is that the Auditor's Report was inappropriate because it undermined rather than supported the Draft EIS, thereby causing public confusion. Some comments suggested that the audit should have taken place at key times during the study program and any deficiencies it contained addressed prior to release of the Draft EIS.

Other issues raised in submissions regarding the EIS process included: the calling into question of the independence of the study team; the vested interests of PPK; the process of the Department of Transport and Regional Service's review of information related to the Government prior to its release; and the involvement of some members of the study team in the preparation of the Sydney Airport Third Runway EIS.

The submission of the NSW Government expressed concern that the preparation of the Draft EIS should have allowed greater input to the engineering design so that any major environmental impacts could be minimised before the EIS' completion. In support of this, the submission suggested that the Second Sydney Airport Planners commenced work on the EIS before PPK, and that the airport design and planning work was completed prior to the completion of data collection and analysis of existing environmental conditions.

Concern was also expressed in submissions that the politicians responsible for the decision-making process have neither relevant qualifications nor experience, or the time to read the Draft EIS thoroughly. It was feared that the decision would be based on political rather than environmental factors. The NSW Government and the Total Environment Centre, amongst others, suggested that it was the role of the EIS to recommend a preferred airport option.

Uncertainty regarding the location of Sydney's Second Airport was an issue of concern to many people and organisations who made submissions on the Draft EIS. The view was expressed that this uncertainty should not be allowed to continue, and that a decision should be made as soon as possible.

3.2.2. Issues Raised by the Auditor

The Auditor suggested that the Draft EIS considered too many airport options, and therefore, did not provide a clear definition of the objectives of the proposal, as required by the EIS Guidelines. The inclusion and subsequent removal of the Holsworthy option was criticised on the grounds that this consumed resources that could have been spent on more detailed assessment of Badgerys Creek. The Auditor questioned the scope and methodology of several studies and investigations of issues, notably those relating to health, noise, air quality, economics and environmental management. The Auditor also stated that certain areas of work, including field studies for water quality and flora and fauna, were constrained by time and cost limits imposed by the Department of Transport and Regional Development. The absence of further field work following extension of the program for the preparation of the Draft EIS was also questioned.

The Auditor concluded that the consultation strategy failed to promote community confidence in the EIS process. It was indicated that much of the information of critical importance to the community was not made available to the community in a timely way, and that some initial information was inaccurate.

The Auditor also made some positive comments concerning the consultation process. The Auditor stated that the consultation strategy provided an excellent approach to an extremely difficult task and that it achieved its aim of alerting large numbers of those likely to be affected of the general nature of the proposal and giving them the opportunity to comment. It was also acknowledged that the major environmental issues raised by the public were identified in the Draft EIS.

3.3 Response to Issues Related to the Decision-Making Process

3.3.1 Compliance with Legislation and EIS Guidelines

Preparation of this EIS has been undertaken in accordance with the provisions of the *Environment Protection (Impact of Proposals) Act 1974* and the Administrative Procedures under the Act. Under the Commonwealth environmental assessment process there are four basic steps: the preparation of EIS Guidelines by Environment Australia following a period of public review; the preparation of a Draft EIS; public review of the Draft EIS; and the subsequent preparation of a Supplement to the Draft EIS. Making the Draft EIS available for public review and inviting written comment is part of a process of including the public in a full examination of the implications of the proposal. The *Summary of the Draft EIS* invited individuals to comment on any aspect of the proposal, to provide information, options or suggestions on the material contained in the Draft EIS, to identify errors or omissions or to suggest related facts or topics that should also be considered. During the preparation of the Draft EIS, the Department consulted with Environment Australia to ensure that the contents of the Draft EIS were acceptable in terms of the relevant procedures prior to the Department of Transport and Regional Development releasing the Draft EIS for public review.

The EIS Guidelines stated that detailed original studies were required to provide an adequate assessment of the environmental impacts of the proposal. Detailed original studies were completed for all the major issues covered by the Draft EIS including noise, air, water, hazards and risks, transport and social impacts. Previous studies investigating proposals to construct and operate an airport at Badgerys Creek were initially reviewed as background information, although the conclusions of the Draft EIS did not rely on this information.

The purpose of any environmental impact assessment is to ensure all relevant environmental matters are examined and information about the potential adverse impacts and its likely benefits associated with a proposal are put before the community and its interest groups and decision makers. It is necessary, particularly in the context of the precautionary principle of ecologically sustainable development, for any limitations to the data and assessments to be clearly stated. None of the studies conducted during preparation of the Draft EIS were affected by time constraints; nor did the inclusion and then later exclusion of the Holsworthy Military Area materially affect the assessment of the Badgerys Creek options.

Specific issues raised, either by the Auditor or in submissions regarding the adequacy of areas of environmental assessment or consideration in the Draft EIS, have been addressed in the relevant Chapters of this Supplement.

The Auditor concluded that the Draft EIS should have contained a review of basic data leading to the selection of Badgerys Creek and an assessment of whether conditions have changed since the 1985 EIS. This was not a specific requirement of the EIS guidelines, which clearly state that "*alternative site locations for Sydney's second major airport will not be addressed in detail by this environmental assessment process, having been subject of a separate 'site selection' EIS in 1985 and subsequent Government decisions*" (Department of the Environment, Sport and Territories, 1997).

It is likely that presentation of data from the 1985 EIS would have made the document overly-complex, given the amount of current environmental data that has been presented. As outlined in the Draft EIS and highlighted in the EIS Guidelines, a large number of alternatives to the proposal were available for consideration. A 'detailed study' of the environmental consequences of these alternatives, as suggested by the Auditor, was neither practical nor was it specifically requested in the EIS Guidelines. An overview of the sites previously considered was presented in the Draft EIS, along with the reasons for their rejection. Notwithstanding the above, *Chapter 5* of this Supplement provides further discussion of alternative airport sites in response to public review of the Draft EIS.

Additional investigations and environmental assessments have been carried out for this Supplement. Some of these have been undertaken as a consequence of recommendations contained in the Draft EIS that there be further investigation of, for example, air and water quality impacts. Others have been undertaken directly in response to issues raised in submissions to the Draft EIS. These additional investigations and assessments include:

- *Chapter 4 The Need for a Second Major Airport for Sydney* – revision of passenger and aircraft movement forecasts, the need for a second Sydney airport and strategic alternatives, including the 'do nothing' option;
- *Chapter 5 Alternative Sites* – further consideration of alternative sites within and outside the Sydney basin for the location of a second Sydney airport;
- *Chapter 7 Planning and Land Use* – further analysis of population and employment assumptions, review of the potential for urban development in South Creek Valley and further consideration of infrastructure requirements;
- *Chapter 8 Aircraft Overflight Noise* – further analysis of the effects of aircraft overflight noise on learning and sleep disturbance, review of noise modelling results including daily and seasonal variations, impact at night and below 20 ANEC, and review of impacts on noise sensitive land uses;
- *Chapter 9 Other Noise Impacts* – assessment of additional construction noise scenarios and consideration of ground operation and run-up noise with mitigation measures in place;
- *Chapter 11 Air Quality* – consideration of new air quality goals, vertical profile sensitivity testing, further analysis of motor vehicle emissions, and additional modelling of air quality impacts using new meteorological data;
- *Chapter 13 Water* – further analysis of groundwater, surface water and hydrological issues, further analysis of water requirements and sewage treatment options, further analysis of the potential for water supply contamination and additional consideration of environmental management;
- *Chapter 14 Flora and Fauna* – further analysis of impacts on threatened communities and species, and further consideration of cumulative impacts and environmental management;
- *Chapter 16 Hazards and Risks* – further consideration of the risks posed within the airport boundary, the transport of dangerous goods and the preparation of new risk contours to address the potential risk to sensitive facilities;
- *Chapter 17 Aboriginal Cultural Heritage* – further consultation with the Aboriginal community and additional assessment of the cumulative impacts on the Cumberland Plain Aboriginal archaeological resource;
- *Chapter 18 Non-Aboriginal Cultural Heritage* – assessment of the significance of non-Aboriginal heritage items against the Australian Heritage Commission's criteria for inclusion in the Register of the National Estate;
- *Chapter 19 Land Transport* – consideration of travel demand management, further consideration of the timing and location of rail and non-rail public transport options and construction traffic impacts;
- *Chapter 20 Aviation* – further consideration of airspace management, the way aircraft from the Second Sydney Airport, Sydney Airport and general aviation airports would operate together, restricted airspace requirements and fuel venting episodes;

- *Chapter 21 Visual and Landscape* – further consideration of visual and landscape issues and the impacts of operational lighting;
- *Chapter 22 Economic Issues* – benefit cost analysis and consideration of impacts on local, regional and national economies;
- *Chapter 23 Health* – further analysis of potential health impacts related to air quality, noise and water, including management and monitoring options and potential cumulative impacts;
- *Chapter 24 Social and Cumulative Impacts* – further analysis of the nature and extent of cumulative impacts on the communities surrounding the Second Sydney Airport; and
- *Chapter 25 Overview of Environmental Management* – further consideration of the approach to environmental management and greater detail regarding potential environmental management measures.

A glossary was not included in the Draft EIS although technical terms and abbreviations were explained in the text. A glossary is included with this Supplement.

3.3.2 Scope of the Draft Environmental Impact Statement

Level of Detail Provided in Draft EIS

One of the key objectives of an EIS under the *Environment Protection (Impact of Proposals) Act, 1974* is to ensure, to the greatest practicable extent, that matters significantly affecting the environment are fully examined and taken into account. In this regard the Draft EIS is supported by approximately 5,000 pages of detailed technical assessment contained within 15 Technical Papers. Finding the appropriate balance between too much and too little information for an audience is always difficult. For example, a specialist in a particular field is unlikely to be satisfied by the degree of detail, while a lay person is likely to find some areas of the assessment complicated.

In this regard, it is considered that the provision of substantial additional information would not necessarily assist the environmental assessment process or help the community in understanding potential impacts. It is unlikely that placement of substantial additional technical information into the document would achieve an appropriate balance between technical detail and the accessibility of that information. The need for and extent of this additional technical detail in the Draft EIS was discussed with the Auditor prior to the preparation of this Supplement. Additional investigations reported in the following chapters have been undertaken in part, to address issues raised in the Auditor's Report and the outcomes of subsequent discussions.

Definition of the Proposal

The Commonwealth Government has proposed the development of a second major airport for Sydney capable of handling up to about 30 million domestic and international passengers a year. Initially, the Commonwealth Government did not develop detailed objectives or a detailed proposal to satisfy this identified need. To further define the proposal for the purposes of environmental assessment and decision making the generalised proposal was developed and a major airport planning investigation was undertaken as part of the EIS process.

The Draft EIS assessed in detail three airport options at Badgerys Creek. It allowed the community to examine the relative merits of those options and if they desired, to make a formal submission as part of the environmental assessment process. Allowing such extensive community input was appropriate, as options were developed that were significantly different from expectations arising from the *Second Sydney Airport Site Selection Programme Draft Environmental Impact Statement and Supplement* (Kinhill Stearns, 1985a; 1985b). The community would have been unfairly excluded from the process if the number of options being considered had been further reduced.

This Supplement provides substantial additional information in response to many of the issues raised. Together, the Draft EIS and Supplement provide a comprehensive assessment of the proposal being considered.

Influence of the Definition of the Proposal on Predicted Environmental Impacts

The proposal by the Commonwealth Government is for an international and domestic airport capable of handling up to about 30 million passengers and 360,000 aircraft movements per year. Air traffic forecasts used for the Draft EIS show that about 30 million passengers could be accommodated by 245,000 aircraft movements. The environmental assessment is, therefore, based on this lower level of aircraft movements.

The Draft EIS used three air traffic forecasts and two, or three, depending on the airport option, airport operation scenarios to allow an assessment to be made of the potential range of impacts that could result from the airport's operation. It is likely that an approach focusing on either a single or a small number of options, as suggested by the Auditor, would have led to an understatement of potential impacts; such an approach would have suggested a level of precision in the assessment that does not in practice exist. The operation and role of the airport would, in fact, depend on a number of factors, including Government policy (which is subject to alteration or modification with a change of Government); the ramifications of the operational decisions of the airport operator; changed airspace management arrangements; the commercial responses of major users; and environmental issues.

There would also be many other influences and factors, including: the results of increasing environmental awareness in the community; changing technology; and assessment of the commercial viability of services.

In its adoption of conservative assumptions for the impact assessment methodologies the resulting range of impacts presented in the Draft EIS allowed the community to be informed of probable worst-case environmental impacts. Further noise analysis of single, more refined operating scenarios for each airport option is contained in *Chapter 8* of this Supplement. This analysis provides an example of the noise impacts that might result from a situation involving one potential noise management approach; that is, modifying flight paths to minimise the population exposed to aircraft overflight noise. It is, however, appropriate that the decision on whether or not to proceed with the proposal is made on the conservative assessment adopted in the EIS, which addresses the range of likely operating scenarios.

Inclusion of Holsworthy Military Area

In May 1996, the Commonwealth Government decided to broaden the scope of the environmental assessment process already underway for the Second Sydney Airport to include the Holsworthy Military Area as an alternative site to Badgerys Creek. While Badgerys Creek remained the preferred site, the Government indicated that the Holsworthy site warranted detailed examination as it has major advantages in terms of its proximity to the Sydney CBD, its accessibility to road and rail, its size and its Commonwealth ownership (Minister for Transport and Regional Development, 1996). Following the substantial completion of the environmental assessment of the potential use of Holsworthy Military Area as a site for the Second Sydney Airport, the Government decided to eliminate the Holsworthy site from further consideration. The reasons for this decision related to the scale of adverse environmental impacts that would result from the development of the Holsworthy site compared with those associated with the potential development of Badgerys Creek. These reasons are explained in Section 6.4 of the Draft EIS and other published documents (refer PPK Environment & Infrastructure, 1997, and Technical Papers).

A thorough understanding of the unsuitability of the Holsworthy Military Area was not achieved until after substantial investigation had been carried out. However, these investigations did not divert resources from the analysis of the Badgerys Creek options. Furthermore, excluding the Holsworthy Military Area from the outset would not have reduced the range of airport options and operating scenarios for Badgerys Creek which were examined in the Draft EIS.

In response to the Auditor's conclusion that timing and cost constraints were a major impediment to the conduct of the Draft EIS, while conceding that such constraints exist with all project development and assessment processes, such constraints did not significantly influence the scope of work for the Draft EIS. Further studies have been undertaken for this Supplement where that work is technically achievable and adds to the understanding of the potential impacts of the proposal.

Assessment of Health Issues

There was not a separate chapter dealing specifically with health issues in the Draft EIS. Health issues were considered within the air quality and noise chapters, and covered in more detail in the Technical Papers relating to air quality and noise. In response to issues raised in submissions, health issues have now been assessed in more detail and are included in *Chapter 23* of this Supplement. There are also separate chapters in this Supplement dealing in greater detail with social and cumulative impacts, aviation, water, economics and environmental management.

Adequacy of Study Areas

Some submissions suggested that the environmental impact assessment should have examined a wider study area. Many studies within the Draft EIS, however, do contain such a regional analysis. Chapter 15 of the Draft EIS, for example, included an analysis of the impact of the proposal on the entire Sydney basin. The noise study defined an area of investigation which was described in the Draft EIS. While this area of investigation did not include the whole of Sydney, it should be noted that its scope did extend to relatively low levels of noise impacts (equivalent to negative ANEC values) and areas that would receive no aircraft movements generating noise above 70 dBA. Extending the area of the noise analysis would not have provided useful information for the reader of the Draft EIS and would have suggested an unrealistic level of accuracy for the noise modelling.

Need for Further Consideration of Off-site Infrastructure Issues

Detailed assessment of the impacts of the developments of off-site infrastructure needed to support the airport was not required by the EIS Guidelines. The Commonwealth Government is not likely to be the proponent for this infrastructure; each piece of infrastructure would be subject to detailed design and environmental assessment. The planning and assessment of such infrastructure is more appropriately carried out within the framework of strategic metropolitan planning and environmental impact legislation established in New South Wales. A preliminary assessment of the environmental impacts of this off-site infrastructure was included in Chapters 10 and 27 of the Draft EIS. Further consideration of the cumulative impacts of this infrastructure is presented in *Chapter 24* of this Supplement.

3.3.3 Scope and Effectiveness of the Consultation

As outlined in the introduction to this Chapter, an extensive strategy of community consultation was conducted during preparation of the Draft EIS, commencing in October 1996. The consultation strategy is probably one of the most extensive ever undertaken in Australia for an environmental impact assessment of a major infrastructure proposal. Attention was focussed on those areas of western Sydney which were likely to be directly affected by the impacts of an airport, including suburbs surrounding the proposed airport sites at Holsworthy Military Area and Badgerys Creek. This involved a target audience of approximately 1.8 million people.

Table 3.1 presents the consultation material released for the purpose of disseminating information about the Second Sydney Airport proposal during preparation of the Draft EIS.

Table 3.1 Consultation Material Released During Preparation of the Draft EIS

Title of Material	Date Released	Quantity Produced for Distribution[1]
Second Sydney Airport Proposal Brochure	November 1996	200,000
Fact Sheet 1: EIS Process	December 1996	10,000
Fact Sheet 2: EIS Study Team	December 1996	15,000
Air Traffic Forecasts for Sydney	February 1997	25,000
Information Update 1: Preliminary Airport Masterplans	March 1997	37,000
Second Sydney Airport EIS Brochure	March 1997	38,000
Multi-Lingual Fact Sheets 1 to 16	March 1997	20,000
Information Update 2: Road and Rail Access to the Airport Sites	April 1997	35,000
Information Update 3: Assessing the Impact of Noise	April 1997	38,000
Preliminary Flight Paths	May 1997	22,000
Summary of Draft EIS (Badgerys Creek)	December 1997	100,000
Draft EIS	December 1997	1,500

Note: 1. A small proportion of the quantity produced for distribution was retained to meet specific requests for information and material received, for example, over the telephone information line.

During preparation of the Draft EIS, between October 1996 and September 1997 approximately 1,450 submissions were received. In addition, during this same period PPK study team members attended 93 meetings involving either presentations to community groups, councils or attendance at information days or mobile displays set up in shopping centres. Attendance at approximately 15 meetings was declined by the EIS study team either due to scheduling difficulties with already arranged meetings or the heavy involvement of the team in the community information program. In addition, in January 1997, PPK and the Department of Transport and Regional Development attended a meeting with Australia's major air carriers, Qantas and Ansett. From August 1997, PPK deferred attendance at any further meetings until such time as the Draft EIS was placed on exhibition for public review to enable completion of the documentation.

In addition to the distribution of Fact Sheets in 16 languages (Macedonian, Lao, Italian, Vietnamese, Serbian, Greek, Spanish, Croatian, Pilipino, Chinese, Arabic, Cambodian, Polish, Maltese, Tongan and Samoan), general information regarding the EIS, the master plans, advertisements, information days and, finally, the date of release of the Draft EIS were placed in community newspapers directed towards persons from non-English speaking backgrounds. This strategy was further supplemented by the dissemination of information through 15 ethnic community radio stations, eight television stations and utilisation of the NSW Government's Interpreter Service when necessary.

A total of 58 individuals from various statutory and Government authorities, museums and Local Aboriginal Land Councils and Aboriginal organisations were consulted in the preparation of the Aboriginal cultural heritage assessment. In response to concerns that the consultation with Aboriginal communities was not sufficiently extensive, additional consultation has been undertaken for this Supplement as described in *Chapter 17*.

While it is understandable that members of the community would become frustrated that staff performing consultation duties might be unable to answer specific detailed questions, it would be unreasonable to expect that any individual could answer detailed questions concerning all aspects of the proposal. Every effort was made to ensure that consultation staff were fully informed regarding the scope and nature of the investigations being undertaken in preparation of the Draft EIS and the most up-to-date information was available. Errors and inaccuracies regarding any of the material released were corrected as soon as practicable.

The exhibition period was extended beyond the minimum period required in recognition of the complexity of the issues and the likely concerns over the timing of the release of the Draft EIS. The Draft EIS was released on 21 December 1997. The minimum period for exhibition of a Draft EIS under the *Environment Protection (Impact of Proposals) Act, 1974* is 28 days. The Minister for the Environment determined that the Draft EIS be exhibited for a period of 14 weeks or 98 days.

3.3.4 Other Issues Related to the Decision-Making Process

In November 1996, an Environmental Auditor was appointed by Environment Australia for the purpose of auditing the EIS process. The scope of the audit and the audit process itself were determined by Environment Australia and the Auditor.

The Auditor was given access to PPK's technical files, with the exception of a small number of files containing confidential management and commercial information. All written requests for information from the Department of Transport and Regional Development were met. Neither the Auditor nor PPK were granted access to "Cabinet–in–Confidence" documents associated with the decision-making process. These are not normally released. A review of Cabinet decisions in respect of Holsworthy Military Area or Badgerys Creek were not within the scope of either the EIS or audit processes.

PPK Environment & Infrastructure Pty Ltd does not have a vested interest in a proposal for a Second Sydney Airport at Badgerys Creek. Only two members of the study team, Professor Richard de Neufville and Robert Hyde were involved in the preparation of the EIS for the proposed Third Runway at Sydney Airport. Professor

Richard de Neufville of the Massachusetts Institute of Technology was engaged for the Draft EIS to review work he undertook during preparation of the Third Runway EIS regarding the operation of multi-airport systems. Robert Hyde, a meteorologist from Macquarie University, was engaged to prepare meteorological studies.

The three airport Stage 1 and master plan options assessed in the Draft EIS were based on a preliminary level of investigation and design. Detailed design, having regard to environmental management measures presented in the Draft EIS or this Supplement, would not be commenced until after a decision has been made by the Commonwealth Government to proceed with a Second Sydney Airport. During preparation of the Draft EIS, regular meetings of the EIS team were held which included members of the Second Sydney Airport Planners and PPK staff. The purpose of these meetings was to ensure communication and feedback between the airport planning and design work and environmental assessments. The appointment of PPK approximately one month after the Second Sydney Airport Planners did not constrain the ability of PPK to provide feedback and input to the airport design process.

Under the *Environment Protection (Impact and Proposals) Act 1974*, the decision whether or not to proceed with a Second Sydney Airport rests with the Minister for Transport and Regional Services, after taking into consideration comments, suggestions or recommendations made by the Minister for the Environment and Heritage considered necessary for the protection of the environment. This EIS Supplement is an important step in the process of reaching that decision.

3.4 Overview of the Decision-Making and Consultation Process

In May 1996, the Commonwealth Government announced the proposal to consider the construction and operation of a second major airport for Sydney at either Badgerys Creek or Holsworthy Military Area. Following environmental assessment of these two sites, the Government decided to eliminate the Holsworthy Military Area option. Badgerys Creek was the Government's preferred option at the commencement of the environmental assessment process and proved to be a significantly superior site. The Draft EIS for a Second Sydney Airport at Badgerys Creek was completed and placed on public exhibition in December 1997.

During the preparation of the Draft EIS, a wide range of inputs was sought from a variety of sources. These included a consortium of companies retained by the Commonwealth Department of Transport and Regional Development and referred to as the Second Sydney Airport Planners. The airport planning and design information developed by the Second Sydney Airport Planners was used by PPK to assist the assessment of potential environmental impacts.

The Commonwealth Government supplemented the standard EIS process by adopting several of the findings of the Senate Select Committee on Aircraft Noise in Sydney (1995). The Committee's recommendations included the need for extensive consultation and a transparent and independent audit of the EIS process. An extensive community consultation strategy was implemented. An Environmental Auditor was commissioned to prepare a report on the Draft EIS and this report was released in January 1998. A second audit report will review the adequacy of the Final EIS and will also be available to the public.

Environment Australia will prepare an environmental assessment report to be submitted to the Minister for the Environment and Heritage. The Minister for the

Environment and Heritage will then provide recommendations to the Minister for Transport and Regional Services. Finally, the Commonwealth Government will consider the proposal and make a decision.

The EIS is the central, but not the only, part of the environmental impact assessment process that seeks to ensure all relevant environmental matters are examined and that all interested organisations and individuals are involved. The EIS provides objective information about the proposal and its potential impacts to decision makers, other relevant authorities, interest groups and the community. Data in the EIS may also provide a baseline for monitoring the environmental performance of the airport development in the future if it proceeds.

The EIS is, therefore, a tool to assist the decision-making process, but does not make a decision itself. Its purpose is to ensure that the Minister for Transport and Regional Services will make a decision with full knowledge of both the potentially adverse and beneficial impacts of the proposal.

PART B

Project Need and Alternatives

Chapter 4

The Need for a Second Major Airport for Sydney

Chapter 4
The Need for a Second Major Airport for Sydney

4.1 Summary of the Draft Environmental Impact Statement

4.1.1 Historical Perspective of Aviation in Sydney

The background to some of the developments that have influenced and will continue to influence decisions on the Second Sydney Airport was outlined in Chapter 4 of the Draft EIS. Providing capacity for Sydney's airport needs has been the subject of considerable attention for a long time and a number of major studies have been undertaken. The *Second Sydney Airport Site Selection Programme Draft Environmental Impact Statement and Supplement* (Kinhill Stearns, 1985a; 1985b) led to the selection of Badgerys Creek as the site for the second airport in February 1986. Since then, aviation demand in the Sydney basin has grown strongly, with the traffic being accommodated by progressive development of Sydney Airport. A discussion of the existing role of general aviation and military airports in the Sydney region was also included in Chapter 4 of the Draft EIS.

4.1.2 Future Passenger and Aircraft Movements

Chapter 5 of the Draft EIS described historical passenger and aircraft movements within the Sydney basin and forecast future growth patterns for the domestic and international sectors. Growth forecasts were also included for air freight as well as non-scheduled aircraft movements.

4.1.3 Strategic Alternatives

The strategic alternatives for providing increased airport capacity in the Sydney basin were reviewed in Chapter 6 of the Draft EIS. Alternative sites both within and outside the Sydney basin were discussed, as was the option of building an airport offshore from Sydney. The planned capacity of Sydney Airport, recent operational and environmental management initiatives, and the potential to expand the airport's capacity to meet the long-term demand, were also considered. The capacity of other Sydney airports, as well as that of other major airports in Australia, was also discussed. Also included was a description of alternative airport systems overseas, and the consequences of not developing a second major airport for Sydney.

4.2 Summary of Issues Related to the Need for a Second Sydney Airport

4.2.1 Issues Raised in Submissions

Passenger and Aircraft Movement Forecasts

The magnitude and reliability of the passenger and aircraft movement forecasts were questioned in submissions on the Draft EIS. Although a range of views were expressed – some considered them to be too high, others too low - the general thrust of the majority of comments on this issue was that not all factors affecting future air traffic levels had been taken into account, leading to the forecasts being higher than they would otherwise have been. Factors identified in submissions included an anticipated worldwide shortage of aviation fuel, the recent Asian economic downturn, and the deregulation of the New South Wales intra-state aviation market. It was also suggested in submissions that the origin and destination of passengers and freight in western Sydney would influence the forecasts, and that this should be the subject of more study.

Overall Need for a Second Airport

There were comments in submissions disputing the need for a second airport, it was argued that there was a lack of factual data to support the case for a new airport. Other submissions presented the opposite case and supported the need for the second airport. Submissions also included comments that the objectives of the proposal had not been clearly stated, and that the principles of ecologically sustainable development had not been addressed. Comments were also made that the environmental consequences of doing nothing had not been addressed, particularly the resultant impacts on Sydney Airport.

Strategic Alternatives

Comments in submissions raised a broad spectrum of issues on this element of the Draft EIS. The general thrust of the comments was that the consideration of alternatives was inadequate and that further details should be provided on this aspect.

The 'do nothing' option was one alternative that was raised in submissions, with views both for and against this option. However, the concept of 'do nothing' was interpreted in different ways. Some submissions adopted the literal interpretation of 'do nothing' as meaning 'taking no action' while others considered it to involve the further expansion of Sydney Airport (and possibly Bankstown Airport) in lieu of developing a second airport. There was both support for and opposition to increasing the capacity of Sydney Airport. Particular suggestions for increasing the capacity of Sydney Airport included the use of the slot system to manage capacity and alterations to the *Long Term Operating Plan for Sydney (Kingsford Smith) Airport and Associated Airspace* (Airservices Australia, 1996), which is used to manage the noise from aircraft using the airport. There were also suggestions that air traffic should be diverted from Sydney to other major airports and that market forces should determine the balance between airport capacity and demand.

The other main category of potential alternatives raised in submissions was alternative airport sites, both within and outside the Sydney basin. This included existing airports serving other functions or cities, new greenfield sites, as well as an offshore location. Potential alternative sites for the Second Sydney Airport are addressed in *Chapter 5* of this Supplement.

The development of a very high speed train, in conjunction with the development of a second airport at an outlying site, was an alternative suggested in submissions (this is also addressed in *Chapter 5* of this Supplement). The impact of a very high speed train network without a second airport was also raised.

4.2.2 Issues Raised by the Auditor

The Auditor's assessment of Chapters 4 to 7 of the Draft EIS, which dealt with the need for a second major airport for Sydney, was that the requirements of the EIS

Guidelines had generally been met, with three exceptions. These were that the objectives of the proposal were not clearly stated, the environmental consequences of doing nothing were not addressed (particularly the resultant impacts on Sydney Airport), and the principles of ecologically sustainable development had not been addressed. (This last issue is addressed in *Chapter 25* of this Supplement.)

4.3 Review of Passenger and Aircraft Movement Forecasts and the Need for a Second Airport

4.3.1 Latest Passenger and Aircraft Movement Statistics

In responding to the range of comments in submissions on the issue of passenger and aircraft movement forecasts, it is appropriate firstly to examine the latest statistics in this area. Section 5.3 of the Draft EIS details the historical growth in passenger and aircraft movements at Sydney Airport for the period 1965-66 to 1995-96. A 'passenger movement' is defined as the arrival at or departure from Sydney Airport of a passenger. International passengers transiting through Sydney Airport are not included in the passenger movement statistics.

Statistical data for 1996-97 and 1997-98 are now available. *Figure 4.1* shows the increase in passenger movements for the period. Total passenger movements at Sydney Airport have increased from 20.3 million in 1995-96 (the latest data in the Draft EIS) to 21.3 million in 1997-98 (7.2 million international and 14.1 million domestic and regional passengers).

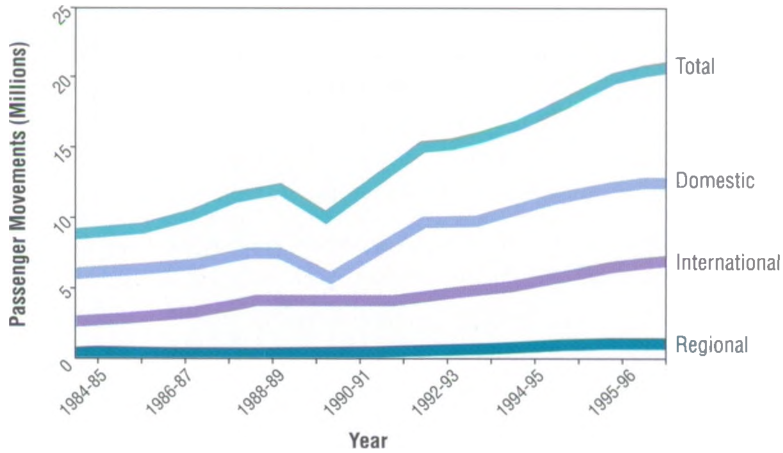


Figure 4.1
Total Passenger Movements at Sydney Airport from 1984-85 to 1997-98
Source: Department of Transport & Regional Services, 1998

The growth in passenger movements at Sydney Airport also translates into an increase in the number of aircraft movements. However, the average size of commercial aircraft using Sydney Airport has increased over recent years. This, along with the increasing sophistication of airline yield management techniques, which ensures that aircraft fly with a minimum of empty seats, has meant that the rate of increase in aircraft movements has been slower than the rate of increase in passenger movements.

Figure 4.2 shows the number of aircraft movements through Sydney Airport for the period 1984-85 to 1997-98. Total scheduled aircraft movements have increased from 244,500 in 1995-96 (the latest data in the Draft EIS) to 248,000 in 1997-98 (45,800 international and 202,200 domestic/regional movements). Non-scheduled aircraft movements (including freighters) have increased to 28,300 in 1997-98, bringing the total aircraft movements at Sydney Airport in 1997-98 to 276,300.

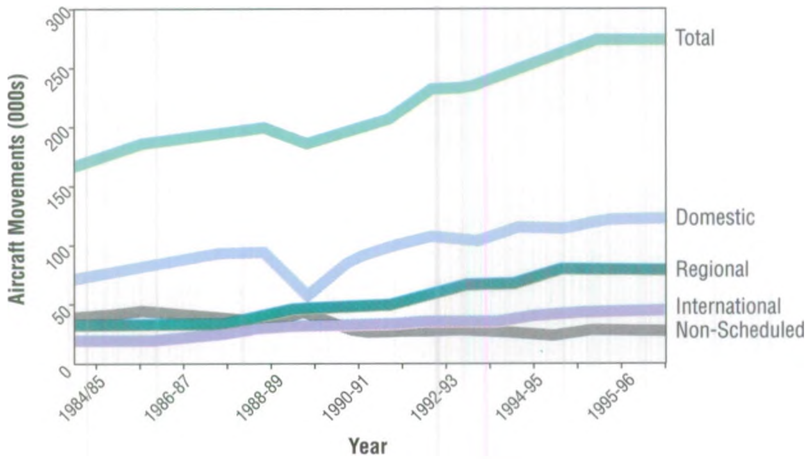


Figure 4.2
Total Aircraft Movements at Sydney Airport from 1984-85 to 1997-98
Source: Department of Transport & Regional Services, 1998

4.3.2 Review of Background Assumptions and Projections

Comments in submissions questioned the factors that affected the air traffic forecasts. Several important factors and inputs have been considered in formulating the demand outlook for air travel to the Sydney region, including:

- the economic growth outlook for Australia and various markets in the Asia-Pacific region;
- tourism outlook forecasts;
- aircraft size, fleet mix and load factor trends;
- population and demographic forecasts developed for the Sydney and NSW regions;
- effects of the 2000 Olympics;
- forecasts undertaken by the International Air Transport Association, Boeing and Airbus; and
- trends in the price of air travel (average yield trends).

Of the various factors affecting the long-term underlying demand for air travel, the most significant are economic growth and the price of travel. These factors are used in econometric modelling to estimate long-term trends in air travel demand.

It should be noted that actual future air traffic growth will exhibit variations from an underlying forecast base line trend due to business and economic cycles. There are also unexpected events such as the impact of the current Asian economic downturn.

Since the release of the Draft EIS, there have been major changes in the economic environment of the Asia-Pacific region. These changes have already had a negative influence on international traffic to and from Australia and there is evidence of some softening of the Australian domestic aviation market.

The changes also have a bearing on the outlook for international and domestic air traffic operating to and within Australia. The overall impact will depend on the severity of the economic changes in the Asia-Pacific region, and the extent and pace of any recovery. The emergence of new markets could partially offset the impact of softening in Asia-Pacific demand.

Comments in submissions suggested that forecasts would be influenced by the degree to which passengers and freight might originate or terminate in western Sydney. The origin and destination of passengers and freight in Sydney is not relevant to the preparation of forecasts for the Sydney basin as these do not distinguish between different parts of Sydney. The origin and destination of potential air passengers and freight would be a factor in the actual demand at a second airport. However, this would be only one of many factors such as the role of the airport. This was addressed in the scenarios prepared for the environmental assessment of the proposal.

4.3.3 Revised Forecasts

The magnitude of the passenger and aircraft movement forecasts for the Sydney basin was the subject of comment in submissions. In response to the changed economic climate in the region, the Department of Transport and Regional Services revised, in July 1998, its projections of international, domestic, regional and non-scheduled passenger and aircraft movements to the year 2021-22. This review drew on a range of inputs from organisations such as the major Australian airlines, the Federal Airports Corporation, Airservices Australia, Tourism Forecasting Council, Bureau of Tourism Research and the Bureau of Transport Economics.

This section provides revised forecasts of annual passenger and aircraft movements in the Sydney basin over the period from 1997-98 to 2021-22. For the purposes of this analysis, Sydney basin traffic is taken as passenger and aircraft movement traffic which would be expected to be accommodated at either Sydney Airport or the proposed Second Sydney Airport. Traffic that would be accommodated at secondary airports such as Bankstown is not included in this analysis.

Figure 4.3 shows central, high and low case forecasts for total passenger movements into and out of the Sydney basin, for the period to 2021-22. Total passenger movements (excluding international transits) at Sydney are expected to grow at an average rate of 4.0 percent per year to 1999-2000, then at 4.2 percent per year to 2009-10 and 2.8 percent per year from 2009-10 to 2021-22. This would result in an increase of total passenger movements from 21.3 million in 1997-98 to 23.2 million in 1999-2000, 35.1 million in 2009-10 and 49.1 million in 2021-22.

Figure 4.4 shows central, high and low case forecasts for total aircraft movements into and out of the Sydney basin for the period to 2021-22. Total aircraft movements are expected to grow at an average rate of 2.6 percent per year to 1999-2000, then at 2.7 percent per year to 2009-10 and 1.9 percent per year from 2009-10 to 2021-22. This would result in an increase in total aircraft movements from 276,300 in 1997-98 to 291,000 in 1999-2000, 350,000 in 2006-07, 380,000 in 2009-10 and 480,000 in 2021-22.

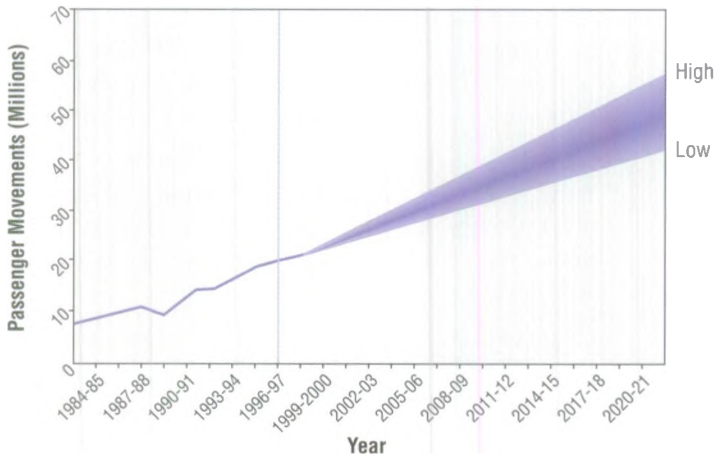


Figure 4.3

Forecasts of Total Passenger Movements for the Sydney Basin to the Year 2021-22

Source: Department of Transport & Regional Services, 1998

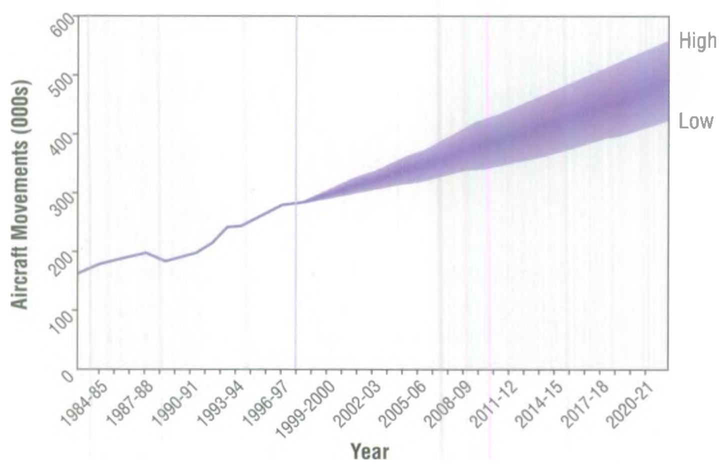


Figure 4.4

Forecasts of Total Aircraft Movements for the Sydney Basin to the Year 2021-22

Source: Department of Transport & Regional Services, 1998

4.3.4 Implications of Revised Forecasts

Implications for Environmental Assessment Methodology

Table 4 1 provides a comparison between the central forecasts for passengers and aircraft movements contained in the Draft EIS, and the revised Sydney basin forecasts discussed above.

Table 4.1 Comparison between the 'Central' Forecasts of Aviation Activity in the Sydney Basin in the Draft EIS and the Supplement

	1999-2000	2009-10	2021-22
Passengers (millions)			
Draft EIS	25.8	40.4	58.2
Revised forecasts	23.2	35.1	49.1
Total Aircraft Movements (thousands)			
Draft EIS	316	426	537
Revised forecasts	291	381	480

Chapter 7 of the Draft EIS identified the need to develop assessment scenarios for the Second Sydney Airport. This included forecasts of air traffic at the Second Sydney Airport, including its growth and changing make-up over time (international, domestic and general aviation). Defining traffic forecasts for the Second Sydney Airport required splitting the Sydney basin air traffic forecast between Sydney Airport and the second airport. Three air traffic forecasts were developed with *Air Traffic Forecast 3* assuming a rapid development of the Second Sydney Airport to approximately 30 million passengers by 2016. The lower revised forecast outlined in *Section 4.3.3* of this Supplement would extend the time it would take for the Second Sydney Airport to reach such an operating level. The revised air traffic forecast, however, does not necessitate a revision of the assessment scenarios used in the Draft EIS as the impacts reported rely on a conservative worst-case assumption of rapid development of the Second Sydney Airport to its proposed capacity of 30 million passengers a year. This precautionary approach to the assessment is considered appropriate notwithstanding the revised air traffic forecast, which suggests that slower development of the airport is more likely.

Implications for Overall Need for a Second Sydney Airport

It is clear that the objective of the Second Sydney Airport proposal is to provide additional airport capacity in the Sydney region to help meet the forecast growth in passengers and aircraft movements. Although the overall Sydney basin forecasts have been adjusted downwards, the forecast growth in air traffic over the coming decades is still substantial. The revised forecasts would not obviate the need for additional major airport facilities for the Sydney basin in the latter part of the next decade, even though they may have implications for the staging of the development of that infrastructure.

As noted in *Section 4.3.2* of this Supplement, the currency of the revised forecasts will depend on the extent and pace of recovery in the Asia Pacific region and the emergence of new markets: each with the potential to increase demand. This, coupled with the long lead times involved in building additional airport infrastructure, further underlines the need to plan for additional airport infrastructure in line with the forecast increase in Sydney basin demand.

4.4 Review of Strategic Alternatives

As well as suggesting alternative sites for the Second Sydney Airport, both within and outside the Sydney basin (this issue is addressed in *Chapter 5* of this Supplement), submissions made comments on a number of other strategic alternatives for handling the forecast growth in aviation demand. The strategic alternatives to the development of a second major airport for Sydney include:

- the 'do nothing' option; that is, allowing the capacity of Sydney Airport to expand under current operational and broad policy settings;
- expanded use of Bankstown Airport;
- major expansion of Sydney Airport;
- transferring traffic to other capital city airports; and
- the development of an extensive, very high speed train network.

These possibilities are discussed in the following sections.

4.4.1 The 'Do Nothing' Option

Submissions which raise alternatives to developing a Second Sydney Airport define the 'do nothing' option in a wide range of ways. The range of alternatives canvassed in submissions mirrors the difficulty which the Draft EIS expressed in defining the 'do nothing' option.

Defining a 'do nothing' option as it relates to Sydney Airport has become somewhat clearer since the preparation of the Draft EIS, because the operating environment for Sydney Airport is now more settled.

The main elements of the operating environment at Sydney Airport are:

- the application of a curfew between the hours of 11.00 pm and 6.00 am;
- the implementation of a slot management system, with the hourly aircraft movement rate capped at 80, and provisions for continued availability of slots for regional airlines;
- the implementation of *The Long Term Operating Plan for Sydney (Kingsford Smith) Airport and Associated Airspace* (Airservices Australia, 1996), which is designed to reduce and share aircraft noise, while maintaining appropriate safety levels; and
- the extent to which Sydney Airports Corporation Limited (the successor to the Federal Airports Corporation as the operator of Sydney Airport) can develop airport facilities to meet projected demand under existing environmental approvals and consistent with the existing airport layout.

The Slot Management Scheme for Sydney Airport, which is enshrined in the *Sydney Airport Demand Management Act 1997*, limits airport capacity to 80 movements per hour. The scheme came into effect for the scheduling season beginning 29 March 1998. The scheme is delivering for Sydney Airport:

- less clustering of flights in airline schedules;
- greater predictability thereby promoting investment;
- fewer delays, and, as a consequence, fewer delays at other airports;
- reduced time spent by Airservices Australia rescheduling airlines, thereby increasing resources available for core responsibilities;
- guaranteed access for NSW regional communities; and
- less fuel waste leading to savings in costs and reduced emissions.

The *Long Term Operating Plan for Sydney (Kingsford Smith) Airport and Associated Airspace* (Airservices Australia, 1996) is the program that has been introduced to address Sydney Airport's noise problems by redistributing aircraft noise. This reduces the concentration of noise which resulted from operating Sydney Airport almost exclusively in a parallel runway mode in the period late 1994 to mid-1996.

The Plan was drawn up through a major consultative process during 1996 and 1997. The Plan is designed to ensure that aircraft movements are maximised over water and non-residential land. Where overflight of residential areas cannot be avoided, the noise is shared between communities.

Under the Plan, aircraft departing from Sydney Airport to the south continue to pass either through the Botany Bay Heads or over the Kurnell Sandhills and thus avoid flying over residential areas. Departure flight paths from the other runways have been spread to reduce the concentration of noise over a small number of populated areas that existed under the previous arrangements.

A key feature of the Plan is the runway rotation system. This system involves different runways being used at different times of the day, to provide, where possible, individual areas with periods of respite from aircraft noise.

Calculating the future capacity of a major airport such as Sydney requires judgements about the capacity of the infrastructure (such as runways, terminals and transport access), the capacity of the airspace management system, the commercial decisions of major users and the effect of measures to mitigate environmental impacts. The complex interaction of these elements and their potential to change over time underline the difficulty of defining the capacity of Sydney Airport if a Second Sydney Airport were not built.

Two capacity scenarios for Sydney Airport are presented for illustrative purposes. Both scenarios are based on the assumption that the future capacity of Sydney Airport will be determined by the number of aircraft that can be handled in peak hours, rather than by the number of passengers which can be processed. The aircraft handling limit is set by the number of slots allocated per hour, which is set by legislation at 80. The differences between the scenarios, therefore, reflect different assumptions about the types and loadings of aircraft using Sydney Airport. Both scenarios are broadly consistent with the current operating environment at Sydney Airport. They are:

- *Sydney Airport Capacity Scenario 1*, which assumes that current trends in aircraft size and loading apply, and that the percentage of slots allocated to regional, domestic, and international aircraft remains unchanged; and
- *Sydney Airport Capacity Scenario 2*, which assumes that there would be a significant consolidation of regional and domestic services over time. It is assumed that, in the longer term, every three forecast regional aircraft movements would be consolidated into two movements without impacting on the number of regional passenger movements. This would result in an increase in the average aircraft size.

These capacity scenarios for Sydney Airport are shown in *Figure 4.5*. The capacity limit for both scenarios is 380 movements over the five hour morning peak period from 6 am to 11 am (60 movements in the first hour and 80 movements in each of the subsequent four hours).

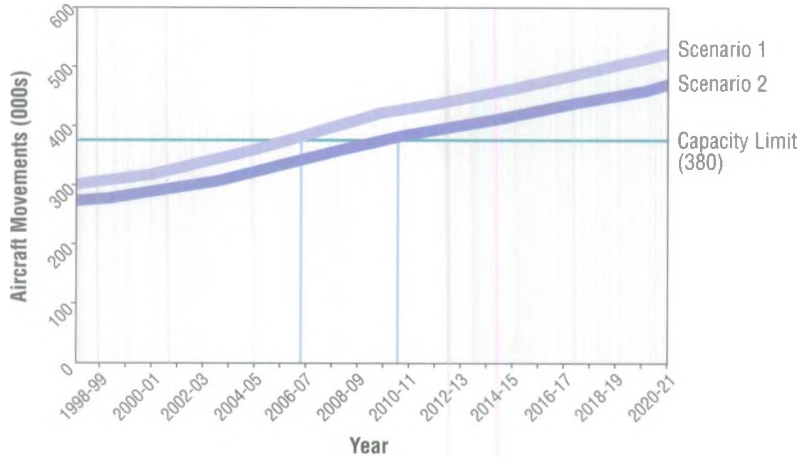


Figure 4.5
Aircraft Movements at Sydney Airport During the Morning Peak Period (6 am to 11 pm)
Source: Department of Transport & Regional Services, 1998

It can be seen from *Figure 4.5* that, under *Sydney Airport Capacity Scenario 1*, capacity in the morning peak at Sydney Airport would be reached in 2006-07, when demand in the Sydney basin is forecast to be 350,000 aircraft movements per year (31.3 million passengers, excluding international transits). Under *Sydney Airport Capacity Scenario 2*, capacity would be reached in 2010-11, when demand in the Sydney basin is forecast to be 36.1 million passengers (excluding international transits).

Sydney Airport Capacity Scenario 2 illustrates the fact that the number of passengers using Sydney Airport could be increased by changing the average size of aircraft flying there. As capacity becomes more constrained in the Sydney basin in the absence of a second airport, airlines operating into Sydney Airport can be expected to increase passenger throughput by a range of means, including improving the load factors of aircraft and increasing the average size of aircraft.

The increase in passengers at Sydney Airport within given maximum traffic levels will have a number of consequences for the Airport's operating environment. Perhaps most importantly, increased passenger numbers will run up against the major physical constraints of Sydney Airport. These include the need for additional terminal space, eventually in new precincts on the current site, and significant upgrading of road access to the airport. As only limited development can occur on and around the current airport site, the cost of such developments would be expected to grow significantly over time. Ground congestion would also feature more highly, with consequent costs to passengers and airlines.

Major environmental considerations (particularly for *Sydney Airport Capacity Scenario 2*) are likely to include the noise impacts of larger aircraft and air quality and noise impacts of an increase in road traffic to Sydney Airport. Gauging the noise impacts of larger average aircraft at Sydney Airport is not straightforward, mainly because such aircraft could prompt different operational practices at the airport. For example, turbo prop and jet aircraft could be expected to use different flight paths, which may require changes to operating modes. Changes to the aircraft using Sydney Airport will raise other air traffic management issues, although an increase in the average size of aircraft may simplify some aspects of traffic handling, such as aircraft separation.

Sydney Airport Capacity Scenarios 1 and 2 represent only two of the possible outcomes for the future capacity of Sydney Airport. A further possible scenario is that environmental pressures associated with the operation of Sydney Airport lead to a lower level of traffic movements than that suggested by, say, *Sydney Airport Capacity Scenario 1*. For example, the capacity of Sydney Airport may be further constrained by more stringent noise management practices, or by a failure to obtain necessary environmental approvals to expand ground infrastructure to cope with an increase in passengers beyond its current level of development. On the other hand, it might be possible to increase the capacity of Sydney Airport through action by the airlines to use larger aircraft, increase load factors and reduce the number of passengers that transit through Sydney.

4.4.2 Potential for Expanded Use of Bankstown Airport for Regional Traffic

It was suggested in some submissions that Bankstown Airport could be used for regional traffic reducing the demand for regular public transport services at Sydney Airport, thereby delaying the need for a second major airport in the Sydney basin. The background to this proposal is that no regional airlines provide scheduled passenger services from Bankstown and existing policy settings guarantee regional airlines access to Sydney Airport through the continued availability of special slots.

Bankstown Airport, which is 18 kilometres west of Sydney Airport and 22 kilometres south-west of the Sydney central business district, is Sydney's primary general aviation airport. The airport has three parallel sealed runways and a single sealed cross wind runway. It handled 410,000 aircraft movements in 1997.

The facilities at Bankstown Airport are capable of handling the aircraft types which account for 99 percent of aircraft movements by regional airlines at Sydney Airport, for example, those involving aircraft such as Dash 8 and Saab 340. Bankstown is not, however, capable of expansion within the current airport site to handle B737 or larger aircraft.

Sydney Airport currently handles about 17 scheduled regional services per hour averaged over the 6 am to 11 am weekday period (excluding non-jet services to and from Canberra). The transfer of some of these services to Bankstown would make available slots at Sydney Airport and potentially extend its operational life.

A number of factors would influence the ability of Bankstown to accommodate regular public transport turbo prop movements. Of these, perhaps the most important would be the arrangements for managing airspace interaction between Bankstown and Sydney Airports. These arrangements would require substantial changes, involving the Civil Aviation Safety Authority and Airservices Australia, if significant levels of regular public transport traffic were to operate into Bankstown.

Section 6.5.4 of the Draft EIS highlights the range of other significant issues that would need to be addressed before significant levels of regular public transport traffic at Bankstown could be contemplated. These include:

- the need for additional terminal and runway facilities, and land transport access;
- assessment of noise and other environmental impacts on surrounding communities;
- potential changes to arrangements for general aviation, training and related activities which would be displaced from the airport;

- arrangements for the handling of interlining passengers; and
- provision of additional navigation aids.

As also noted in the Draft EIS, high levels of regular public transport traffic at Bankstown would cause the displacement of a considerable amount of other general aviation traffic, including that engaged in-flight training. This would have significant consequences for the aviation industry currently based at the airport.

It is difficult to gauge the precise noise impacts for communities surrounding Bankstown if some general aviation traffic were replaced by turbo prop aircraft. Such a development would see changes to flight paths, and to training activities in airspace around the airport. This would have varying implications for noise impacts on communities around the airport.

There has so far been little incentive for regional airlines to establish services at Bankstown. While the ability to interline with interstate and international services contributes to passenger preference for Sydney Airport, the travel time associated with access to Bankstown Airport is also an important consideration. However, given the proximity of the M5 Motorway and the commitment to extend the motorway to Sydney Airport by mid-2002, travel times should be reduced significantly, making Bankstown Airport more attractive to regional passengers.

While better facilities at Bankstown Airport and improved road access would go some way to attracting regional traffic, Sydney Airport is likely to remain the preferred airport for most regional passengers. More interventionist policies would be required to direct regional traffic to Bankstown in volumes that would enhance Sydney Airport's capacity in the event that a second airport were not built. This would have economic consequences for regional operators and their passengers.

4.4.3 Major Expansion of Sydney Airport

In the absence of a second major airport for Sydney, there is likely to be continued and growing pressure to expand significantly the capacity of Sydney Airport. A number of submissions favoured a major expansion of Sydney Airport as an alternative to developing a second airport at Badgerys Creek. Other submissions on the Draft EIS expressed opposition to any expansion of Sydney Airport.

Section 6.5.2 of the Draft EIS pointed to modelling commissioned by Airservices Australia which indicated that removing the existing 80 movement per hour cap at Sydney Airport would be unlikely to have a major effect on airport capacity. Section 6.5.2 of the Draft EIS argued that removing the night-time curfew would be unlikely to increase throughput significantly, as demand for flights in that period would be relatively small. Significantly expanding the Airport's capacity would, therefore, mean development options which expand the airport site and increase its physical capacity.

Expansion of the airport site would be severely constrained by the existing level of commercial and residential development around the airport. For example, expansion to the east would curtail the operation of Port Botany; expansion to the west would require significant acquisition of residential property in the suburbs of Kyeemagh and Brighton le Sands and increase aircraft overflight of suburbs in the vicinity of the airport. Likewise, construction of a runway at a location in Botany Bay (that is, physically detached from the current airport site) would constrain the use of the Bay for commercial and recreational purposes. Even if a suitable location for a fourth runway could be identified, access by aircraft to Sydney airspace and Sydney Airport terminal facilities (for example, across other runways/taxiways) could severely compromise the overall efficiency of the airport.

As noted in Section 6.5.2 of the Draft EIS, attempts to substantially expand traffic movements at Sydney Airport would run up against the major physical, operational and environmental constraints. As discussed above, the physical constraints alone provide a practical threshold that is a barrier to major expansion of the Sydney Airport.

4.4.4 Other Capital City Airports

It has been suggested that, if Sydney Airport were to reach capacity, traffic could use existing capital city airports such as Melbourne, Brisbane or Canberra. This possibility was discussed in Section 6.5.3 of the Draft EIS.

Using existing capital city airports such as Melbourne, Brisbane or Canberra is not considered to be a practical option. The substantial additional travel times that would be involved would make this option unattractive to air travellers originating in, or bound for, Sydney. Many international travellers would find this option inconvenient. Domestic travellers would also be adversely affected, especially interstate business travellers who are time sensitive and would consider long trips by surface transport to be unacceptable.

The economic impacts of such an alternative could be significant. Diversion of international traffic would have national economic consequences and the diversion of domestic traffic would have an adverse effect on the NSW economy, but beneficial effects on the economies of other States and Territories.

4.4.5 Very High Speed Train Linking Capital Cities

A number of submissions raised the possibility that a very high speed train would attract passengers normally travelling by air to and from Sydney to such an extent that a Second Sydney Airport would not be required for the foreseeable future. This option includes the idea that other capital city airports would serve as air gateways to Sydney for international passengers, as discussed in *Section 4.4.4*. The suggestion that a very high speed train could service a second airport outside the Sydney basin is addressed in *Chapter 5* of this Supplement.

The key issues are the possible future extent of any very high speed train system and the number of passengers that the mode could potentially capture from air travel. The present proposal is for a very high speed train link between Sydney and Canberra. Similar links to Melbourne and Brisbane are examined here for illustrative purposes.

The number of passengers travelling between these centres by air in 1997-98 is shown in *Table 4.2*.

Table 4.2 Air Passengers Travelling Between Eastern Seaboard Capital Cities via Sydney

Air Passenger Travel Route	Total Number of Passengers (1997-98)
Sydney and Canberra	585,000
Sydney and Melbourne	3,634,000
Sydney and Brisbane	1,940,000
Canberra and Brisbane	141,000
Melbourne and Brisbane	139,300

Source: Department of Transport and Regional Services, 1998

In determining the extent to which a very high speed train might capture air passengers, the responsiveness of demand to changes in price and travel time is critical. Whereas some parts of the leisure market might be very responsive to price but relatively unresponsive in terms of travel time, most of the business market and the higher end of the international leisure market is characterised by being relative unresponsive to price and very responsive to changes in travel times.

To illustrate the possible impact of a very high speed train service on Sydney basin air traffic, assumptions about the proportion of air passengers lost to rail contained in *Table 4.3* have been combined with assumptions about the possible commencement dates for very high speed train services (Sydney-Canberra in 2003; Sydney-Melbourne in 2007; and Sydney-Brisbane in 2011). The assumptions reflected in *Table 4.3* are not based on detailed modelling. Both the proportion of air passengers and the assumed commencement dates for a very high speed train service are considered by the Department of Transport and Regional Services to be optimistic in favour of rail. Nevertheless, they demonstrate the upper limit of the impact of a very high speed train service on air travel between these destinations, and, therefore, on Sydney Airport's capacity.

Table 4.3 Possible Diversion of Air Passengers to a Very High Speed Train System from Air Travel[1]

Services	Proportion of Air Passengers Lost to Very High Speed Train (percent)
Sydney and Canberra	90
Sydney and Melbourne	40
Sydney and Brisbane	40
Canberra and Brisbane	20
Melbourne and Brisbane	10

Source: Department of Transport and Regional Services.
Note: 1. The percentage estimates quoted in this table are for illustration only and do not represent estimates by the Department of Transport and Regional Services of the likely market impact of very high-speed train services.

This example indicates that, based on the capacity level represented by *Sydney Airport Capacity Scenario 1*, the aircraft movement capacity of Sydney Airport could be extended from 2006-07 without a very high speed train to around 2009-10 (that is by three years) with the Sydney-Canberra and Sydney-Melbourne links of a very high speed train network in place.

Based on the capacity level represented by *Sydney Airport Capacity Scenario 2*, and assuming that all eastern seaboard links of the very high speed train are operational, the aircraft movement capacity of Sydney Airport could be extended from 2010-11 to around 2015-16 (that is by four years). This is a conservative scenario as it is doubtful that a very high speed train network connecting Melbourne and Brisbane would be built by 2010, especially considering the need for the community, project proponents and Government to be satisfied about viability and environmental impacts.

It is beyond the scope of this Supplement to identify the potential social, economic and environmental impacts of a very high speed train network on the eastern seaboard. These impacts would be assessed in separate environmental impact assessments should the proposals proceed to that stage.

What is clear, however, is that a very high speed train service is very unlikely to be a substitute for a Second Sydney Airport. The very large scale of investment required to establish very high speed train services would only displace a relatively small number of aircraft movements at Sydney Airport. For example, the operation of a very high speed train between Sydney and Canberra would extend the capacity of Sydney Airport by less than two years even if there was almost complete diversion of traffic in the corridor from air to a high speed train.

4.5 Overview of Need and Strategic Alternatives

The need for additional airport facilities for Sydney is driven by two basic factors: the forecast strong growth in demand and the likely limits on the capacity of Sydney Airport.

Since the Draft EIS was released in December 1997, there have been significant changes to some of the factors which are likely to influence future demand for air travel to and from the Sydney region. This has led the Department to reduce its forecasts of future growth.

The 1998 forecasts predict that passenger movements (excluding international transits) at Sydney will grow at four percent per year to 1999-2000, 4.2 percent to 2009-10 and 2.8 percent to 2020-22. On this basis, passenger movements would increase from 21.3 million in 1997-98 to 23.2 million in 1999-2000, 35.1 million in 2009-10 and 49.1 million in 2021-22.

Total aircraft movements are expected to grow at an average rate of 2.6 percent per year to 1999-2000, 2.7 percent to 2009-10 and 1.9 percent from 2009-10 to 2021-22. This would see total aircraft movements increase from 276,300 in 1997-98 to 291,000 in 1999-2000, 381,000 in 2009-10 and 480,000 in 2021-22.

The latest forecasts are significantly lower than the predictions in the Draft EIS. For example, the forecasts for passenger movements in 2009-10 of 35.1 million is about five million smaller than the corresponding figure in the Draft EIS. Similarly, the most recent aircraft movement forecast for 2009-10 of 381,000 is 45,000 lower than the earlier figure.

Although the overall Sydney basin forecasts have been adjusted downwards, the forecast growth in air traffic is still substantial. The revised forecasts do not obviate the need for additional major airport facilities for the Sydney basin in the latter part of the next decade.

The future capacity of Sydney Airport is addressed in this Supplement through an analysis of the 'do nothing' option (that is, allowing the capacity of Sydney Airport to expand under current operational and broad policy settings). Two scenarios are used, both of which are consistent with current operating and policy settings. Under *Sydney Airport Capacity Scenario 1* current trends in aircraft size and loading are assumed to continue, with Sydney Airport reaching capacity in 2006-07 when demand is forecast to be 31.3 million passengers per year.

Sydney Airport Capacity Scenario 2 assumes that, in the longer term, regional passengers would be carried in larger aircraft. This would reduce the number of regional aircraft movements and allow slots to be used for domestic and international services. Under this scenario, capacity would be reached in 2010-11 when demand is forecast to be 36.1 million passengers.

On the basis of this work, the 'do nothing' option is not feasible and Sydney will require additional major airport facilities in the latter part of the next decade if demand is to be satisfied.

Other reasonable scenarios for the future of the Sydney Airport could be developed which would either reduce or increase its predicted capacity relative to *Sydney Airport Capacity Scenarios 1* and *2*. For example, Sydney Airport's capacity would be reduced if more stringent noise management practices were introduced, or if environmental approvals to develop currently planned facilities were difficult to obtain. On the other hand, it might be possible to increase the Sydney Airport's capacity through action by the airlines to use larger aircraft, increase load factors and reduce the number of passengers which transit through Sydney.

Increased passenger numbers would run up against the major physical constraints of Sydney Airport. These include the need for additional terminal space, eventually in new precincts of the current site, and significant upgrading of road access to the airport. The cost of such developments could be expected to grow significantly over time. Major environmental considerations (particularly for *Sydney Airport Capacity Scenario 2*) are likely to include the noise impacts of larger aircraft and air quality and noise impacts of an increase in road traffic to Sydney Airport. Gauging the noise impacts of larger average aircraft at Sydney Airport is not an easy process, mainly because such aircraft could necessitate different operational practices at the airport.

The Draft EIS discussed a number of ways of providing the needed additional airport facilities for Sydney and, largely in response to public comment, this discussion is extended considerably in this Supplement.

Bankstown Airport could be used for regular public transport services to regional centres, thereby delaying the need for a second major airport. Bankstown Airport is not capable of handling major jet services, but could handle small volumes of regular public transport traffic without reducing the capacity of Sydney Airport. Introducing regular public transport services would have a significant impact on general aviation activities at Bankstown and would raise environmental considerations.

There has been almost no demand for regular public transport services from Bankstown to date and regional airlines have guaranteed future access to Sydney Airport through the continued availability of special slots.

While better facilities and improved road access would go some way to attracting regional traffic to Bankstown Airport, Sydney Airport is likely to remain the preferred airport for most regional passengers. More interventionist policies would be required to direct regional traffic to Bankstown in volumes that would enhance Sydney Airport capacity in the event that a second airport were not built. This would have environmental implications for residents and economic consequences for regional operators and their passengers.

Another suggestion has been to build a major extension to Sydney Airport. Work commissioned for the Draft EIS indicated that removing the existing 80 movement an hour cap at Sydney Airport and/or removing the night-time curfew would be unlikely to have a major effect on airport capacity. Significantly expanding Sydney Airport's capacity would, therefore, mean development options which expand Sydney Airport and increase its physical capacity, such as construction of a fourth runway.

Expansion of Sydney Airport is severely constrained by the existing level of commercial and residential development around the site, including the major use of Botany Bay and the location of Port Botany. Even if a suitable location for a fourth runway could be identified, access by aircraft to Sydney airspace and Sydney Airport terminal facilities (for example, across other runways/taxiways) could severely compromise the overall efficiency of the Airport.

Another possible alternative would be for traffic to use other capital city airports. The substantial surface travel times that would be involved using existing transport modes would make this option unattractive to both domestic and international travellers bound for Sydney.

Since the Draft EIS was released, there has been considerable debate about the development of a very high speed train system to link major urban centres on Australia's east coast. The issue is whether this development would delay, or even negate, the need for additional airport facilities in Sydney.

Preliminary work indicates that, even with assumptions about the diversion of passengers from aviation to high speed rail weighted in favour of rail, there would only be a modest extension to the life of Sydney Airport if a very high speed train system linking Sydney with Melbourne, Brisbane and Canberra was introduced.

In view of the demand forecasts and the future constraints on Sydney Airport's capacity, there are no prudent and feasible alternatives to building a second major airport for Sydney if long-term demand is to be satisfied.

It is difficult to estimate accurately when a second major airport will be required for Sydney. However, based on demand forecasts and an analysis of Sydney Airport's future capacity, new major airport facilities will be required in the latter part of the next decade.

The timing of the proposed airport development would not substantially effect the potential environmental impacts or the measures used to manage the impacts. The environmental impacts of the proposal would depend on the scale of the airport development and the level and type of aircraft traffic, rather than on the timing of the construction program and the rate of traffic growth.

Chapter 5

Alternative Sites

Chapter 5
Alternative Sites

5.1 Summary of the Draft Environmental Impact Statement

The location and timing of the development of a second major airport for Sydney have been the subject of investigations for more than 50 years. Over this time a large number of sites both within and outside the Sydney basin have been investigated and several studies undertaken. The Draft EIS provided a summary of these studies and associated decisions.

The *Second Sydney Airport Site Selection Programme Draft Environment Impact Statement* (Kinhill Stearns, 1985a) examined ten short-listed sites and prepared detailed environmental assessments on two of these: Badgerys Creek and Wilton. In 1986, the then-Commonwealth Government announced that Badgerys Creek had been selected as the site for the Second Sydney Airport. The site, comprising 1,700 hectares, was acquired by the Commonwealth between 1986 and 1991.

The Holsworthy Military Area was initially included in the latest environmental assessment process but was eliminated by the Commonwealth Government in September 1997. A detailed assessment found that airport options available within the Military Area were environmentally unacceptable.

The possibility of developing a second airport for Sydney outside the Sydney basin was discussed in the Draft EIS. The Draft EIS indicated that there were major disadvantages of sites outside the Sydney region. The major difficulty lay in their distances from Sydney, making it relatively time consuming, costly and inconvenient for airport users to travel to and from the city area or to connect with Sydney Airport. It would, therefore, be extremely difficult to attract passengers and airlines to a second airport at a remote site. Pertaining to some remote sites, are significant costs in providing suitable transport links and other support services, such as fuel supply.

The possible use of the existing military airfield at Richmond was also discussed in the Draft EIS. However, its relatively small size, constraints on further expansion, operational restrictions imposed by the Blue Mountains, and other factors, meant that Richmond could not fulfil the role of Sydney's second major airport.

In an attempt to solve Sydney Airport's aircraft noise problem, an offshore airport has recently been proposed as a potential replacement for the existing Sydney Airport. This proposal is not intended to be a long term alternative to developing a second major airport for Sydney.

A detailed review of alternative airport sites is not required in the EIS. The EIS Guidelines (Department of the Environment, Sport and Territories, 1997) state that alternative site locations for the second airport will not be addressed in detail as this has been the subject of a separate site selection process and subsequent Government decisions.

5.2 Summary of the Issues Related to Alternative Sites

5.2.1 Issues Raised in Submissions

History of Site Selection

There was comment in some submissions regarding changes that have occurred in recent years in the vicinity of Badgerys Creek invalidating the 1986 decision to select the site for the development of a major airport. There were also comments that the history of the site selection process was well documented and that there was a sound basis for the selection of the Badgerys Creek site.

Alternative Sites Within the Sydney Basin

Comments in submissions expressed opposition to the development of a second major airport anywhere within the Sydney basin. Reasons given covered the spectrum of potential environmental impacts.

There was support in submissions for the development of an airport offshore from Sydney. This support related to either the recent private sector offshore airport proposal or other unspecified concepts.

The potential use of RAAF Base Richmond as an alternative to the development of a second airport was raised in submissions. There were also comments suggesting that the Kurnell Peninsula could be utilised for airport development purposes.

Alternative Sites Outside the Sydney Basin

Many submissions expressed the view that Sydney's second airport should be developed outside the Sydney basin. Many of these submissions did not express a preference for any particular alternative site.

Goulburn was the most commonly-suggested potential location for the new airport. There was also support for Lithgow and Newcastle. Some submissions also expressed support for Wilton as a suitable site outside the Sydney basin (it is noted, however, that Wilton is on the boundary of Sydney's air drainage basin). Parkes, Dubbo and other more distant locations were also mentioned.

In general, submissions that supported the development of an airport at an outlying site acknowledged the need for a fast surface transport link and advocated a very high speed train as the best solution.

5.2.2 Issues Raised by the Auditor

The Auditor commented that, while the EIS guidelines did not require alternative site locations to be addressed, the Draft EIS should have contained a review of the basic data leading to the selection of Badgerys Creek and an assessment of whether conditions had changed since the 1985 EIS (Kinhill Stearns, 1985a; 1985b).

5.3 Responses to Issues Related to Alternative Sites

5.3.1 Selection of Badgerys Creek Site in 1986

The Auditor commented that, given that the 1985 EIS (Kinhill Stearns, 1985a; 1985b) is more than 12 years old and copies are not readily available, a review of the basic data leading to the selection of Badgerys Creek and an assessment of whether conditions have changed since 1985 would have considerably strengthened the Draft EIS. This section responds to the Auditor's comments, as well as to comments in submissions, regarding changes which have occurred in recent years that now might invalidate the 1986 decision to select Badgerys Creek as the site for the development of a major airport.

Sections 4.2.4 and 6.3.1 of the Draft EIS provide an outline of the *Second Sydney Airport Site Selection Programme Draft Environmental Impact Statement* and *Supplement* (Kinhill Stearns, 1985a; 1985b) that led to the selection of the Badgerys Creek site in 1986. The Draft EIS does not contain a review of the basic data leading to the selection of Badgerys Creek or an assessment of whether conditions have changed since 1985, as this was not a specific requirement of the EIS Guidelines. Presentation of data from the 1985 EIS would have made the document overly complex, given the amount of current environmental data that has been presented. However, to clarify the basis for the 1986 decision, a review of why Badgerys Creek was selected is provided below.

The *Second Sydney Airport Site Selection Programme Draft Environmental Impact Statement* and *Supplement* (Kinhill Stearns, 1985a; 1985b) was the fifth attempt by the Commonwealth to select a site for a second Sydney airport. Altogether, 106 sites had previously been investigated, with 19 studied in detail. All possible airport locations were re-examined as part of the site selection process and ten were chosen for preliminary examination, grouped as follows:

- closer sites: Badgerys Creek, Bringelly, Holsworthy, Scheyville and Londonderry;
- mid-distance sites: Darkes Forest, Somersby, Warnervale and Wilton; and
- an outlying site: Goulburn.

These sites were evaluated against 25 factors covering the natural and socioeconomic environment, access, the operation of the proposed airport and the costs of acquisition and provision of infrastructure. Each location was then reviewed for serious weaknesses and the following three sites were eliminated:

- Darkes Forest: adverse meteorological factors (wind shear, fog and turbulence) would render the site unsafe for use as an airport;
- Goulburn: it was too far from Sydney to adequately serve the market; and
- Holsworthy: topographic constraints and operations there would force the closure of Bankstown Airport. (Reasons why Holsworthy was reconsidered in 1996 are discussed in Section 4.2.7 of the Draft EIS.)

The four remaining closer sites, Badgerys Creek, Bringelly, Londonderry and Scheyville, were then compared in terms of the four major factors of environment, access, operations and cost. Badgerys Creek emerged from this evaluation as the superior of the closer sites, principally because of its relative environmental and cost advantages. There was little to distinguish between the closer sites on access or operational factors.

Disadvantages in terms of site and location constraints at Londonderry and Scheyville could not be reduced to a scale that would be competitive with a site in the area of Badgerys Creek. It was further concluded that, in view of the scale of relocation of people associated with the acquisition of the Bringelly site, Bringelly did not merit further consideration as a site for a second Sydney airport independent of Badgerys Creek (with which it shared other characteristics).

The three remaining mid-distance sites, Somersby, Warnervale and Wilton, were also compared in terms of the four major factors of environment, access, operations and cost. Wilton emerged from this evaluation as the superior site, followed closely by Somersby. Wilton's advantages over Somersby were in the area of cost and environmental impact, although Wilton's environmental advantage was marginal, as it is located in the catchment area for Sydney's water supply.

Warnervale offered very few advantages over Wilton and Somersby and was clearly inferior in terms of access. Warnervale was considered by State Government authorities as an attractive area for current and longer term urban growth.

A choice between the superior closer site, Badgerys Creek, and the superior mid-distance site, Wilton, would have involved a comparison between factors that have no common measure. The closer site was more accessible but would have involved greater socioeconomic impacts and would have cost more to acquire than the mid-distance site.

Both Badgerys Creek and Wilton were subject to full environmental impact assessments (Kinhill Stearns, 1985a; 1985b) which were completed in December 1985. This process found that no serious drawback had been identified for either site. In February 1986, the then-Commonwealth Government announced that Badgerys Creek had been selected as the site for the Second Sydney Airport (Department of Aviation, 1986) because it:

- was closer to the markets it was intended to serve;
- would involve a lower development cost; and
- would have less effect on the natural environment.

Changing Social and Biophysical Environment

Some of the submissions on the Draft EIS suggested that the site selection process should have been re-opened because of changes to the social and biophysical environment at Badgerys Creek since 1986. The same issue was raised in response to the Draft EIS Guidelines, but the final EIS Guidelines do not require the EIS to address in detail alternative locations for a second airport.

Although the Badgerys Creek site was acquired by the Commonwealth between 1986 and 1991, there has been little airport-related construction on the site except for a stormwater detention basin, part of an access road and some fencing (work undertaken as part of a now defunct general aviation airport development). Most of the residential, rural and other properties comprising the site continue to be leased for purposes similar to those which existed in 1986.

Following the selection of the Badgerys Creek site, State and local Government authorities imposed planning and building restrictions in areas around the airport site to limit incompatible development through a *Section 117* direction issued under the *Environmental Planning and Assessment Act 1979* in May 1985. The boundaries of these restricted areas were based on the ANEF contours for the airport proposal identified in the 1985 EIS (Kinhill Stearns, 1985).

The restrictions applied to residential development within the 25 ANEF contour, while the development of schools, hospitals, churches and theatres was restricted within the 20 ANEF contour. Therefore, since 1985, little new residential development has occurred in areas extending up to about eight kilometres to the north-east and south-west of the ends of the runways described in the 1985 proposal.

Areas outside those affected by airport-related building restrictions have experienced different degrees of development since 1986. Rural residential development on small acreage blocks has occurred in the vicinity of the airport site. Examples include Bringelly, which is immediately adjacent to the airport site, as well as Silverdale, Mount Vernon and Orchard Hills, all of which are between six and 10 kilometres from the end of any proposed runways at Badgerys Creek.

More intensive urban development has occurred in areas such as Glenmore Park, St Clair, Cecil Hills, Hinchinbrook and Harrington Park although these are at least eight kilometres from the end of any proposed runways. The noise and other environmental impacts on these and other communities are being addressed in detail in the EIS process.

As the land use within the airport site has essentially not changed since 1986, the site itself would have had little or no part to play in changes to the biophysical environment in the area. Any biophysical degradation in the region is likely to be a cumulative effect resulting from urban developments outside the site.

On the other hand, there might also have been improvements to the biophysical environment from government initiatives such as improved water system management and emission controls on vehicles. The water, air quality and other biophysical factors linked to a second airport development at Badgerys Creek are analysed in the Draft EIS.

While the actual biophysical environment of the airport site might not have changed significantly since 1986, the lack of development on the site may have resulted in an increase in the ecological value of the site. This is particularly so as more flora and fauna species have been listed as threatened during the intervening period. The implications of this are addressed in *Chapter 14* of this Supplement.

It is doubtful whether a detailed comparison of the changes in the social and biophysical environment at Badgerys Creek since 1986 would provide a guide to the suitability of Badgerys Creek as a site for a major airport. The proposal must be assessed on the basis of an analysis of present and forecast conditions, rather than on past conditions. The current EIS is the appropriate mechanism for such an assessment.

5.3.2 Alternative Sites Within the Sydney Basin

The Auditor commented that no explanation had been given as to why other sites, that had been considered more suitable than Holsworthy in the 1985 environmental assessment process, had not been worthy of re-examination. This section addresses the Auditor's comment in relation to sites within the Sydney basin and also responds to comments in submissions that RAAF Base Richmond, Kurnell or an offshore site may be suitable for the Second Sydney Airport.

Overview

The only possible alternative 'greenfield' sites that were identified as lying within the Sydney basin (Holsworthy, Scheyville, Londonderry and Bringelly) were assessed in the 1985 EIS (Kinhill Stearns, 1985a; 1985b) and were all found to be inferior to the Badgerys Creek site (see *Section 5.3.1* of this Supplement). A subsequent detailed review of the Holsworthy site in 1996-97 failed to displace Badgerys Creek as the more suitable site.

It is most unlikely that a detailed review now would find any of the other three sites identified above as more suitable than Badgerys Creek, particularly given that none have been subject to any planning constraints in the intervening period. For example, the close proximity of urban areas to the Londonderry site has been exacerbated by further urban development around Penrith. Similarly, new urban areas such as West Hoxton and Harrington Park have developed close to the Bringelly site. The establishment of Scheyville National Park has affected a large part of the Scheyville site.

Other sites within the Sydney basin, including those offshore, that have been raised in submissions on the Draft EIS (*Figure 5.1* shows location of sites) are discussed below.

Richmond

Details of current activities at RAAF Base Richmond are provided in Section 4.6.1 of the Draft EIS and some of the implications of using the airport for civil air traffic are discussed in Section 6.5.4 of the Draft EIS.

RAAF Base Richmond, located about 55 kilometres north-west of Sydney's central business district, is the Australian Defence Force's main air transport facility; it contains substantial RAAF infrastructure. There were about 48,000 aircraft movements at the Base in 1996, involving training and transport operations with B707, C130 Hercules and Caribou aircraft.

Richmond has a sealed 2,134 metre long runway that could accommodate regional and some domestic traffic, but the runway is not long enough for international and long haul domestic services.

The proximity of the Blue Mountains escarpment to the existing east-west runway limits the use of the western approach to the airport. This impacts on some RAAF operations and would constrain civil aircraft operations.

The relatively small size of this airfield (280 hectares compared with about 880 hectares at Sydney Airport and 1,700 hectares at the existing airport site at Badgerys Creek) is a major limitation on the potential development of this site as Sydney's second airport.

The existing runway is constrained severely in both directions in regard to possible extensions, with the nearest houses in Richmond being only some 600 metres from the runway end, while the nearest houses in Windsor are about 1,500 metres from the other end.

The airport site is too small for the construction of a major runway in any alternative direction within the site. The Hawkesbury Nepean River floodplain immediately to the north of the airport makes expansion in that direction impractical. The Windsor to Richmond road and rail line are constraints for expansion to the south.

Richmond RAAF Base is susceptible to fog and records about 100 closures per year for this reason (compared with about ten recorded fog days per year on average at Badgerys Creek). This would be a serious limitation to its use for scheduled passenger services.

As indicated in the Draft EIS, the existing facilities at RAAF Base Richmond suffer serious operational limitations and have only limited potential for accommodating civil aircraft activity. The existing site cannot be developed to handle the level of traffic being proposed for the Second Sydney Airport. Any proposal to expand the site and to construct new runways would subvert the perceived benefit of Richmond, which lies in its existing infrastructure. Proposed expansion of the airport at Richmond would also raise many of the environmental concerns common to Badgerys Creek, such as aircraft noise and air and water quality.

Proximity of the site to Sydney would mean that a very high speed train service may be neither the most technologically appropriate nor the most cost effective form of mass transit system.

Figure 5.1

Alternative Sites for the Second Sydney Airport Suggested in Submissions

Note: An airport proposal for the Newcastle/Kooragang Island site was announced by a private sector consortium in the latter part of 1998.

Kurnell

There are fundamental flaws in any suggestion that the Kurnell Peninsula could be utilised as a site for a second Sydney airport, as a site for a new replacement airport, or even to accommodate an expansion of the existing Sydney Airport.

The close proximity of Kurnell to Sydney Airport and the fact that it is in line with the parallel runways, would result in serious airspace conflict between aircraft using the two airports. This would be a major constraint on the capacity of the two-airport system and would be counter to one of the prime objectives of building a second airport, which is to significantly expand aviation capacity for Sydney. Therefore, the development of a second Sydney airport on the Kurnell Peninsula is not practical from an operational perspective.

The Kurnell Peninsula is too small for the development of a single airport to replace both the existing Sydney Airport and the proposed second airport. Even with the costly acquisition of the Ampol/Caltex oil refinery and land and houses in the suburb of Kurnell, major incursions would still be required into the natural and cultural environment. This might involve reclamation in Botany Bay, earthworks in Botany Bay National Park, Captain Cook's Landing Place, the internationally-important Towra Point Nature Reserve and the associated Aquatic Reserve.

Arguably, acquisition costs, construction costs and the impacts on the natural and cultural environment of this option would be unacceptable. Aircraft noise, however, is still likely to be a serious problem for residential areas in the vicinity of Botany Bay. It is, therefore, doubtful that a replacement airport at Kurnell is a realistic proposition.

The provision of additional infrastructure and supporting facilities at Kurnell, such as an additional runway and terminal, to supplement Sydney Airport is also not a practical option. In addition to the airspace conflicts cited earlier, it would not be feasible to provide essential taxiway links between the two sites, thereby preventing access to other runways when necessitated by wind conditions. The transfer of passengers between the two sites for interlining purposes would be difficult and time consuming and could involve the costly option of driving a tunnel beneath Botany Bay. These, along with likely environmental deficiencies, make this option impractical.

Offshore Airport

There are three main approaches that could be considered for the development of an offshore airport: a floating airport; an airport on reclaimed land; or an airport on piers.

Floating Airport

A recent proposal for a floating airport was based on the construction of an airport on a concrete deck supported on linked concrete flotation units designed to flatten ocean waves. The proposal is conceptual and there are no examples in the world of an airport constructed in this manner. Significant research and development expenditure would be required to prove the viability of such technology.

An experimental floating structure 300 metres long and 60 metres wide has recently been constructed in Tokyo Bay, Japan as a possible forerunner of a floating airport. The Japanese Ministry of Transport is reported to have established a research centre to investigate the feasibility of a floating airport.

Given the early stages of research involved in the floating airport concept and the likely timeframe for proving such technology, the floating airport option is not considered to be a practical alternative for the Second Sydney Airport.

Airport on Reclaimed Land

There are a number of examples in which solid fill has been used to reclaim land from bays and other relatively sheltered bodies of water, for airport development purposes. Most of the new parallel runway (16L/34R) and a large part of the main parallel runway at Sydney Airport have been built on reclaimed land. Kansai Airport in Osaka and Chep Lap Kok Airport in Hong Kong are recent examples of new airports built on island platforms developed on reclaimed land.

In the case of Sydney, an offshore airport would need to be built at a significant distance from the coast in order to avoid creating aircraft noise problems. However, the substantial depth of water off the coast of Sydney and the lack of any coastal landforms to provide shelter from ocean waves makes it highly unlikely that the construction of a major airport using this method could be achieved at an acceptable cost.

Airport on Piers

The proposal for an offshore airport built on piers is discussed in Section 6.3.3 of the Draft EIS. The concept has been developed by a private sector consortium and is intended to be a replacement airport for the existing Sydney Airport. It has not been proposed as a long term alternative to a Second Sydney Airport. (The proximity of the offshore airport to Sydney Airport and the likely conflicts between flight paths would make it unlikely that the two airports could co-exist and operate efficiently.)

The offshore airport concept proposes to adopt existing technology used to build offshore oil platforms and apply it on a very large scale. Two parallel runways, 4,000 metres and 3,000 metres long, would be built on a 3.5 square kilometre concrete platform located about one kilometre off the coast north of Botany Bay. The platform would be some 17 metres above sea level and would be supported on about 5,000 piers driven into the seabed. It is understood that piled structures have been built in the open ocean at depths of up to 150 metres, and that the ocean depth off the coast north of Botany Bay, at the proposed location of the offshore airport, does not exceed 60 metres.

Terminals for passengers and cargo, as well as a range of supporting facilities, would be housed on the platform, which would be linked to the mainland by a multi-lane bridge. It is envisaged that some facilities, such as administration, accommodation and parking, could be sited on-shore, in the vicinity of Prince Henry Hospital.

As indicated in the Draft EIS, no offshore airport on piers has been constructed anywhere else in the world. While technology has been developed for building certain types of off-shore structures, there is still a substantial degree of uncertainty associated with adapting this technology to a very large scale structure, such as an airport. The design consortium has acknowledged that the proposal is still at a preliminary stage and considerable further work would have to be undertaken on a wide range of engineering issues before a broader economic and environmental assessment of the proposal could be undertaken.

The main objective of the offshore airport proposal is to solve Sydney's aircraft noise problem by eliminating the need for aircraft to take off or land over suburbs. It is claimed that, by providing increased capacity and allowing 24-hour operations, the offshore airport would have the effect of postponing the need for a Second Sydney

Airport. However, the forecast growth in aviation traffic would mean that a second airport would still be required in the medium term. The offshore airport proposal is, therefore, not a substitute for a Second Sydney Airport.

Conclusion

The alternative sites within the Sydney basin, including the offshore airport proposal, that have been discussed in this section are not considered to be prudent or feasible alternatives to the Badgerys Creek site as a location for Sydney's second major airport. Consequently, none warrant detailed environmental impact assessment in this EIS.

5.3.3 Alternative Sites Outside the Sydney Basin

In regard to the Auditor's comment concerning the worthiness of re-examining other sites considered in the 1985 EIS (Kinhill Stearns, 1985a; 1985b), this section discusses those sites that lie outside the Sydney basin. It also responds to comments in submissions which advocated locating the Second Sydney Airport outside the Sydney basin, at locations such as Goulburn, Lithgow and Newcastle, and serving these sites with a very high speed train. Some submissions also placed Wilton in this category of sites even though it is on the boundary of Sydney's air drainage basin.

Overview

A number of mid-distance sites (Darkes Forest, Somersby, Warnervale and Wilton) and an outlying site (Goulburn) were assessed in the *Second Sydney Airport Site Selection Programme Draft Environmental Impact Statement* (Kinhill Stearns, 1985a) (see Section 5.3.1 of the Draft EIS). As Wilton was found to be the best of the mid-distance sites, no further discussion of the other mid-distance sites is provided in this section. (*Figure 5.1* shows location of Wilton and other suggested sites outside the Sydney basin.)

The Draft EIS (Section 6.3.2) briefly discusses some of the disadvantages of Goulburn and other possible outlying sites, with the main issue being the distance from Sydney and the associated cost, inconvenience and travel time penalty involved. Further discussion of a number of these options is included below, with the exception of very distant sites that had been suggested, such as Parkes and Dubbo, which are unlikely to have an overall advantage compared with sites closer to Sydney.

The feasibility and implications of serving an outlying airport with a very high speed train are examined in more detail below.

Implications of Very High Speed Train Proposals

The suggestion that a very high speed train could make airport options outside the Sydney basin viable for Sydney's second airport depends on whether a very high speed train can provide a fast, high frequency service at an affordable price from the airport to Sydney.

Travel Times and Frequency of Service

Travel times would be a function of the airport's distance from Sydney Central station and the quality of infrastructure supplied for the very high speed train service (especially in the Sydney area). The latter is critical. For example, travel times would be extended if the investment in track was insufficient to allow very high speed train services to travel on the most direct route at maximum speed, if access to the Sydney network was compromised by congestion, or if train platforms did not allow for quick embarkation and disembarkation of passengers with luggage. Achieving the fastest possible service would have substantial cost and fare implications.

To service an airport of the scale required to meet projected demand for air travel in the Sydney basin would also require trains to run very frequently.

Indicative estimates of frequency have been undertaken for this Supplement based on the assumption that a very high speed train was used by 90 percent of airport passengers. This assumption is considered realistic because of the remoteness of most alternative sites under discussion, and because it favours the potential viability and lower fares which would be required for a very high speed train service to be put into place.

The indicative estimates show that a 90 percent patronage level would mean a very high speed train servicing a daily morning peak period of about 10,500 arriving passengers when the airport is carrying ten million passengers a year, and in the order of 35,300 arriving passengers when the airport is at 30 million passengers a year. These passenger numbers are very high by the standards of long distance rail.

As further illustration, a very high speed train carrying a total of nine million airport passengers per year would require around 67 double-deck trains per day (average occupancy per trip of 184), with the frequency in the morning peak rising to a maximum of around five trains an hour; that is, a train every 12 minutes. This assumes an equal number of arriving and departing passengers on the very high speed train.

By the time an airport reached the proposed operating capacity of 30 million passengers per year, it could be assumed that a very high speed train would be carrying 27 million airport passengers per year. This number of passengers would require about 138 double-deck trains per day (average occupancy per trip of 268), with the frequency in the morning peak rising to a maximum of around 17 trains an hour; that is, a train about every three minutes.

These frequencies are without precedent in international airport rail services. Many airports rely on rail as one mode of transport to major centres. However, there is currently no international precedent for a remote airport whose passengers rely almost entirely on a very high speed train to reach their ultimate destination.

It is worth noting also that these illustrative estimates are based solely on airport patronage. Patronage for a very high speed train not related to the airport (for example, from surrounding regions) could be expected to require additional trains and to demand greater usage of the track, with implications for the level of infrastructure underpinning the service.

Infrastructure Requirements

As noted above, the high level of frequency and low travel times required to serve airport passengers would need to be underpinned by significant investment in infrastructure.

Infrastructure would include:

- dedicated and, eventually, duplicated track outside the Sydney network;
- efficient access to the Sydney rail network, probably eventually using dedicated track;
- multiple platforms at the airport and Sydney Central;
- adequate provision for passengers connecting to Sydney Airport;
- upgrades to the electrical supply system to power trains;

- modern train control systems; and
- trains designed to service any special requirements of airport passengers and the routes used.

Meeting these infrastructure requirements would raise major engineering, logistical and environmental issues. Among these are the need for extensive tunnelling in some circumstances, finding alignments which protect sensitive environments such as national parks (especially for airport options to the north and west of Sydney) and avoiding urban areas, and safely managing train paths of the high frequency required to service an airport.

Costs and Fare Levels

The substantial infrastructure requirements for a very high speed train (estimated cost of the Sydney-Canberra Speedrail proposal is $3.5 billion) serving an airport outside the Sydney basin would be reflected in the costs of the project, the viability of the service, and the level of fares which passengers are charged.

Even if some of the infrastructure issues could be resolved at reasonable cost, recovering that cost would depend on the level of patronage for the airport and the very high speed train. The lower the patronage, the higher the fares, and the less commercially viable the very high speed train service and the airport. Given the relative inconvenience of an airport remote from Sydney, it would be unlikely that it would develop at the same rate as one located at Badgerys Creek. This would result in lower patronage and marginal commercial viability would result.

For all remote options, a number of factors are likely to have an adverse impact on airport (and, therefore, very high speed train) patronage. These include: the combined air and train travel times to reach Sydney; adverse passenger reaction to the need for interchange between an aircraft and a train and possibly a third mode of transport to and from the actual point of travel within the Sydney area; the combined cost of air and train travel; and a general preference for point-to-point modes as against mass transit. Measuring these factors is difficult, but each are part of the reason that most second airports in international experience are within 50 kilometres of the major centre which they are servicing.

It is likely that many regional passengers travelling to Sydney would choose not to fly to an airport that is well outside of Sydney; they would be likely to use other, more direct transport modes. The time-sensitive nature of business travel would mean that only a small proportion of this market would be likely to use a remote airport. The cost of a very high speed train fare on top of an air fare may also discourage price sensitive parts of the domestic and international leisure market from flying to or from a remote airport.

The resulting reduction in patronage for the airport would feed directly through to lower patronage for a very high speed train, and reduce the commercial viability of the service.

An airport option closer to Sydney (such as Wilton) might improve airport patronage numbers, but reduce train patronage because other travel modes, such as car and bus travel by freeway, become more competitive.

In considering any very high speed train option, it must be recognised that the opportunities to use the high-speed characteristics of the train are limited due to the alignment of corridors in the approaches to Sydney and in the urban area; this will limit the trains' speed. To improve these alignments would be extremely costly and might be environmentally impossible.

The Current Proposal for a Sydney-Canberra Very High Speed Train

Details of the current proposal for a Sydney-Canberra very high speed train are provided below to help place the preceding discussion into context.

On 4 August 1998, the Speedrail Group was announced as the preferred proponent for a high speed rail link between Sydney and Canberra. Its proposal at that time involved a service with a 45 minute frequency, taking 81 minutes (without intermediate stops) to travel the 270 kilometres between Sydney Central railway station and Canberra Airport. The projected cost at that time was $3.5 billion, taking an estimated 45 months from the start of construction to completion.

On 8 March 1999, the Commonwealth Government signed a Proving Up Agreement with Speedrail. The Agreement sets in place a range of committees and procedures to further test the viability of the proposal. A Heads of Agreement was also signed with the Governments of New South Wales and the Australian Capital Territory to ensure effective co-operation between governments. The proving up stage is due to be completed in late 1999.

Goulburn

The potential airport site is located on the Gundary Plains south of Goulburn, in the Mulwaree Shire. It is about 210 kilometres by road from the Sydney central business district. The site that was assessed in the 1985 EIS (Kinhill Stearns, 1985a; 1985b) is about 11 kilometres south of Goulburn, although Goulburn City Council has suggested an alternative site some 16 kilometres south of the city.

The Gundary Plains are sparsely populated, mostly flat and approximately 700 metres above sea level. The land is used for sheep and cattle grazing as well as some cropping. There are no coal or other economic extractive resources at the site. The 1985 EIS (Kinhill Stearns, 1985a; 1985b) found that no significant native vegetation had been identified at the site. Nor were there any Aboriginal archaeological or European heritage sites within the notional airport boundary. The 1985 EIS (Kinhill Stearns, 1985a; 1985b) also found no significant regional air quality problems to which the airport would contribute. The site examined drains into creeks that form part of the catchment for Warragamba Dam.

The airport site is susceptible to fog, with records indicating that there have been 25 fog days per year on average (compared with about 10 recorded fog days per year on average at Badgerys Creek). Technology could help overcome this problem, but there would be a high cost to install it at the airport and also in all aircraft using the airport.

The existing road along the Hume Highway is relatively good but the trip to Sydney would still take over two hours in normal traffic conditions and more in peak periods. The Hume Highway around Campbelltown is already congested during peak periods and upgrading would be required to cater for additional airport generated traffic. The current rail link involves a travel time of around three hours, which would be unacceptable for most airline passengers.

It has been estimated that minimum travel time from Goulburn to Sydney Central on a very high speed train could be around 60 minutes. This travel time is dependent on the level of infrastructure underpinning the service. Assuming that a very large proportion of air passengers use the very high speed train, it is likely that duplicated line would be required outside the Sydney network before 10 million passengers are reached at the airport, and a dedicated line in the Sydney network would be required at a relatively early stage.

Lithgow

Three airport sites have been proposed near Lithgow, all located on the Newnes Plateau about 10 to 20 kilometres north of the city. The sites are about 165 kilometres by road from the Sydney central business district. There were no sites near Lithgow included in the ten short listed sites examined in the 1985 EIS. The airport proposal is a relatively recent initiative, having been developed by the Council of the City of Greater Lithgow.

The Newnes Plateau is a mostly unpopulated sandstone plateau situated at a height of about 200 metres above Lithgow and 1,100 metres above sea level. There are relatively flat areas on the plateau, but these are limited in size and bordered by steep gullies and escarpments. The gullies intrude onto the plateau and would make it difficult to prepare a suitable platform for the development of a major airport.

The vegetation on the plateau is a mixture of native forests with mature trees, typically 20 metres high, as well as pine plantations. It is understood that the plateau has several significant Aboriginal archaeological sites and flora and fauna sites.

Water from the plateau drains into rivers that flow through the Blue Mountains National Park into the Hawkesbury Nepean River system. Part of the plateau drains into the Cox's River, which in turn flows into the Warragamba Dam. Maintaining water quality in these streams during construction and operation of an airport would be a major environmental consideration.

Aircraft noise would also be an environmental issue, as the site adjoins a number of popular national parks, including Blue Mountains and Wollemi, as well as being relatively close to a number of communities in the Blue Mountains area.

The existing road links from Lithgow to Penrith (Great Western Highway) or Lithgow to Richmond (Bells Line of Road) traverse the Blue Mountains and would require major upgrading in order to significantly reduce travel times. Because of the rugged terrain, there is limited opportunity to improve the overall alignment of these roads. Construction costs could be expected to be high. The road link from Penrith to the Sydney central business district would require further upgrading of the M4 Motorway, while the link from Richmond to the central business district would require a significant extension of the M2 Motorway.

The existing Main Western Line railway link from Lithgow to Sydney via Penrith, Blacktown and Parramatta is already heavily trafficked at peak times and could not accommodate significant additional traffic from an airport. There are major physical constraints to expanding the capacity of the Main Western Line, particularly as it approaches the Sydney central business district.

It would be very difficult, costly and potentially environmentally damaging to build a very high speed train from Sydney to this airport site. The rugged terrain of the Blue Mountains would provide a major engineering challenge for an additional railway link. A suitable alignment for a very high speed train would almost certainly necessitate encroaching into the Blue Mountains National Park. The environmental issues pertaining to such a very high speed train service would be significant.

The rail approaches to the Sydney central business district from the west are the most congested in the urban region, particularly on the lines between Strathfield and Sydney Central. Any high speed rail link might have to be located outside the existing rail corridor between Parramatta and the Sydney central business district.

Accurately estimating travel times for a very high speed train from Newnes Plateau to Sydney Central is difficult given that this is so dependent on finding a suitable alignment and putting in place the necessary infrastructure. The costs associated with this, including the prospect of extensive tunnelling to reduce impacts on the National Park, would be substantial. In addition, almost all of the costs of a very high speed train would have to be covered by airport passengers using the service; little patronage would be generated by the small population of the district. The impact of these factors would be in the form of higher fares.

Newcastle/Williamtown

RAAF Base Williamtown is located 15 kilometres north of Newcastle and about 174 kilometres by road from the Sydney central business district. The Base is owned by the Department of Defence with the civil areas of the airport being leased by Newcastle Airport Limited, a company jointly owned by the Newcastle City Council and the Port Stephens Shire Council. There is a single, 2,438 metre long runway that would be suitable for a wide range of civil passenger jet aircraft. It would, however, be too short for aircraft on many international or long range domestic routes.

A squadron of FA-18 military jet aircraft is based at Williamtown. Integration of existing civil and military aircraft activity is presently strictly regulated. The forecast level of civil aircraft operations associated with a Second Sydney Airport could not co-exist with the current level of Defence operations.

The potential expansion of aircraft activity at Williamtown would be likely to raise a number of local environmental issues. Increased aircraft noise could be expected over the town of Raymond Terrace. Concerns could be raised in regard to water quality, as Newcastle's water supply storage facility (Grahamstown Lake) is located immediately to the north-west of the airport.

The existing road link to Sydney via the Newcastle freeway is reaching capacity and access from Hornsby to the Sydney central business district along the Pacific Highway is currently congested at peak times. The cost of upgrading the freeway to cater for additional airport generated traffic would be substantial because of the engineering difficulties associated with the steep terrain. The present rail line runs via Newcastle with a poor alignment north from Morisset to Newcastle. Any major improvements to the road and rail links in the Hawkesbury River area (between Hornsby and Gosford) are likely to raise a number of environmental concerns because of the potential impact on adjoining national parks in this area.

These environmental considerations would be a major obstacle to finding a suitable alignment for a very high speed train service to the airport. The high levels of urbanisation on the northern approach would also complicate access to Sydney. It is probable that a route which seeks to keep travel times to a minimum would require extensive tunnelling. Tunnelling may also be required within the Sydney network to avoid lines that are already well used, and that are probably unsuitable for operating trains at high speed. As with the Lithgow/Newnes Plateau option, larger infrastructure costs will be reflected in the viability of the service and higher break-even fare levels.

Newcastle/Kooragang Island

Kooragang Island is located between the north and south channels of the Hunter River, immediately north of Newcastle. A private sector consortium has recently announced a proposal to develop a second international airport for New South Wales on a site encompassing part of Kooragang Island and the nearby BHP steelworks site. The proposal follows BHP's recent announcement of the intended closure of the steelworks.

Preliminary planning for the airport is based on an initial Stage 1 development with a capacity of 10 million passengers per year (Abigroup Limited, 1998). This would involve the provision of a 4,000 metre long runway suitable for large aircraft and a 1,500 metre long crosswind runway for light aircraft. The ultimate capacity of the airport would be 30 million passengers per year and would involve the provision of an additional 4,000 metre long runway parallel to the initial main runway and at a separation distance of 1,525 metres.

The proposal claims that aircraft flight paths would not be over major residential areas of Newcastle, and that preliminary noise analysis for the initial development indicates limited or no noise impact on the suburbs of Newcastle. The few properties affected by noise to an unacceptable level would need to be acoustically treated, or acquired and the residents relocated.

The proximity of Kooragang Island to RAAF Base Williamtown has the potential to create airspace conflicts between the two airports. The proposal suggests that the RAAF Base could continue to operate following the development of an airport on Kooragang Island and that the two airports would have integrated air traffic control. The proposal indicates that all existing regional and general aviation operations at Williamtown could be expected to relocate to the new airport.

Given the location of Kooragang Island within the estuary of the Hunter River and the low lying nature of the land, flood management would be a significant consideration in the detailed assessment of this proposal. Areas of the proposed airport site are also likely to be contaminated as a result of past industrial activities and would probably require de-contamination or other remedial action before use as part of the airport.

A significant portion of Kooragang Island forms part of the Kooragang Nature Reserve, an estuarine wetland habitat of international importance. The airport proposal would encroach into part of the Nature Reserve. The nature reserve is also home to large numbers of water birds and migratory waders. The potential impact of aircraft operations on the bird population, and conversely, the implications of these birds on the potential safety of aircraft operations, would need to be carefully assessed.

The proposal acknowledges that a very high speed train link to Sydney would be essential although there is no stated preference for any specific train technology. The implications for serving this site with a very high speed train would be similar to those for Williamtown discussed in the previous section.

Wilton

This site is located about three kilometres south of the village of Wilton in the Shire of Wollondilly, and around 81 kilometres by road south-west of the Sydney central business district (and arguably on the boundary of the Sydney basin). The majority of the site is NSW Crown land. The site was considered to be the best of the mid-distance sites short-listed in the 1985 EIS (Kinhill Stearns, 1985a; 1985b) and, at that time, was subject to a full environmental assessment along with the Badgerys Creek site (see *Section 5.3.1* of this Supplement).

The airport site is situated on the Woronora Plateau at an average elevation of about 310 metres above sea level. It is generally more undulating, has a greater range of elevation and contains a higher proportion of steeper slopes than does the Badgerys Creek site. It is located on the boundary of Sydney's air drainage basin. The 1985 EIS (Kinhill Stearns, 1985a; 1985b) identified substantial coal deposits underlying the Wilton site.

A large proportion of the site is a major water catchment for the Sydney region, and all water run-off from the site drains to protected waterways. While the 1985 EIS (Kinhill Stearns, 1985a; 1985b) identified a potential engineering solution to avoid contamination, water quality would remain a major environmental issue.

The site is mostly undisturbed native forest and woodland with some rural development. The 1985 EIS (Kinhill Stearns, 1985a; 1985b) found the Wilton site to be of high ecological value, containing a number of endangered fauna species. While a number of Aboriginal heritage sites were discovered, these were thought to be of relatively low significance. However, given the experience derived from studies undertaken for the current EIS into Badgerys Creek (and recent studies for Holsworthy), the number, value and extent of endangered species and Aboriginal sites would probably be found to increase if detailed survey work was undertaken.

Based on the east-west runway alignment adopted for the 1985 EIS (Kinhill Stearns, 1985a; 1985b), the zones of high aircraft noise would stretch east over uninhabited areas near Lake Cataract and west over sparsely populated rural residential properties to the south of Bargo.

The existing road access along the Hume Highway is good but congestion around Campbelltown during peak periods would necessitate upgrading of the highway to cater for additional airport generated traffic. The Main Southern rail line passes close to the Wilton site. Travel times to and from the Sydney central business district could be expected to be in the order of 80 to 90 minutes by road and 70 to 80 minutes by rail.

It has been estimated that minimum travel time from Wilton to Sydney Central on a very high speed train could be around 35 minutes. This may be impossible to achieve due to alignment of the East Hills rail corridor, particularly between the Wolli Valley and the central business district. The close proximity of Wilton to Sydney may force changes to train design to achieve the correct speed and acceleration requirements.

As with the other options, access to the Sydney rail network for a high frequency service would raise significant logistical and engineering issues to be resolved. However, because of its relative closeness to Sydney, the level of patronage for a very high speed train servicing Wilton could be much lower than for more outlying sites as other modes of transport would be more competitive in time and travel costs. Lower levels of patronage for the very high speed train would have a direct and negative effect on the viability of the service with the likelihood that fares would need to be higher.

The combination of these factors may lead to the conclusion that cheaper and more conventional rail technology would provide a suitable link between an airport at this site and Sydney. However, travel times by this mode would be longer.

Conclusions

The major difficulty of all of the alternative sites that lie outside the Sydney basin is their distances from Sydney, which would make it time consuming, costly and inconvenient for airport users to travel to and from the city area or to connect with Sydney's existing airport. Most major airports around the world are located within 50 kilometres of the central business district for the very reason that they have to be close to the markets they serve.

While a very high speed train is the commonly suggested solution for providing surface access to outlying sites, a preliminary examination of this option reveals serious doubts whether this would be practical due to the cost, environmental impacts and limited availability of corridors in which a very high speed train could travel. The very high service frequencies that would be required for a very high speed train would be unprecedented in international airport rail services. There are no international precedents for accessing an outlying airport primarily by a very high speed train.

Some of the suggested outlying sites would be likely to experience a greater local environmental impact from the development of a major airport than may be apparent from a cursory review of each site. The full extent of the potential environmental implications could only be determined from a comprehensive environmental assessment of each site.

5.4 Overview of Alternative Sites

5.4.1 History of Site Selection

The location and timing for the development of a second major airport for Sydney has been the subject of investigations for more than 50-years. The *Second Sydney Airport Site Selection Programme Draft Environmental Impact Statement* and *Supplement* (Kinhill Stearns, 1985a; 1985b) re-examined all potentially feasible airport locations and chose Badgerys Creek, Bringelly, Darkes Forest, Goulburn, Holsworthy, Londonderry, Scheyville, Somersby, Warnervale and Wilton for preliminary evaluation. These sites were evaluated against a range of factors covering the natural and socioeconomic environments, access to the city, airport operations, the cost of acquisition and provision of infrastructure.

A site selection process was then undertaken, as part of the 1985 environmental assessment process, by dividing the Sydney sites into two groups: a group of closer sites and a group of mid-distance sites. Goulburn was considered separately but was eliminated early on the grounds of distance and travel time to Sydney. A preferred site was selected from each group. Badgerys Creek was considered to be the best of the closer sites, and Wilton the best of the mid-distance sites.

Both Badgerys Creek and Wilton were subject to a full environmental assessment which was completed in December 1985 (Kinhill Stearns, 1985a; 1985b). This process found that no serious drawback had been identified for either site. In February 1986, the then-Commonwealth Government announced that Badgerys Creek had been selected as the site for the Second Sydney Airport because it was closer to the markets it was intended to serve; would involve a lower development cost; and would have less effect on the natural environment. The Badgerys Creek site was progressively acquired by the Commonwealth between 1986 and 1991.

5.4.2 Alternative Sites Within the Sydney Basin

The only possible alternative 'greenfield' sites that were identified as lying within the Sydney basin, that is Holsworthy, Scheyville, Londonderry and Bringelly, were assessed in the *Second Sydney Airport Site Selection Programme Draft Environmental Impact Statement* and *Supplement* (Kinhill Stearns, 1985a; 1985b) and were all found to be inferior to the Badgerys Creek site. A subsequent review of the Holsworthy site in 1996-97 failed to displace Badgerys Creek as the better site (see Chapter 4 of the Draft EIS). It is most unlikely that a detailed review now would find any of the other three sites identified above, superior to Badgerys Creek.

A number of other sites within the Sydney basin including RAAF Base Richmond, the Kurnell Peninsula, and an offshore location have been suggested as possible alternatives to Badgerys Creek. Each of these has serious deficiencies that are unlikely to be remedied within the time frame required for a decision on the second airport. These options, therefore, cannot be considered as prudent or feasible alternatives for a Second Sydney Airport.

5.4.3 Alternative Sites Outside the Sydney Basin

The siting of the Second Sydney Airport outside the Sydney basin was suggested in many public submissions on the Draft EIS. Alternative sites proposed include Goulburn, Lithgow, Newcastle/Williamtown and Wilton. A private sector proposal has also been announced for the location of a second international airport for New South Wales on Kooragang Island near Newcastle.

The major difficulty with all of the sites that lie outside the Sydney basin is the distance from Sydney which would make it time consuming, costly and inconvenient for airport users to travel to and from the city area or to connect with Sydney's existing airport. Most major airports around the world are located within 50 kilometres of the central business district.

While a very high speed train is the commonly suggested solution for providing surface access to outlying sites, a preliminary examination of this option indicates that there are serious doubts whether this would be practical. The very high service frequencies that would be required for a very high speed train would be unprecedented in international airport rail services. There are no international precedents for accessing an outlying airport primarily by a very high speed train.

5.4.4 Conclusions

The selection of Badgerys Creek as the site for Sydney's second major airport was the culmination of an exhaustive process which examined all reasonable alternatives. It is considered that there are no realistic alternative sites for a second major airport within the Sydney basin.

The viability of sites outside the Sydney basin (with the possible exception of Wilton) is almost entirely dependent on the feasibility of servicing these sites with a very high speed train. At this time, there is significant doubt that a very high speed train is capable of meeting the travel requirements of air passengers.

PART C
The Proposals

Chapter 6

Definition of the Proposal

Chapter 6
Definition of the Proposal

6.1 Summary of the Draft Environmental Impact Statement

6.1.1 Role of the Second Sydney Airport

In response to the long-term growth projections for aviation demand in the Sydney region, the Commonwealth Government proposed the development of a second major airport for Sydney, capable of handling up to about 360,000 aircraft movements and 30 million passengers per year.

As a precise role for the second airport was not defined, different scenarios of possible growth in air traffic at the second airport were developed for the Draft EIS. A range of traffic forecasts for the second airport (*Air Traffic Forecasts 1, 2* and *3*) was prepared based on different assumptions. *Air Traffic Forecast 1*, reflected the situation where the second airport would cater for overflow traffic from Sydney Airport. Higher rates of growth, as represented by *Air Traffic Forecasts 2* and *3* would require initiatives by the Commonwealth Government by way of economic regulation or administrative measures in order to reduce the attractiveness of Sydney Airport relative to the new airport.

The air traffic forecasts prepared for the Draft EIS showed that about 30 million passengers per year could be accommodated by some 245,000 annual aircraft movements.

6.1.2 Planning and Development of the Second Sydney Airport

The airport planning process was outlined in Chapter 8 of the Draft EIS. Master plans for the Second Sydney Airport were developed for the Draft EIS based on the need to accommodate about 30 million passengers per year. Key features of the master plans included two widely spaced parallel runways of up to 4,000 metres in length and capable of handling existing and proposed aircraft types. The provision of a cross wind runway, where possible, was intended to maximise airport useability for a variety of aircraft types.

A wide range of supporting facilities for domestic and international traffic was also included. Details were outlined of a possible Stage 1 level of development capable of handling about 10 million passengers per year. Also included was a description of the preliminary airport options considered in the planning process, the ongoing planning and design process, and the future management of the airport.

Three airport design options were considered in the Draft EIS. Master plans for each option, together with the potential Stage 1 development of each of the options, were included in Chapter 9 of the Draft EIS. The three airport options were:

- Option A, which was generally consistent with the planning for this site since 1986. The airport would be developed within land presently owned by the Commonwealth (1,700 hectares) with two parallel runways at a separation of 1,670 metres, and constructed on an approximate north-east to south-west alignment;

- Option B, which adopted an identical runway alignment to Option A, but had a greater distance between the parallel runways (separation of 2,300 metres), an expanded land area (additional 1,200 hectares), and also a cross wind runway; and
- Option C, which included two main parallel runways at a separation of 2,300 metres, on an approximate north to south alignment, in addition to a cross wind runway. The land area would also be expanded (additional 1,150 hectares) above that already owned by the Commonwealth.

The Draft EIS outlined the construction activities, the program, and the indicative cost estimates associated with building either the Stage 1 or the master plan level of development for the airport options. Conceptual plans were also included showing how Options B and C could be expanded to accommodate more than 30 million passengers per year if required. However, it was considered that such an expansion could not proceed unless a further environmental assessment and decision making process was undertaken by the Commonwealth Government. A conceptual plan was not prepared for Option A as the intention was to confine this option within the previously defined airport site boundaries.

6.1.3 Operation of the Second Sydney Airport

The Draft EIS showed flight zones that described in general terms the airspace that may be used by aircraft operating to and from the airport. Preliminary flight paths were also developed that took account of the management of Sydney's airspace and the need to ensure safe and efficient aircraft operations. The preliminary flight paths formed the basis for the assessment of the aircraft noise impacts.

Three airport operation scenarios were described in the Draft EIS. *Airport Operation 1* represented a preferred northerly flow of aircraft landings and take-offs on the parallel runways while *Airport Operation 2* represented the reverse flow of aircraft movements. *Airport Operation 3* represented a deliberate noise-sharing arrangement with seven percent of movements on the cross wind runway and the remainder distributed equally between the two parallel runway directions.

6.2 Summary of the Issues Related to the Definition of the Proposal

6.2.1 Issues Raised in Submissions

Role of the Second Sydney Airport

Submissions considered that the role of the second airport had not been adequately defined in the Draft EIS. There were different aspects to this issue in submissions ranging from fear that the second airport may be developed as a replacement for Sydney Airport, to concern that the new airport may enable the transfer of smaller aircraft from Sydney Airport, thereby increasing the capacity of Sydney Airport for larger aircraft. The submission from the NRMA commented that the potential role of the second airport would influence the nature of land transport links to major centres in the Sydney region as well as to Sydney Airport.

Submissions, most notably those from the Australian commercial airline industry, proposed that the second airport should only accommodate overflow traffic from Sydney Airport, which should be allowed to develop to its maximum or optimum operating capacity. The contrary view, particularly emanating from councils representing the areas around Sydney Airport, was that the second airport should be developed as a fully operating international airport that could lead to a reduction in the level of traffic at Sydney Airport.

There were comments in submissions that the three air traffic forecast scenarios prepared for impact assessment purposes were developed without consultation with the major air transport operators. Submissions also commented that the scenarios should have been optimised to reflect planning or airport needs. Others suggested that any changes to the scenarios may alter the environmental impacts.

Submissions, such as that from The Greens NSW, questioned the assumed capacity limit of 30 million annual passengers at Sydney Airport and the implications of this for the air traffic forecasts for the Second Sydney Airport. It was noted that no reason was offered as to why the future expansion of Sydney Airport would be so limited.

Planning and Development of the Second Sydney Airport

Submissions raised concerns that airport master plans could be changed in the future without adequate community consultation. Some submissions suggested that airport planning should be market driven. Doubts were expressed that a new airport at Badgerys Creek would have adequate capacity for the long-term. There was also comment that futuristic aircraft types, for example supersonic jets, had not been considered in the planning process. Submissions noted that the location of the airport radar facility had not been identified in the Draft EIS.

These was comment in submissions that environmental issues had not been adequately considered in the development of the airport options. The combination of three airport design options, three (or two for Option A) aircraft operating scenarios and three air traffic forecast scenarios, were considered to be excessive; this led to complexity in the environmental assessment and a broad rather than a detailed assessment.

There was support in submissions for one or more of the airport options. The main basis for support was the potential reduction in the impact of aircraft traffic at Sydney Airport, with some acknowledgment of the economic benefits of the second airport.

The submissions which supported Option C rather than the other two options, were based mainly on the perceived benefits associated with airspace compatibility of this option with Sydney Airport. Some submissions also considered both Options A and B to be unacceptable because of the potential for airspace conflict with operations at Sydney Airport. Option A was identified as having less potential for accommodating future traffic than Options B or C. It was suggested that Options A and B were preferable to Option C based on wind data. Opposition to Options B and C was expressed in submissions from some residents whose properties would need to be acquired, and further details were sought on how the acquisition process would proceed.

There were comments on specific features of the individual master plans for the three airport options. Submissions questioned the need for a cross wind runway in Option B. On the other hand, concern was expressed that the cross wind runway length may be inadequate. The lack of an internal connecting road within each airport master plan was also raised. There were also comments on the location of the airport rail station and the planning process required to ensure that a feasible rail link was established. Concern was expressed in regard to the possible need to undertake earthworks in the Blue Mountains and at Bringelly Hill in order to eliminate penetrations of the Obstacle Limitation Surfaces for the airport.

Submissions raised the issue of the potential ultimate development of the airport options and considered that this matter was not addressed adequately. It was even suggested that the second airport would not meet the forecast demand for the long-term and that work should proceed on identifying a site for a third major airport for Sydney.

Issues related to the future management of the airport were raised in submissions. Clarification was sought on the likely management framework, including the roles and responsibilities of each component of the organisational structure, as well as the various stages when different environmental management plans would be required.

Operation of the Second Sydney Airport

Submissions suggested that more detailed flight paths should have been developed for use in the environmental assessment. The limited assessment of the potential interaction of flight paths between Sydney Airport and the second airport also attracted comment. In this context, submissions also commented on the potential implications of the *Long-Term Operating Plan for Sydney (Kingsford Smith) Airport and Associated Airspace* (Airservices Australia, 1996).

There was comment in submissions that flight paths should have been modified to take account of noise abatement procedures.

6.2.2 Issues Raised by the Auditor

The Auditor considered that more detailed flight paths should have been developed for use in the environmental assessment, while recognising that final flight paths could not be developed at this stage in the planning process.

In addition, the Auditor found that the interaction of flight paths between Sydney Airport and the proposed Second Sydney Airport had not been assessed particularly in terms of the capacity of the two airports and the consequences for aircraft noise and other environmental impacts.

Finally, the Auditor found that the role of the second airport had not been defined adequately, but did acknowledge that a precise role and consequential staging of development was difficult to predict.

6.3 Responses to Issues Related to the Definition of the Proposal

6.3.1 Role of the Second Sydney Airport

Nature of Airport Development

In commenting that the role of the second airport had not been defined adequately, the Auditor considered that there should have been some attempt at collaboration and agreement between the Commonwealth Government and the aviation industry to determine a more precise role for the second airport. The Auditor also pointed out that knowledge of the future role of the Second Sydney Airport would greatly assist with the airport planning process.

While these comments are valid, it is not possible at this stage to define precisely the role of the second airport. The timescales are too long, the issues too complex and the stakeholders too numerous to enable the role of the second airport to be determined accurately at this stage in the planning process.

The airport's role would evolve over time in response to a wide range of economic, environmental, policy and operational considerations. This is likely to continue to be a complex process in view of the large number of stakeholders involved, including the airlines, communities and governments. Consistent with the deregulation of the airline industry, the privatisation of Qantas and the airports leasing program, private sector interests would play important parts in defining the role of the second airport.

In the absence of a precise definition of a future role of the second airport, a range of development scenarios was used in the Draft EIS for environmental assessment purposes. This approach was designed to give a comparison between different development options, and provide the community with a chance to comment on them. It also intended to help ensure that adequate flexibility was built into the planning process.

Review of Air Traffic Scenarios

Since the release of the Draft EIS, the air traffic forecasts for the Sydney basin have been reviewed. As discussed in *Section 4.3* of this Supplement, there has been an overall downward adjustment in both the passenger and aircraft movement forecasts. This reduction could be expected to result in some reduction, for any given year, in the traffic levels in the three air traffic scenarios for the second airport. As the proposal is for an airport capable of handling 30 million passengers per year, the downward adjustment in the forecasts means that the year in which this level of traffic would be reached would be later than 2016, on which the assessment in the Draft EIS was based.

Accurate predictions of background environmental conditions beyond 2016 are not considered to be practical particularly in relation to population levels and distribution. However, as the development of the airport would likely have a dampening effect on population growth in the areas adversely affected by the airport, it is considered reasonable to continue to use the predicted 2016 background conditions for the environmental assessment of the proposal rather than attempting an assessment for a later year.

On the issue of the capacity of Sydney Airport and the associated implications of this for the air traffic forecasts for the Second Sydney Airport, the Draft EIS assumed a notional capacity of 30 million passengers per year at Sydney Airport, reflecting planning work undertaken by the airport operator. While the Commonwealth Government has indicated that no further major infrastructure development will be allowed which increases the airport's runway capacity, there is no stipulated limit on the airport's passenger capacity. *Section 4.4.1* of this Supplement discusses scenarios for the capacity of Sydney Airport, which exceed 30 million passengers per year, and also identifies circumstances in which the airport's capacity could be further constrained by environmental factors.

Given the uncertainty surrounding the annual passenger capacity of Sydney Airport and the time at which this may be reached, it is considered that the air traffic forecasts that have been developed for the Second Sydney Airport are likely to be conservative and, therefore, are still a reasonable basis for the environmental assessment of the proposal.

The Auditor commented that the three air traffic scenarios used for impact assessment purposes had been developed without consultation with the major air transport operators, and that this was directly related to the lack of definition of the role for the second airport. In their submissions on the Draft EIS, both Qantas and Ansett indicated that their preference was for the Second Sydney Airport to develop in response to market demand, with Sydney Airport being allowed to grow to its maximum or optimum capacity. This effectively corresponds with *Air Traffic Forecast 1* for the Second Sydney Airport. However, all three traffic scenarios needed to be considered to allow for the environmental assessment of a 'worst-case' scenario as well as providing for possible policy initiatives by the Commonwealth Government in relation to traffic distribution between Sydney Airport and the new airport.

The Auditor commented that the scenarios that were developed might not have reflected the operational experience of other multi-airport systems overseas. Section 6.6 of the Draft EIS contained a discussion of international experience with multi-airport systems. Each multi-airport system has a unique range of circumstances applying to it, and although common elements might exist between systems, the experience derived from one multi-airport system cannot necessarily be compared directly to another. Based on overseas examples, it could generally be concluded that *Air Traffic Forecast 1* would be the most likely scenario for Sydney if market forces were to prevail, and even this may be optimistic, depending on the ultimate capacity of Sydney Airport. However, as stated in the previous paragraph, other scenarios need to be considered to allow for possible Commonwealth Government intervention in relation to traffic distribution.

Potential Staging of Airport Development

Linked to the role of the airport and the influence of market forces on demand is the issue of the scale of initial airport development. It is likely that the proposed airport would be developed in stages in line with growth in aviation demand. The Commonwealth Government has indicated that it expects that the new airport would be capable of handling domestic and international traffic from the outset. A potential Stage 1 development was outlined in the Draft EIS capable of handling 10 million passengers per year (based on year 2006 for *Air Traffic Scenario 2*).

An airport with an annual passenger throughput of 10 million passengers is a major airport by Australian standards. It is comparable, for example, to Brisbane Airport. Given the uncertainties associated with the likely rate of air traffic growth at the second airport, it may be preferable to construct the Stage 1 level of development in a number of phases rather than as a single major project. Subject to a predetermined minimum level of development that may be specified by the Commonwealth Government, the scale and timing of each phase is likely to be strongly influenced by the financial viability of the development for the airport lessee. This, in turn, will be largely dependent on actual aviation demand at the second airport.

6.3.2 Planning and Development of the Second Sydney Airport

Purpose of an Airport Master Plan

The issue of future changes to airport master plans without adequate community consultation was raised in submissions. In response, it should be noted that an airport master plan may be misinterpreted as representing a commitment by an airport owner to the provision of a specific level of infrastructure and supporting facilities. Alternatively, a master plan may also be viewed as a rigid constraint on how an airport would be developed over the long-term.

In practice, the purpose of a master plan is to set out the broad framework (for example runway alignments and terminal areas) for the possible long-term development of the airport and to include an indication of the size, extent and timing of required support facilities for the airport. The master planning process needs, however, to be flexible so that changes that occur over time can be accommodated. Long-term aviation forecasts are generally reviewed on a regular basis and this may have flow-on implications for the airport master plan.

The future development of the Second Sydney Airport is expected to be subject to the *Airports Act 1996*. The Act contains specific provisions dealing with the process for developing master plans for airports. These provisions are intended to ensure that master plans are developed in a transparent manner allowing for appropriate consultation with stakeholders.

The Act requires that, within 12 months of the sale of the airport lease, the lessee company must lodge a master plan for the airport with the Minister for Transport and Regional Services for approval. The master plan is to have a 20 year strategic outlook and remains in force for five years unless a replacement plan is approved beforehand.

In preparing the master plan, the lessee company must advise the Minister of any consultations undertaken with State and local government authorities, airlines or other airport users, or other persons. A draft master plan is to be made available for a 90 day public consultation period before being presented to the Minister, and after any changes have been made as a result of community input.

There is no requirement for the environmental assessment of master plans. However, a major development plan would need to be prepared prior to the building of any major element of the airport infrastructure such as a runway, large passenger terminal, capacity enhancing taxiway or the like. Major development plans are also subject to a process of community consultation and must be approved by the Minister for Transport and Regional Services. If the Minister considers the proposed development to be environmentally significant, then the development would be subject to the provisions of the *Environment Protection (Impact of Proposals) Act 1974*.

The roles and responsibilities of airport management in the preparation of Environmental Management Plans for the construction and operation of the airport are addressed in *Chapter 25* and *Appendix* M of this Supplement.

Airport Facilities and Requirements

It was suggested in some submissions that the planned capacity of the Second Sydney Airport of 30 million passengers per year might prove inadequate in the long-term. The planned capacity is some 50 percent greater than the current traffic at Sydney Airport. Even for the most optimistic growth projection (*Air Traffic Scenario 3*), the capacity of the Second Sydney Airport is unlikely to be reached before 2016. For lower growth rates, the capacity would be adequate until well beyond 2016. Some provision has been made to expand the capacity of the airport in the future if required (see *Section 6.3.3* of this Supplement).

In response to comments that futuristic aircraft types, including supersonic jets, have not been considered in the planning process, it is pointed out that airport planning was based on accommodating New Large Aircraft still in the concept development stage. With a wingspan of up to 84 metres, it is much larger than the B747-400, which has a wingspan of 65 metres. While new and innovative aircraft types, including new supersonic types, may be developed in the future, aircraft manufacturers will have to ensure that these aircraft are compatible with infrastructure at existing major airports given the likely constraints on airport expansion.

The sonic boom associated with supersonic aircraft does not influence airport planning as aircraft responsible for this effect would not be flying at very high speeds when arriving at or departing from the airport.

The omission of an airport radar installation on the master plans in the Draft EIS is identified in some submissions as a deficiency. Planning for the airport (Second Sydney Airport Planners, 1997b) has included provision of a Terminal Area Radar as one of the supporting facilities for the airport. The location of the Terminal Area Radar is not a major design parameter at the concept design stage and its omission from the master plans in the Draft EIS at this stage is not significant. A final decision on the location of the Terminal Area Radar would need to reflect the detailed design of the airport and off-site obstacles and reflections. It is possible that, as at some other airports, the Terminal Area Radar could be located off-site.

Aspects of the master plans such as the possible need for an internal access road between the main terminal area and the general aviation/aircraft maintenance area are refinements that can be determined in the detailed design process after a decision has been made on a specific development proposal.

Other elements of the master plans, such as the location of and timing for the provision of the airport railway station, are matters that would need to be linked to further studies on the provision of external infrastructure to service the airport. Such studies would be a matter for negotiation between the Commonwealth and NSW Governments.

Cross Wind Runway

The need for a cross wind runway (in Options B and C) was questioned in some submissions, with the suggestion made that this runway could be eliminated without a significant detrimental impact on airport operations. The basis for this argument is that regular public transport aircraft likely to use the Second Sydney Airport have a cross wind tolerance of at least 20 knots and that an appropriate level of airport useability for these aircraft types can be achieved without a cross wind runway.

Australia has adopted a planning goal for wind useability for runways of 99.8 percent at capital city airports and 99.5 percent for other aerodromes. The wind useability for each of the current airport options is shown in *Table 6.1*:

Table 6.1 Runway Useability under Different Wind Conditions for the Master Plan Options

Airport Option	Overall Wind Useability (percent) — Aircraft Cross Wind Tolerance		
	10 knots	13 knots	20 knots
Option A	94.15%	97.25%	99.84%
Option B	97.75%	99.30%	99.96%
Option C	99.23%	99.91%	99.99%

Source: Second Sydney Airport Planners, 1997a

The deletion of the cross wind runway in Options B and C would result in the wind useabilities shown in *Table 6.2*:

Table 6.2 Runway Useability under Different Wind Conditions for the Airport Options Without Cross Wind Runway

Airport Option	Overall Wind Useability (percent) — Aircraft Cross Wind Tolerance		
	10 knots	13 knots	20 knots
Option A	94.15%	97.25%	99.84%
Option B	94.15%	97.25%	99.84%
Option C	90.97%	95.18%	99.52%

Source: Second Sydney Airport Planners, 1997a

As can be seen in *Table 6.2*, the elimination of the cross wind runway for Option B would reduce the overall airport useability to that of Option A. While the airport would still meet the useability planning goal for aircraft with a 20 knot cross wind tolerance, the useability for smaller aircraft would be reduced. The effect of eliminating the cross wind runway is much more pronounced for Option C, which would no longer meet the planning goal even for aircraft with a 20 knot cross wind tolerance.

On this basis, it would be premature to delete the cross wind runway from the master plans for Options B and C. However, it should be noted that the actual provision of a cross wind runway would depend on a number of factors, including the costs and benefits to aircraft operators and the airport lessee company, or any specific requirement to implement a 'noise sharing' policy at the airport.

The length of the cross wind runway does not need to be the same as the main runways as the requirement for its use is relatively limited. With a planned maximum length of 2,500 metres, the cross wind runway would be suitable for most aircraft types except for long haul jets. For comparison, the cross wind runway (runway 07/25) at Sydney Airport has a length of 2,529 metres.

6.3.3 Airport Options

Retention of Options

The Auditor and others commented that too many options (that is air traffic forecasts, airport designs, and operation scenarios) had been considered in the Draft EIS. In the case of the three airport design options developed by the airport planners, early elimination of one or two of these options would have denied the community the opportunity to examine the relative merits of these options and to make formal submissions as part of the environmental assessment process. Allowing such extensive community input was appropriate as two of the options were significantly different from expectations about airport development arising from the 1985 EIS (Kinhill Stearns, 1985a; 1985b).

The situation has not changed since the release of the Draft EIS. Taking account of the submissions on the Draft EIS as well as of the further work undertaken for this Supplement, it would be very difficult to justify eliminating one or two of the options from the assessment process at this time. In fact, eliminating options at this stage could be interpreted as compromising the integrity of the EIS process.

It was suggested in submissions that environmental issues were not adequately considered in the development of airport options. Section 8.7 of the Draft EIS outlines the process that was followed in considering preliminary airport options. Environmental issues were considered in refining the options to the three presented in the Draft EIS.

The current environmental assessment process itself is the mechanism for identifying any refinements to the airport options that are related to environmental factors. In this context, no major changes in the airport options have been identified and they remain a reasonable basis for evaluation purposes.

Option A Proposal

It was commented that Option A could not be expanded to become Sydney's principal airport. Section 9.2.1 of the Draft EIS indicated that this option was designed to be consistent with the proposal considered in 1985 and to fit within the site already acquired by the Commonwealth. Unlike Options B and C, there would be no room in Option A to develop further runways. However, the master plan for

Option A was designed to accommodate 30 million passengers per year, the same capacity as the master plans for Options B and C. The development of the Second Sydney Airport as Sydney's principal airport is not one of the objectives of the proposal.

No changes have been made to the master plan for this option.

In response to the comment that Option A is preferable to Option C based on wind data, *Table 6.2* shows that the useability of the parallel runways in Option A would be greater than for the parallel runways in Option C (without the cross wind runway). However, *Table 6.1* shows that the comment is not valid when the cross wind runway in Option C is taken into account.

Other comments in relation to this option were made mainly on the basis of the potential airspace conflict with Sydney Airport. This issue is considered further in *Section 6.3.4* and *Chapter 20* of this Supplement.

Option B Proposal

The only specific comments relating to the master plan for Option B concerned the need for the cross wind runway. This issue is addressed in *Section 6.3.2* of this Supplement.

The response to the comment that Option B is preferable to Option C based on wind data is basically the same as that provided on the same issue for Option A.

There were comments made in relation to the potential of this option to be expanded beyond a capacity of 30 million passengers per year. This issue is considered further in *Section 6.3.3* of this Supplement. Other comments on this option were made mainly on the basis of its potential airspace conflict with Sydney Airport. This issue is considered further in *Section 6.3.4* of this Supplement.

No changes have been made to the master plan for this option.

Option C Proposal

The only specific comments relating to the master plan for Option C concerned the need for the cross wind runway. This issue is addressed in Section 6.3.2 of this Supplement.

Comments were made on the relative merits of Option C compared with the other two options, mainly because of its perceived compatibility with aircraft operations at Sydney Airport. This issue is discussed in *Section 6.3.4* of this Supplement. Some submissions also regarded this option as the only one that had the potential to be developed as Sydney's principal airport. As noted previously, this is not an objective of the proposal.

No changes have been made to the master plan for this option.

Airport Construction and Cost Estimates

The Auditor considered that the discussion of construction works in the Draft EIS was too general and that further detail would be required to develop an environmental management plan for airport construction. Section 9.5 of the Draft EIS outlines the airport construction process. Specific construction impacts such as noise, air quality and traffic are covered in other chapters of the Draft EIS. Further details on airport construction are provided in the *Planning and Design Summary Report* (Second Sydney Airport Planners, 1997b).

An environmental management plan is not being prepared at this stage, but would be developed once a specific airport option was selected. Details on the process for developing an Environmental Management System and an outline of proposed environmental management measures for airport construction are provided in *Chapter 25* and *Appendix* M of this Supplement.

The Auditor commented that there was no limitation placed on construction working hours. Section 9.5.4 of the Draft EIS provided details of the daily time periods during which normal construction activity would be undertaken. It was acknowledged that some construction activities, such as major concrete and asphaltic paving operations, would be likely to be carried out 24-hours per day, as they require intensive use of specialist construction equipment. Subject to appropriate environmental approval, 24-hour construction is the generally the case on major infrastructure projects, for example, the Sydney Airport Rail Link and the Eastern Distributor. The overall duration of such activities would be relatively short; that is, for the life of the total airport construction project.

It would be reasonable to limit construction working hours if it was demonstrated that the impact on nearby residents was unacceptable. This could be determined once a decision was made on a specific airport development proposal. The length of working hours would then be one of the issues addressed in the preparation of an environmental management plan for construction.

The Auditor noted that the accuracy of the indicative cost estimates was minus 10 percent to plus 20 percent, and considered that this was suitable only for comparison purposes. The level of accuracy reflected the level of investigation and design undertaken and was considered appropriate for environmental assessment purposes.

Submissions by residents affected by the additional land requirements of Options B and C sought further details on the acquisition process. Any additional land that may be required for the development of one of the airport options would need to be acquired by the Commonwealth under the provisions of the *Lands Acquisition Act 1989*. It would be a matter for the Commonwealth Government to decide whether additional properties were acquired on a compulsory basis or by agreement with the current owners. This would be dependent on the timing of airport construction, the scope of development and the need to obtain access to the various properties involved. It is expected that any required land could be acquired within a period of 12 months from any decision on the need for additional land. The process for compulsorily acquiring land by the Commonwealth Government is clearly defined in the Act and well established in practice; it ensures that:

- the Commonwealth would issue a 'pre-acquisition declaration' to affected landowners stating that it was considering acquiring land for a public purpose;
- landowners may appeal to the Commonwealth to reconsider the decision to acquire the land;
- the Minister for Finance and Administration would consider the appeal and advise the landowner of his decision to either confirm the original declaration, vary the declaration or to revoke the declaration;
- if the Minister did not revoke or vary the pre-acquisition declaration, the landowner could seek a review of that decision by the Administrative Appeals Tribunal;
- if the acquisition proceeded, the Commonwealth would issue an 'acquisition declaration' stating that the land has been acquired by compulsory process;

- compulsory acquisition would entitle the former landowner to compensation which would take into account the market value of the land and improvements, severance (where only part of a property is acquired), disturbance (for relocation and resettlement costs), solatium (for unforeseen effects of moving home), and reasonable legal or professional costs; and
- former landowners would generally be able to rent their properties for at least six months after acquisition. This period may be shortened if there was an urgent need for the Commonwealth to take possession of the land.

There were concerns expressed in submissions in regard to possible earthworks away from the airport sites in order to remove infringements of the Obstacle Limitation Surfaces. While a number of potential terrain penetrations of the Obstacle Limitation Surfaces for the airport options have been identified, these do not necessarily need to be removed. An assessment by the Civil Aviation Safety Authority, based on preliminary design details provided by the Second Sydney Airport Planners, concluded that existing terrain intrusions of the Obstacle Limitation Surfaces outside the airport site would not impose restrictions or operational penalties on aircraft operations for any of the options. This matter would be reviewed in the detailed design phase of the airport development.

Ultimate Level of Airport Development

Further details were sought in submissions on the possible development of the airport options beyond the master plan stage. Section 9.6 of the Draft EIS outlines Conceptual Plans for Options B and C which describe how these options could be expanded in the long-term (possibly in about 30 years time) to accommodate more than 30 million passengers per year, which is the basis for the current master plans. The Conceptual Plans shown are based on the provision of a double, wide-spaced parallel runway system and associated supporting facilities.

As stated in the Draft EIS, it is not feasible for an EIS to examine potential impacts of a major airport within Sydney over a timeframe of more than 20 years. There would be so many variables to consider that any predictions of impacts would be speculative.

Through the current environmental assessment process, approval is being sought for the development of the airport to an operational limit of 30 million passengers per year. It is expected that the airport would be developed in stages with each major stage of infrastructure expansion being subject to the requirements of the *Airports Act 1996*. Therefore, the environmental implications of accommodating more than 30 million passengers per year or the implementation of any element of the Conceptual Plans would be addressed in accordance with the provisions of the Act.

6.3.4 Operation of the Second Sydney Airport

Flight Paths

The Auditor expressed the view that flight paths should have been determined before the environmental assessment process began, rather than as part of the airport planning and EIS process. There were, however, certain advantages in the approach adopted, as it provided the opportunity for early findings of the environmental assessment to be considered in the development of the airport design options.

Submissions, as well as the Auditor's, considered that more detailed flight paths should have been developed for use in the environmental assessment rather than the preliminary flight paths described in the Draft EIS. However, it was not practicable to develop more detailed flight paths for the proposed airport at this stage of airport planning.

The preliminary flight paths in the Draft EIS took account of Sydney Airport flight paths, although some flight paths for Sydney Airport were still being developed as a result of the introduction of the *Long-Term Operating Plan for Sydney (Kingsford Smith) Airport and Associated Airspace* (Airservices Australia, 1996). In December 1997, the new departure flight paths associated with the Sydney Airport *Long-Term Operating Plan* were introduced as part of the Government's noise sharing policy.

Prior to the new flight paths for Sydney Airport being introduced, modelling was carried out to ascertain their operational suitability. However, it took months of evaluation to assess their practicality.

To design more detailed flight paths for Badgerys Creek, Standard Instrument Departures, Standard Arrival Routes and Instrument Approach and Landing Procedures would need to be prepared. In addition, the baseline for the Sydney Airport flight paths would need to be established. The proposed airport and its surrounds would also need to be surveyed for obstacle clearance prior to the design of Standard Instrument Departures, Standard Arrival Routes and Instrument Approach and Landing Procedures.

The preparation and design of these procedures could be expected to take several months. For each airport option at Badgerys Creek, these procedures would then need to be modelled in real-time against all modes of operation at Sydney Airport. This time and resource consuming task would not be appropriate at this stage of the airport planning process.

As a number of airspace arrangements associated with the *Long-Term Operating Plan* at Sydney Airport are still to be implemented, it would be both unrealistic and misleading to provide, at this stage in the airport planning process, flight paths for Badgerys Creek that are any more detailed than those provided in the Draft EIS.

The preliminary flight paths for each airport option are presented in a number of diagrams in Chapter 9 of the Draft EIS. There was a comment by the Auditor that the range of air traffic movements per day presented in these diagrams was unclear. The legend in each diagram explains that the range of movements presented on the diagrams represents the assumed aircraft movements per day (on average) for *Air Traffic Forecast 3* in the year 2016. Allowing for variations in wind conditions, the range of aircraft movements per day, for landings and take offs in a particular direction, results from a deliberate policy of using one of the operating scenarios.

Potential for Modification of Flight Paths

There were comments in submissions that flight paths should have been modified to reduce potential noise impacts. Existing and foreseeable operational constraints were the primary factors considered in the development of the preliminary flight paths presented in the Draft EIS. This approach resulted in a worst case scenario in terms of potential noise impacts as a number of flight paths were located over areas of urban development that could have been avoided. The opportunity, therefore, exists to modify some of the preliminary flight paths to reduce the overflight of residential areas, thereby reducing the overall noise impact.

Chapter 8 of this Supplement demonstrates how the preliminary flight paths could be modified to mitigate noise impacts. However, given that the development of more detailed flight paths is not considered practicable (see previous section) it would be misleading to attempt to refine all of the preliminary flight paths at this stage with a view to significantly reducing the overall aircraft noise impact.

The Auditor considered that the airport operation scenarios should have been better defined through a process of consultation between the Commonwealth Government, the Department of Transport and Regional Services, Airservices Australia, Environment Australia and representatives of the airline operators. This would have enabled a preferred operating scenario to be identified which could then have been fed into the current environmental assessment process rather than being undertaken after the EIS process was completed.

In response to this comment, it should be noted that wind conditions throughout the day are generally the primary consideration in determining the choice of operating mode. Consequently the variability of the wind necessitates all three operating scenarios (including use of the cross wind runway where relevant) to be considered.

While airport operating policy would determine the choice of operating mode in low wind conditions, it would be premature to identify a preferred long-term operating scenario well in advance of the opening of an airport given that detailed flight paths would not be determined within that time frame. However, further consideration of the airport operating scenarios in the context of options for mitigating aircraft noise impacts is given in *Section 8.6* of this Supplement.

Interaction with Operation of Sydney Airport

The Auditor considered that noise and other environmental impacts arising from the interaction of flight paths between Sydney Airport and Options A and B for the second airport should have been assessed. In developing the flight paths for the second airport, attention was paid to the operation of Sydney Airport at that time. This was particularly important for Options A and B, in which the notional extended centrelines of the parallel runways would intersect with those at Sydney Airport over the northern suburbs of Sydney. However, given the progressive implementation and refinement of the *Long-Term Operating Plan* for Sydney Airport, a meaningful assessment of the noise and other environmental impacts arising from the interaction of flight paths between Sydney Airport and the second airport was not practical in the Draft EIS. This issue is discussed further in *Chapter 20* of this Supplement.

6.4 Overview of the Definition of the Proposal

6.4.1 Role of the Second Sydney Airport

To enable a realistic assessment of the potential impacts of the Second Sydney Airport, three sets of air traffic forecasts were developed and presented in the Draft EIS based on different assumptions on the rate of aviation traffic growth at the Second Sydney Airport. The three scenarios considered were:

- *Air Traffic Forecast 1*, where the Second Sydney Airport would handle overflow traffic from Sydney Airport with the proportion of international and domestic air traffic assumed to be similar at both airports;
- *Air Traffic Forecast 2*, where the Second Sydney Airport would be developed to handle 10 million passengers a year by 2006, with all subsequent growth in air traffic in the Sydney Basin being directed to the second airport (the proportion of international and domestic air traffic is assumed to be similar at both airports); and
- *Air Traffic Forecast 3*, where a greater proportion of international flights (using larger and consequently noisier aircraft) would be directed to the Second Sydney Airport which would accommodate about 29.3 million passengers by 2016.

These three scenarios would address a broad range of possible outcomes for future air traffic and include the likely worst case scenario for the Second Sydney Airport in relation to environmental impacts.

6.4.2 Planning and Development of the Second Sydney Airport

Subject to the findings of the environmental assessment process, the nature and timing of any airport development at Badgerys Creek would be a matter for future decision by the Commonwealth Government. To provide the community with the opportunity to examine the relative merits of more than one airport design, three airport design options were developed and assessed in the Draft EIS. The master plan for each of the options was based on accommodating up to 30 million passengers per year, and included general features such as parallel runways with the majority of terminal and other supporting facilities located between the runways.

The airport options assessed in the Draft EIS were:

- Option A, which would be generally consistent with the planning for this site since 1986. The airport would be developed within land presently owned by the Commonwealth (1,700 hectares) with two parallel runways constructed on an approximate north-east to south-west alignment;
- Option B, which would adopt an identical runway alignment to Option A, but would have a greater distance between the parallel runways, an expanded land area (additional 1,200 hectares), and also a cross wind runway; and
- Option C, which would provide two main parallel runways on an approximate north to south alignment in addition to a cross wind runway. The land area would also be expanded (additional 1,150 hectares) above that already owned by the Commonwealth.

A possible Stage 1 level of development for each of the options has also been prepared, based on accommodating up to 10 million passengers per year. This involves the provision of a single 3,600 metre runway and associated supporting facilities. It would also be possible to develop the Stage 1 of each option in a number of phases to reflect the rate of air traffic growth at the second airport.

There would be major costs involved in the construction, operation and environmental management of the Second Sydney Airport. The costs of constructing the airport to the master plan stage and the costs of providing supporting infrastructure such as road and rail links are outlined in *Table 6.3*.

Table 6.3 Construction and Infrastructure Costs (Master Plan)

Costs	Option A	Option B	Option C
Construction Costs (1997$)[1]	$3 to $4.1 billion	$3.5 to $4.8 billion	$3.4 to $4.7 billion
Infrastructure Costs (1997$)[2,3]	$1 to $1.1 billion	$1 to $1.1 billion	$1 to $1.1 billion

Notes:
1. *Range of costs due to assumed level of accuracy.*
2. *Infrastructure costs are estimated costs of infrastructure required to service the airport. They include roads, a rail line, water supply, fuel pipeline, gas supply, electricity supply, telecommunications and sewage disposal services.*
3. *Infrastructure costs have been increased by $80 million above those identified in the Draft EIS to allow for the upgrading of Devonshire Road.*

There may be a need to expand the capacity of the Second Sydney Airport in the long-term (possibly 30 years time) above the current planned capacity. The most economical way to achieve this would be to add a further parallel runway on the outside of each of the wide spaced parallel runways in the master plan. Conceptual plans have been developed for Options B and C illustrating this possible expansion.

6.4.3 Flight Paths for the Second Sydney Airport

Preliminary flight paths have been developed to allow an environmental assessment to be undertaken of each of the airport options. The flight paths represent the range that may be used if any of the airport options are developed, taking into account existing management of Sydney's airspace and the need to ensure safe and efficient aircraft operations. Any attempt to develop more detailed flight paths at this stage of the airport development process would be likely to be unrealistic and possibly misleading. It would imply a degree of precision and permanency of the flight paths that could not be guaranteed. It would be impossible to ensure that such flight paths would not need to be changed in the future.

PART D

Planning and Land Use

Chapter 7

Planning and Land Use

Chapter 7
Planning and Land Use

7.1 Summary of the Draft Environmental Impact Statement

7.1.1 Methodology and Purpose

The Draft EIS assessed the potential impacts of the airport options on metropolitan, regional and local land use planning and developed land use scenarios to assess the impacts of noise and other environmental factors. It also described the potential infrastructure that would be required to support each airport option. The implications of the airport options for employment-generating activities at and surrounding the airport were also discussed.

Planning scenarios were developed to help predict the influence of each airport option on Sydney's urban development in 2006 and 2016. The year 2006 was chosen because it represents the early years of operation of the airport. By 2016 an operational level of approximately 30 million passengers per year could possibly be reached. In developing these scenarios, consideration was given to relevant demographic and planning information, including previous planning work undertaken for an earlier proposal for an airport at Badgerys Creek (Task Force on Planning for the Sub-Region Surrounding Sydney West Airport, 1995; 1996a).

7.1.2 Planning Assumptions

Two future planning scenarios developed in the Draft EIS described how planning and future development might change as a result of the airport options. One scenario related to Options A and B, while the second scenario related to Option C. Both scenarios were based on a number of common assumptions which included:

- all new release areas identified in the Urban Development Program, which is managed by the NSW Department of Urban Affairs and Planning, would be available for development;
- population forecasts developed by the Department of Urban Affairs and Planning indicated desirable growth rates for the western, south-western and southern areas of Sydney; and
- the potential impacts of aircraft overflight noise.

The future land use scenario for Options A and B was based on the development of urban villages at Edmondson Park and Bringelly on a proposed rail line to the Second Sydney Airport. This possibility was identified in consultancy studies undertaken for the Task Force on Planning for the Sub-Region Surrounding Sydney West Airport (1995, 1996a). Combined, the ultimate population of these areas could reach 65,000 people, however, this population would not be achieved until some time after 2016. The Draft EIS assumed that by 2016 12,000 would live at Bringelly and 14,000 people at Edmondson Park.

The scenario for Option C would see a different rail line alignment to the airport as the development of an urban village at Bringelly would be impacted by aircraft overflight noise from the north–south runway alignment. Consequently, as an alternative to Bringelly, it was assumed that an urban village of 12,000 people by 2016 could be created in the Rossmore area.

In other respects, the planning scenarios were similar. None of the Government's urban release areas were predicted, in the Draft EIS, to experience aircraft noise impacts which would require their development to be abandoned. However, due to the assignment of some populations to the urban villages, a slowing of growth of some existing urban release areas was assumed. Rural and rural residential areas within the local government areas of Penrith, Liverpool and Fairfield would be affected by relatively high levels of aircraft noise that could be expected to slow population growth in these areas.

In relation to employment, the Draft EIS estimated that the Second Sydney Airport would generate 88,000 to 107,000 direct and indirect jobs (assuming 30 million passengers per year pass through the airport).

In Options B and C most of the direct employment would be located at the airport site, where the use of some 185 hectares of employment land is planned. This would not be the case on the smaller Option A site and there would be the potential to develop employment land in the proximity of the airport, possibly north of Elizabeth Drive, on land affected by aircraft noise. The balance of jobs would be likely to locate in existing vacant employment lands in the area around each airport site.

The Draft EIS recognised that development of the Second Sydney Airport would result in the displacement of commercial rural activities and rural residential development on the airport option sites and the surrounding area.

7.1.3 Services and Infrastructure

The Draft EIS described a range of road and rail connections to the Second Sydney Airport, such as the Western Sydney Orbital, and proposals for off-airport site services infrastructure required to support the airport options. The planning objectives of some of these proposals are unrelated to the development of the Second Sydney Airport; developing the airport options would provide significant advantages for regional planning and development.

7.2 Summary of Planning and Land Use Issues

7.2.1 Issues Raised in Submissions

Existing and Future Population Assumptions

Submissions on the Draft EIS considered that the 1996 population census data should have been used as a basis for establishing an accurate platform on which to calculate estimates of the region's future population. Other submissions claimed that, based on their knowledge of population development in the western Sydney region in recent years, the process for estimating future growth resulted in estimates which were understated, or alternatively, that the estimating methodology was flawed. Further, the NSW Government considered that the anticipated growth rate adopted in the Draft EIS for the urban villages was unrealistically high.

Other submissions considered that the existing residential density in the airport region was understated. Attention was drawn to Figure 10.8 of the Draft EIS which showed the land in the region surrounding the sites of the airport options as being 'rural' when, according to submissions, it is 'rural residential'. It was suggested that the two zonings have distinctly different population implications and that if it had been assumed that the whole area was zoned rural, the Draft EIS would have incorrectly assumed a much smaller regional population than is considered to be the case.

Influence of Second Sydney Airport on Future Land Use

Submissions regarding the land use assumptions adopted in the Draft EIS expressed concerns over the development of an urban village in the environmentally sensitive South Creek Valley. The Western Sydney Alliance and Liverpool City Council submissions, among others, raised the issue of the impact the proposed airport and associated urban development might have on local air and water quality, and on air and water quality in the broader western and south-western Sydney region. In particular, it was suggested that these issues were understated in the Draft EIS. The submission of the NSW Government also noted that residential development in the South Creek Valley is contrary to current Government planning policy.

Submissions also queried whether existing planning for the local area had been properly taken into account. These submissions suggested that insufficient recognition was given to previous studies of the area, especially those related to the South Creek Valley.

Submissions also raised the issue that the land use planning scenarios adopted for the airport options should not be based on noise impacts alone as aircraft noise is not the only issue which would determine how land use patterns would develop. In addition, the Western Sydney Alliance and others considered that making an assumption that the land use patterns for Options A and B would be the same was incorrect. The existence of the cross wind runway and the provision of 185 hectares of employment land associated with Option B are pointed to as the basis for adopting different land use assumptions.

The Western Sydney Alliance, Western Sydney Regional Organisation of Councils and Communities Against an Airport in Western Sydney Incorporated, among others, considered that the location of the urban villages in general, and the urban village for Option B at Bringelly in particular, did not take into account the noise impacts arising from the operation of the cross wind runway. Accordingly, it was suggested in the submissions that the location of new high density urban development under the flight path was inconsistent with good planning practice.

Another issue raised in submissions related to the potential range of alternative uses for the Badgerys Creek site should the development of an airport not proceed. The Western Sydney Alliance, the NSW Government and the Western Sydney Regional Organisation of Councils expressed the concern that the environmental implications of any alternative use of the airport site were likely to be significant.

In relation to land use and planning issues overall, submissions presented the view that the Draft EIS failed to take a holistic perspective on issues associated with planning for the airport. In particular, the lack of recognition given to existing land uses and the failure to integrate assessments of transport and support infrastructure within the EIS process was noted. In this regard Liverpool City Council emphasised the need for the Commonwealth Government to commit to the establishment of a regional development co-ordination body. Further, the submissions from the NRMA and Western Sydney Alliance, amongst others, considered that the Draft EIS failed to adequately consider the impacts of the proposal on the wider western Sydney region citing, for example, the exclusion of Parramatta from the study area.

Off-site Infrastructure Issues

A range of general issues were raised in submissions related to the impact that the airport and its associated infrastructure would have on existing regional land use, including rural and agricultural land usage, and over the loss of regional social and community facilities.

The treatment of the environmental impacts related to off-site transport and support infrastructure was considered in submissions from organisations, such as the Western Sydney Alliance, the NSW Government and many of the local councils in the region to be inadequate. It was also suggested that off-site infrastructure, such as the sewage treatment plant, should be assessed separately under the Commonwealth *Environment Protection (Impact of Proposals) Act, 1974*. Other submissions raised the issue of the impact that the development of the airport's support infrastructure would have on existing infrastructure.

The Integral Energy and NSW Government submissions on the Draft EIS suggested that details relating to electricity supply are not correctly portrayed and that the provision of an adequate supply of electricity for the airport proposal is contingent on the construction of considerable additional infrastructure. Other submissions indicated that considerable benefit could be derived from new public infrastructure provided to support a new airport.

Other Planning and Land Use Issues

Employment Land Assumptions

Concerns raised in submissions indicated that the method of calculating the required area of employment land related to the airport's development is not sufficiently detailed. A method should have been used which recognises the different land use needs of different industries. By adopting this broader approach it was suggested a significantly greater amount of employment land would be required than that presented in the Draft EIS.

Proximity of Airport to Urban Areas

Submissions on the Draft EIS also raised the issue of the proximity of the proposed airport to urban areas. It was argued that any new airport should be located in a remote location outside the Sydney basin.

Bents Basin Recreation Reserve

A concern was expressed in submissions that the Bents Basin Recreation Area would close if the airport were to proceed.

7.2.2 Issues Raised by the Auditor

The Auditor found that the Draft EIS ignored the fact that Option B had a 2,500 metre cross wind runway by assuming that Options A and B would generate a common regional land use pattern because they had similar runway alignments. As a consequence the proposed urban village of Bringelly would be situated within the 20 ANEC noise contour, although the impacts of this were not properly assessed.

In addition, the Auditor questioned the 'noise sharing' scenario, a reference to *Airport Operation 3*, whereby seven percent of movements would be directed to the cross wind runway in Options B and C. The Auditor considered that the impact of the greater use of cross wind runways on land use or development of urban villages was not identified.

The Auditor also found that the Draft EIS did not identify and assess the implications of the fact that third parties (non-CityRail operators) can now access rail infrastructure and operate trains.

Finally, the Auditor found that the development of appropriate scenarios to calculate employment land associated with the airport should be undertaken to provide a more accurate prediction of the potential impact on land use and employment land requirements.

7.3 Review of Existing and Future Population and Employment Estimates

7.3.1 Review of Methodology Used

Basis of Methodology

Failure to use the 1996 population census data and the methodology for estimating future population growth in western Sydney were common concerns expressed in submissions on the Draft EIS.

The results of the 1996 Australian Bureau of Statistics Census were not available for the purpose of the planning and land use, and other assessments, undertaken for the Draft EIS. In recognition of this limitation an estimate of the 1996 population was derived from photogrammetry of dwellings within the Community Assessment Areas. The concept of Community Assessment Areas was introduced to allow noise impacts on individual communities to be described and to relate the noise impacts to estimates of 1996 population, forecasts of 2006 and 2016 populations and to the number of noise sensitive land uses, such as educational facilities. This information was supplemented by analysis of published population estimates from the Department of Urban Affairs and Planning, local councils and the Australian Bureau of Statistics. The adopted methodology is described in detail in *Technical Paper No. 2*.

Review of 1996 Draft EIS Population Estimates

In response to the concerns raised in submissions on the Draft EIS regarding the population estimates used, a comparison of the 1996 Census populations against the populations used for the Draft EIS has been completed for this Supplement. For the purpose of this analysis a geographic information system was used based on the CensusView package, with 1996 data supplied by the Australian Bureau of Statistics compiled at the census collector district level. The results of this comparison for each of the 85 Community Assessment Areas is set out in *Table 7.1*.

Table 7.1 Comparison of Estimated 1996 Population Used in Draft EIS with 1996 ABS Census

CAA	Draft EIS - Estimated 1996 Population	ABS 1996 Census (Enumerated Residential Population)	Difference	
			Number	Percent
1	15,130	13,840	1,290	9.3%
2	3,020	3,000	20	0.7%
3	4,350	3,980	370	9.3%
4	50,730	43,690	7,040	16.1%
5	22,620	22,700	-80	-0.4%
6	16,370	15,320	1,050	6.9%
7	19,530	18,340	1,190	6.5%
8	35,190	34,220	970	2.8%
9	10,350	9,820	530	5.4%
10	13,390	13,010	380	2.9%

CAA	Draft EIS - Estimated 1996 Population	ABS 1996 Census (Enumerated Residential Population)	Difference	
			Number	Percent
11	21,470	19,880	1,590	8.0%
12	21,790	20,230	1,560	7.7%
13	30,910	28,590	2,320	8.1%
14	15,550	14,370	1,180	8.2%
15	10,500	10,460	40	0.4%
16	260	220	40	18.2%
17	190	510	-320	-62.7%
18	890	790	100	12.7%
19	12,220	11,520	700	6.1%
20	30,700	28,250	2,450	8.7%
21	50	250	-200	-80.0%
22	23,730	21,790	1,940	8.9%
23	31,810	32,280	-470	-1.5%
24	45,750	44,620	1,130	2.5%
25	450	480	-30	-6.3%
26	570	460	110	23.9%
27	580	640	-60	-9.4%
28	1,530	1,490	40	2.7%
29	2,500	2,300	200	8.7%
30	15,080	14,240	840	5.9%
31	50,050	52,990	-2,940	-5.5%
32	11,170	11,780	-610	-5.2%
33	21,960	26,890	-4,930	-18.3%
34	35,670	33,870	1,800	5.3%
35	3,780	3,550	230	6.5%
36	2,230	2,210	20	0.9%
37	1,620	1,590	30	1.9%
38	1,930	1,970	-40	-2.0%
39	2,820	2,660	160	6.0%
40	3,020	2,990	30	1.0%
41	1,180	1,140	40	3.5%
42	200	190	10	5.3%
43	390	360	30	8.3%
44	1,750	1,890	-140	-7.4%
45	3,000	2,740	260	9.5%
46	3,430	2,470	960	38.9%
47	260	300	-40	-13.3%
48	23,040	21,110	1,930	9.1%
49	6,980	5,670	1,310	23.1%
50	4,010	3,990	20	0.5%
51	18,370	17,420	950	5.5%
52	1,270	710	560	78.9%
53	2,300	2,320	-20	-0.9%
54	590	470	120	25.5%

CAA	Draft EIS - Estimated 1996 Population	ABS 1996 Census (Enumerated Residential Population)	Difference	
			Number	Percent
55	8,890	7,270	1,620	22.3%
56	1,920	2,470	-550	-22.3%
57	9,510	7,360	2,150	29.2%
58	16,180	12,620	3,560	28.2%
59	480	370	110	29.7%
60	18,960	14,300	4,660	32.6%
61	490	2,060	-1,570	-76.2%
62	580	640	-60	-9.4%
63	450	390	60	15.4%
64	320	450	-130	-28.9%
65	500	420	80	19.0%
66	930	820	110	13.4%
67	15,550	18,420	-2,870	-15.6%
68	10,630	8,390	2,240	26.7%
69	6,660	6,590	70	1.1%
70	11,660	9,820	1,840	18.7%
71	7,920	8,200	-280	-3.4%
72	15,770	11,520	4,250	36.9%
73	1,340	1,230	110	8.9%
74	670	720	-50	-6.9%
75	41,190	37,210	3,980	10.7%
76	3,200	2,330	870	37.3%
77	4,940	4,400	540	12.3%
78	300	1,570	-1,270	-80.9%
79	2,900	2,610	290	11.1%
80	19,860	17,970	1,890	10.5%
81	1,720	1,560	160	10.3%
82	320	330	-10	-3.0%
83	1,280	1,590	-310	-19.5%
84	17,570	31,710	-14,140	-44.6%
85	20,570	17,500	3,070	17.5%
Total	**901,490**	**865,410**	**36,080**	**4.2%**

Compared to the 1996 Census the population used in the Draft EIS as a basis for population projections to 2006 and 2016 was over-estimated by approximately 36,000 persons or four percent. The Community Assessment Areas with the greatest proportional under-enumeration of populations are typically those having less than 1,000 persons. If examination is made of only those community assessment areas situated less than 10 kilometres from the centre of the sites of the airport options (that is, Community Assessment Areas 15 to 18, 26 to 29, 36 to 45 and 62 to 63) the aggregate 1996 population was over-estimated in the Draft EIS by 1.5 percent.

Review of Densities

Some submissions considered that the existing residential density of the airport region is understated, partly based on interpretation of Draft EIS Figures 10.7 and

10.8 which showed the area of the airport site and the surrounding region as 'rural'. These submissions indicated that this area is actually zoned rural residential and, as such, these areas contain or are capable of containing a much larger population than would be the case if the area is taken to be zoned rural. It was suggested that this had implications for the numbers of people likely to be affected by future aircraft noise from the Badgerys Creek site.

Figure 10.7 of the Draft EIS depicted the zonings applying to the airport site and surrounding areas based on statutory environmental planning instruments (local environmental plans). These have been reviewed and are considered accurate. No rural residential zones exist within the area depicted by the figure. The Draft EIS acknowledged that substantial rural residential developments have been established in this area. Further, *Technical Paper No. 2*, which discusses planning and land use matters, states, in Section 5.2.1 that while the majority of zonings in the vicinity of the airports are rural or non-urban zonings (usually a 1(a) zone) with a 40 hectare minimum lot size, the distribution of residential dwellings reflects a rural residential density significantly greater than that. An analysis of the photogrammetry undertaken by QASCO estimates a density of approximately one dwelling per seven hectares within a four kilometre radius of Badgerys Creek. *Technical Paper No. 2* also states that the rural residential zonings in the vicinity of the site generally permit subdivisions of no less than two hectares.

Figure 10.8 depicts land uses within the Second Sydney Airport region; it was also compiled from zonings contained in the statutory environmental planning instruments of relevant local councils in effect in October 1997. These zonings were generalised down from specific sub-zones for ease of presentation only. It should be noted that neither Figure 10.7, nor Figure 10.8, have any bearing on the population assumptions or projections adopted in the Draft EIS.

Conclusion

The 1996 population estimate adopted as the basis for the planning and land use analysis in the Draft EIS remains a sound base for future population projections. The slight over-estimate in the 1996 population estimate is likely to have resulted in a conservatively high, that is pessimistic, estimate of future populations potentially effected by aircraft overflight noise and other impacts associated with the operation of the Second Sydney Airport.

7.3.2 Land Use Influences of Airport Options A and B

Population

The Draft EIS indicated that a common set of land use development assumptions was adopted in respect of Options A and B as they both "*have the same parallel runway alignment and, therefore, would have a similar impact on surrounding land use planning controls*" (PPK Environment & Infrastructure, 1997:10-23). Submissions on the Draft EIS, as well as from the Auditor, have indicated that this was inappropriate, as Option B incorporated a cross wind runway and more widely spaced parallel runways on a larger airport site and, consequently, a bigger noise footprint area.

An assumption common to Options A and B was that an urban village might be developed at Bringelly along a potential airport rail link from Glenfield. Submissions on the Draft EIS asserted that aircraft operations from the Option B cross wind runway would impose noise levels on the Bringelly village in excess of the 20 Australian Noise Exposure Concept (ANEC) contour.

The possible location of the Bringelly village is south-east of the intersection of Bringelly Road and The Northern Road and was shown in the Draft EIS (Figure 10.2) as an indicative circle in this general area. *Figure 7.1* shows the location of Bringelly village based on the work undertaken by the Task Force on Planning for the Sub-Region Surrounding Sydney West Airport (1996a) and its relationship to the 2016 20 ANEC contours for each of the three airport operations for Option B. Under Option B, the Bringelly village would be outside the 20 ANEC contour for *Airport Operations 1* and 2. For *Airport Operation 3*, which assumed a noise sharing arrangement with higher use of the cross wind runway, the 20 ANEC would affect the urban form of the village, assuming restrictions on the rezoning of land or carrying out of development provided for by the *Section 117 Direction S19* - Second Sydney Airport Badgerys Creek were enforced. Sufficient flexibility in the design and location of the Bringelly village exists to enable the populations to be relocated so that they would not fall within the area affected by the 20 ANEC contour.

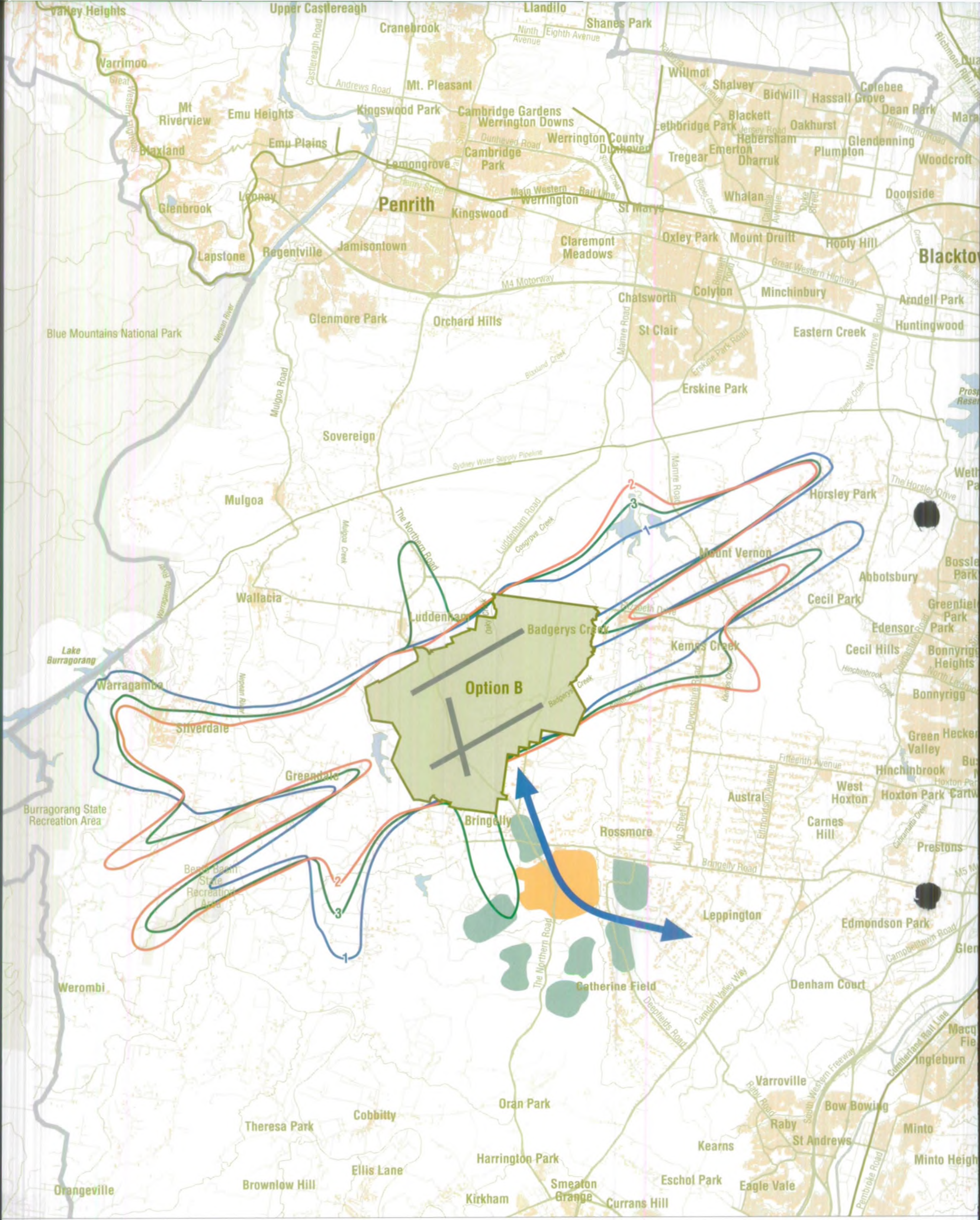
It should, however, be emphasised that the Draft EIS did not precisely define the location or extent of the Bringelly and Rossmore urban villages. Such precision was not warranted for three reasons; that:

- the work of the Taskforce was not completed and was not endorsed by participating organisations, namely Commonwealth, State and local governments;
- the discussion of future land uses in the Draft EIS, and this Supplement, is intended to provide an indication of the possible characteristics of the future environment rather than resolving future land use planning around the airport; and
- any future land use restrictions would be determined by the ANEF contours, based on the actual operation of the airport, rather than the ANEC contours.

It was assumed in the Draft EIS that the villages could be planned to avoid residential development within areas affected by noise greater than 15 ANEC. Adopting the 15 ANEC contour was based on an acknowledgment that communities in quieter areas, such as those living in areas surrounding the proposed airport, were likely to be more sensitive to aircraft overflight noise than communities with previous noise exposure. This went beyond the land use compatibility guidance provided by *Australian Standard 2021-1994*.

The Draft EIS noted that a framework of statutory planning controls, comprising a combination of State Environmental Planning Policies, Regional Environmental Plans, Local Environmental Plans and Development Control Plans, would be needed to regulate future development around the airport site and ensure appropriate land use relationships were created or maintained. Changes to the existing zoning provisions might be required to regulate land uses within identified noise affected areas in accordance with guidance provide by *Australian Standard 2021 - 1994*. Presently, the direction made under *Section 117* of the *Environmental Planning and Assessment Act 1979* is the main instrument used to ensure that urban development does not encroach on the existing airport site.

Generally, these planning policies and controls prevent new residential and other noise sensitive land uses from being established within areas that may be subject to noise levels greater than 20 ANEC. The Draft EIS identified that, due to the uncertainty about how the airport may develop and expand in the future, a conservative approach, involving the application of greater restrictions to land use planning in areas outside of the 20 ANEC, might be appropriate. Some submissions



Core

Neighbourhood clusters

Potential rail corridor

20 ANEC Contours:

Airport Operation 1

Airport Operation 2

Airport Operation 3

Indicates density of dwellings in 1996

Extent of dwelling data

Figure 7.1
Location of Bringelly Urban Village

Source: Task Force on Planning for the Sub-Region Surrounding Sydney West Airport, 1996a
Note: 2016 20 ANEC contours (Air Traffic Forecast 3) for Option B only shown.

commented on the current application of these land use controls and suggested that, because of experience with reaction to aircraft overflight noise around Sydney Airport, more stringent land use controls would, in their opinion, be appropriate.

Australian Standard 2021 - 1994 is based on research into the reaction of people to aircraft overflight noise. Review of the standard would necessitate extensive investigation and would need to be considered in the national context. While outside the scope of this EIS, review of the standard should be considered by relevant planning authorities, including the Department of Transport and Regional Services, if the Second Sydney Airport proceeds.

In addition to the land use and planning controls discussed above, other options also exist for reducing potential noise impacts of any urban villages located around the airport, namely:

- more precisely defining and refining the location of future urban villages at Bringelly or Rossmore, or excluding the development of the urban villages from within the South Creek Valley altogether (potentially as described in *Section 7.4* of this Chapter);
- modifying flight paths (potentially as described in Chapter 8 of this Supplement); and/or
- modifying or restricting airport operations for Option B and C, for instance only using the cross wind runway when meteorological conditions require such use.

Employment

Submissions on the Draft EIS noted that Option A was different from Option B in that it did not contain an adequate supply of employment land on the airport site to cater for airport-related activities. This was a consequence of the smaller size of the Option A site. However, the Draft EIS noted that there would be potential for employment lands to be located both on site and in the aircraft noise-affected lands to the north of the airport site, on the northern side of Elizabeth Drive. As a consequence of the smaller Option A site, there would be a need for approximately 185 hectares of off-site employment land to meet expected demand for airport-related development in 2016.

Under both options, the land within the 20 ANEC contour to the north of the airport site would not be suitable for future residential development based on application of the *Section 117 Direction S19* - Second Sydney Airport: Badgerys Creek. This would limit the future use of this land to employment generating and rural activities. There was no appreciable difference between the land use scenarios for Options A and B in terms of estimates of surrounding populations.

The ultimate development of any land surrounding the airport for employment-generating activities could only proceed after consideration had been given to the advantages and disadvantages of such development proceeding and the potential environmental impacts. Such considerations would occur within the context of the planning process established by State environmental planning legislation and related local government planning controls. While both the activities conducted on major airport sites and the associated provision of infrastructure provide significant attractions for businesses to locate within or close to the boundaries of airports, the provision of upgraded transport links would also make existing employment zones within the region attractive for businesses seeking to derive commercial benefits from the operation of the airport.

Over the years there has been a number of responses to the employment lands needs of an airport at the Badgerys Creek site. These have included recommendations in the *South Creek Valley Draft Regional Environmental Plan* (Department of Planning, 1991), recommendations by the Taskforce on Planning for the Sub-region Surrounding Sydney West Airport (1996a) and recommendations by the *NSW Government Standing Committee on Public Works for the State Infrastructure Requirements Sydney West Airport* (NSW Government Standing Committee on Public Works, 1995) which indicated the desirability of creating an 'airport enterprise zone' at Erskine Park. Similar to the potential future residential planning responses to the Second Sydney Airport, a number of options would exist for satisfying employment needs. The precise planning for those needs would again be a matter for future consideration by the NSW State Government or possibly a multi-government planning organisation.

7.4 Review of Potential Influence of Second Sydney Airport on Urban Development

7.4.1 Purpose of Review

A view expressed in submissions from the NSW Government, the Western Sydney Alliance and the Western Sydney Regional Organisation of Councils, in addition to the individual councils in western Sydney themselves, and others, was that the Draft EIS failed to look holistically at the issues associated with regional land use planning and infrastructure provision. Because of the relationship between urban development and environmental issues such as air and water quality it was suggested that the impacts of the airport and associated infrastructure could not be understood unless the existing regional context was clearly stated.

Accordingly, the purpose of this review is to place in a regional context those issues and concerns raised in submissions on the Draft EIS regarding the potential influence the proposed Second Sydney Airport would have on planning and land use and key environmental issues such as air and water quality. Particular emphasis has been given to the issue of interdependence of future urban development and the provision of public transport. This review allows population scenarios used primarily for the assessment of noise and air quality impacts to be refined, as discussed in *Section 7.5*.

It is important, however, to clarify a number of apparent misconceptions about the Second Sydney Airport proposal. These are:

- the development of urban villages at Bringelly/Rossmore or at Edmondson Park forms part of the proposed airport development. The Commonwealth Government's role relates to the development of a second Sydney airport and does not extend to proposing or promoting the development of urban villages having a particular location or urban form. The Commonwealth Government has previously demonstrated a commitment to working with the NSW State Government to achieve environmentally sound development in the region surrounding the airport. Adoption of land use scenarios involving urban villages located at Bringelly does not represent tacit endorsement by the Commonwealth that this type of development within the South Creek Valley is acceptable. Investigations undertaken by the Taskforce on Planning for the Sub-region Surrounding Sydney West Airport (1995; 1996a), a joint Commonwealth, State and local government initiative, provided much of the framework for the development of the regional land use scenarios for Options A/B and C. The draft strategy prepared by the Taskforce on Planning for the Sub-region Surrounding Sydney West Airport (1996a) was not formally submitted to either the NSW State or Commonwealth Governments. The assumption made in the Draft EIS that these urban villages might exist in the future was made to ensure that the potential worst case bio-physical environmental impacts were considered. The locations of these populations were factored into noise and air quality assessments; and

- the development of urban villages is necessary to support the financial viability of the rail link. No assessment was made in the Draft EIS of the financial viability of the rail link. Section 22.6.2 of the Draft EIS noted that, having regard to previous investigations, the viability of the rail link would be strengthened by an increase in potential airport passenger numbers from 13 million per annum (the nominated limit of the 1985 airport proposal) to 30 million in the current airport proposal.

7.4.2 Background

The Commonwealth Government's choice of Badgerys Creek as the site for Sydney's second airport in 1986 has had a significant influence on several long-term metropolitan land use and transport planning strategies developed by the NSW Government and local governments. Based on experience with airports elsewhere, it is generally acknowledged that development of western Sydney would be significantly influenced by the provision of infrastructure associated with the airport; providing a catalyst to employment and economic growth; potential residential development; and associated human and physical services (Task Force on Planning for the Sub-Region Surrounding Sydney West Airport, 1996a).

The Bringelly/South Creek Valley area was first identified for possible urban development to accommodate forecast metropolitan population growth in the 1988 *Metropolitan Strategy - Sydney Into Its Third Century* (Department of Planning, 1988). Planning for the area was accelerated when the South Creek Valley was included as 'an area under investigation' in the 1989 update of the Strategy, partly as a result of the Commonwealth's decision to develop a general aviation facility at Badgerys Creek by 1992.

In 1991, the *South Creek Valley Draft Regional Environmental Plan*, recognising regional constraints to development, identified approximately 10,000 hectares of land between Penrith and Camden capable of urban development (refer to Figure 10.1 in the Draft EIS) (Department of Planning, 1990a and 1991). Subsequent reviews and investigations (Department of Planning, 1992 and 1993) resulted in the removal of the South Creek Valley from the schedule of potential urban development areas pending resolution of environmental concerns. Specifically these concerns related to:

- the capacity of the Hawkesbury Nepean River to accept increased volumes of pollutants associated with further urban development;
- the tendency of air pollutants generated from all parts of Sydney to gather in the Hawkesbury Nepean Basin;
- the lack of an immediate demand for large areas of employment land given the current and projected take-up rates for industrial land within the Sydney region (at that time); and
- the cumulative impacts on air and water quality in the western Sydney region.

In 1995, the NSW Government adopted two key strategic policies related to the greater metropolitan region, which collectively formed the planning strategy for the development of Sydney. These were *Cities for the 21st Century* (Department of Planning, 1995) and *Integrated Transport Strategy for the Greater Metropolitan Region*

(Department of Transport, 1995). In December 1998, *Cities for the 21st Century* was replaced by *Shaping Our Cities - Planning Strategy for the Greater Metropolitan Region of Sydney, Newcastle, Wollongong and the Central Coast* (Department of Urban Affairs and Planning, 1998a), although the strategies are broadly consistent. The most recent planning strategy is accompanied by *Shaping Western Sydney - The Planning Strategy for Western Sydney* (Department of Urban Affairs and Planning, 1998b). These documents embody the basic principles which currently apply to metropolitan-wide land use and transport planning and their interaction. This, in turn, has significant application for planning for the region around the Second Sydney Airport. A key consideration in the adopted policies is the management of population growth and catering for the expanding employment market, having regard for its changing nature.

In the period to 2016, the metropolitan strategy estimates that about 500,000 new dwellings will be required in the Sydney region to accommodate a projected population of 4.5 million people (Department of Urban Affairs and Planning, 1998a). Most of the dwellings to be built on Sydney's urban fringe will be located in areas already incorporated into the NSW Government's Urban Development Program or in already established areas. Options for the location of long-term urban development include areas such as Rouse Hill, Warnervale, West Dapto and Newcastle West. Decisions on their development will depend on environmental, economic and transport considerations. The South Creek Valley-Bringelly area has been removed from the metropolitan strategy as a potential location for long-term urban development.

In considering opportunities for urban villages in the South Creek Valley-Bringelly area as part of the development of the Second Sydney Airport and the surrounding region, the Draft EIS indicated that development in the South Creek Valley would be contingent on the resolution of several issues, including the provision of a rail link to an airport at Badgerys Creek and those arising from other environmental concerns. The potential for urban development in South Creek Valley was based on the metropolitan strategy current at that time *Cities for the 21st Century* (Department of Urban Affairs and Planning, 1995). Analysis of the airport options for this Supplement were completed before the release of the current metropolitan strategy in December 1998. Despite the removal of a reference to the South Creek Valley in the current metropolitan strategy, the possibility of urban villages situated on a rail link to the airport remains a valid basis for determining the impacts of the airport options. There is a recognition of this in *Shaping Our Cities - The Planning Strategy for the Greater Metropolitan Region of Sydney, Newcastle, Wollongong and the Central Coast* which states:

> *There will continue to be unresolved urban issues which will have a significant bearing on the shape and management of the region. The most significant of these may be the Commonwealth Government's decision on the proposed Second Sydney Airport at Badgerys Creek* (Department of Urban Affairs and Planning, 1998a).

7.4.3 Planning and Environmental Issues

Environmental Issues

As previously stated, submissions on the Draft EIS raised two key environmental issues in relation to any new urban development, either specifically associated with the airport or urban development more generally, within the South Creek Valley.

Community concerns over air quality in western Sydney and water quality within the Hawkesbury Nepean River System led the NSW State Government to defer a decision on proceeding with development in the South Creek Valley as a result of potential adverse effects on air and water quality.

Air Quality

The influence of local topography and air currents in the Sydney basin tend to carry pollutants towards western Sydney, where they can be slow to disperse under certain weather conditions (refer to *Technical paper No. 5*). Air quality in western Sydney is acceptable for the majority of the time; that is, air quality is generally within current health guidelines, although summer ozone levels regularly approach and occasionally exceed the relevant guidelines.

It should be recognised that managing and improving local and regional air quality necessitates actions and strategies at a national, State and local level. Strategies such as the *National Greenhouse Strategy* (Commonwealth of Australia, 1998) identify energy-efficient transport and sustainable urban planning as key components to reducing greenhouse gas and pollutant emissions. The NSW Government's recent air quality management plan *Action for Air* (Environment Protection Authority, 1998a) promotes the following actions to address air quality issues across the Greater Sydney Metropolitan Region:

- developing a transport plan to reduce growth in vehicle kilometres travelled;
- integrating transport issues in regional and local planning and in particular ensuring:
  - urban consolidation policies which provide for a range of housing choices and for higher-density development close to rail and other transport corridors; and
  - 'centres' policies which facilitate multi-purpose trips and reduce demand for car travel by encouraging the concentration of retail, commercial, entertainment and community service activities into centres that can be well served by public transport;
- implementing accessibility criteria for new residential development as a framework for assessing areas for inclusion in the urban development program; and
- setting targets for increasing public transport patronage for journeys to work at key centres.

In relation to any new urban development within South Creek Valley the *Sydney West Airport Sub-region draft Strategic Plan* (Taskforce on Planning for the Sub-region Surrounding Sydney West Airport, 1996a) sought to minimise the increase in vehicle emissions, and by implication moderate the increase in vehicle kilometres travelled, in three ways:

- by providing a rail link to reduce the use of private vehicles by air passengers and employees at the airport;
- by limiting the population of the proposed new urban villages to the minimum number necessary to make the rail link economically viable (stated to be 130,000 persons); and
- by promoting transit supportive development in the rail corridor to reduce the use of private vehicles by residents and employees in that development.

The emissions and the consequent impact of those emissions on local and regional air quality described in *Chapter 11* of this Supplement would occur if the airport were to proceed. These impacts include emissions from aircraft and motor vehicle traffic generated by the airport. Opportunities for reducing these emissions as part of the environmental management measures for the proposal would be limited. Reductions are, however, likely to occur as part of the gradual introduction of more stringent international and national standards in relation to aircraft and motor vehicle emissions. The introduction of further urban development, such as urban villages located along a rail corridor to the airport, would contribute to a further deterioration of air quality.

Water Quality

Construction of the Second Sydney Airport and potentially associated urban development would occur within the upper sections of the South Creek catchment. This catchment in turn forms part of the Hawkesbury Nepean River System. Many parts of the Hawkesbury Nepean River System might be considered to be in relatively good condition, for example, as a result of the presence of National Park and State Recreation Areas; however, smaller urbanised areas of the system are in relatively poor condition, especially in terms of water quality (Healthy Rivers Commission of NSW, 1998). River health is adversely affected by the removal of riparian vegetation; construction of dams and weirs which reduce downstream flows and inhibit fish passage; and effluent disposal from sewage treatment plants and on-site disposal systems, among other factors. The impacts of these activities on the South Creek catchment contributes to blue-green algae blooms, decreased populations of fish and other in-steam species, infestations of exotic species and excessive aquatic plant growth, and the destruction of riverine corridors.

A key finding of the Healthy Rivers Commission (1998:13) is that "*... urban development has already placed great pressure on the river, and that its health could be severely compromised by further developments unless they are most carefully designed and managed to contain their effects*". All forms of urban development have the potential to further degrade water quality through increases in sediment loads and increases in the quantity of gross pollutants and nutrients entering water courses. Construction of impervious surfaces associated with urban development would reduce rainfall infiltration and urban drainage would accelerate the rate of run-off, causing total run-off volumes and peak flood discharges to increase.

Concerns related to water quality in the South Creek catchment are not new and the Task Force's *Sydney West Airport Sub-region draft Strategic Plan* indicated that "*the effects of urbanisation upon water quality in the Sub-Region have been identified as a major constraint to development in the SWA Sub-Region*" (Taskforce on Planning for the Sub-Region Surrounding Sydney West Airport, 1996a).

While water quality management measures, such as sediment control devices, grass swales and constructed wetlands, could compensate for the effect of urban development, an improvement in water quality in the South Creek catchment would only be achieved through a wider application of measures to improve water quality in the remainder of the catchment. Further, the *Sydney West Airport Sub-region draft Strategic Plan* concluded that if sewage effluent were treated to near-potable standard prior to discharge to South Creek, then no effective restrictions on population levels would arise from a sewage management perspective (Task Force on Planning for the Sub-Region Surrounding Sydney West Airport, 1996a).

Chapter 13 of this Supplement outlines the predicted water-related impacts arising from operation of the airport. Environmental management measures, as outlined in *Appendix* M, to mitigate water-related impacts would include:

- treating on-site sewage to enable reuse as a non-potable water supply for the airport and accordingly ensuring that discharges to the South Creek catchment would be infrequent, highly diluted and would contain low levels of nutrients;
- improving downstream water quality, with the exception of suspended solids, over existing conditions by treating all surface water run-off in water quality control ponds prior to discharge to the South Creek catchment; and
- controlling flooding by reducing peak stormwater flows to pre-development levels through the construction of stormwater detention basins.

Planning Issues

The NSW Government has questioned the anticipated growth rate adopted in the Draft EIS for the urban villages as being unrealistically high. To a large extent growth rates are conjectural and, in planning terms, relate to a number of inter-related factors, including:

- the optimal village size that allows a community to be self-sustaining;
- the timing of urban development and the rate of service provision and physical infrastructure;
- the proposed density of development and the ability to achieve high density development in urban fringe locations; and
- the timing and provision of public transport services.

Accordingly, the following discussion seeks to place these factors in the context of previously identified potential land use scenarios identified in the Draft EIS and based on work undertaken by the Taskforce on Planning in the Region Surrounding Sydney West Airport (1996a). No consideration has been given to macro-economic factors such as immigration, migration or natural economic growth, although it is recognised that these factors have considerable potential to influence the location, rate and timing of urban development.

Optimal Village Size

Conventional planning theories suggest that the minimum size of a relatively self-sustaining community should be approximately 5,000 persons. In planning undertaken by the Task Force on Planning in the Region Surrounding Sydney West Airport (1996a) a number of conclusions were drawn regarding the appropriate size of an urban village situated at either Bringelly, Rossmore and Bardia/Edmondson Park. Fundamentally, the village size was determined by the minimum amount of urban development and population likely to be required to make provision of high quality public transport, in the form of a heavy rail link, economically viable. The conclusions were that:

- a population of 130,000 persons would be required to make the rail link economically viable based on a scenario of 14,000 airport related employment jobs and seven million passengers per annum by 2020;
- a population distribution of 35,000 persons at Bardia, 45,000 at Bringelly and 20,000 at Badgerys Creek. It should be noted that an urban village at Badgerys Creek was excluded from the Draft EIS land use scenarios because the village would be situated too close to the airport to remain unaffected by a range of environmental impacts, such as ground running noise and aircraft overflight noise;

- a population of 35,000 persons would be the minimum number required to operate a viable feeder bus service to rail stations; and
- an overall neighbourhood dwelling density of 35 dwellings per hectare would be needed, ranging from 78 dwellings per hectare in high density development, oriented around a district core at a rail station, to nine dwellings per hectare in low density outer neighbourhoods.

The current proposal for a Second Sydney Airport, as described in the Draft EIS, reflects an operational scenario anticipating up to 30 million passengers annually and approximately 35,000 on-site employees. It is, therefore, a reasonable assumption that a smaller total population would be required to provide rail link economic viability. In these circumstances and having regard for the Draft EIS' airport noise contours, the proposed Badgerys Creek village was not included in the regional land use planning scenario used for assessment purposes.

Ultimately, if the economic viability of a rail link is removed from the equation, the optimal village size is conjectural and would be influenced by location, servicing and environmental considerations. Distance from a major urban area may suggest in any event that a larger population might be appropriate to achieve economies of scale in the provision of community services. Similarly, infrastructure provision, such as water or sewerage, may require a community size of at least 10,000 to make economic the provision of the necessary facilities.

Some guidance as to the populations required to support various human services can be gained from examining the various planning guidelines as set out in *Table 7.2*.

Table 7.2 Planning Guidelines for Human Services[1]

Service	Guideline
Primary School	One for every 5,000 to 6,500 persons
High School	One for every 15,000 to 30,000 persons
Local Community Centre	One for every 10,000 persons
District Community Centre	One for every 35,000 persons
Youth Centre (small)	One for every 10,000 persons
Library	One for every 10,000 to 20,000 persons
Early Childhood Clinic	One for every 10,000 persons
District Community Health Centre	One for every 30,000 to 50,000 persons

Source: *Adapted from Task Force on Planning for the Sub-Region Surrounding Sydney West Airport, 1996; Department of Housing and Urban Development, 1994; Commonwealth Department of Housing and Regional Development, 1995.*

Note: 1. *The rate at which human services would be provided would depend on the demographic characteristics of the population and the life cycle of the community.*

Density

The average net neighbourhood density proposed by the Task Force for Bringelly is 35 dwellings per hectare. By way of comparison, the current metropolitan strategy (Department of Urban Affairs and Planning, 1998b) seeks to achieve an average of 15 dwellings per hectare on new greenfields housing estates. Achievement of higher residential densities is desirable to take advantage of opportunities afforded by a rail link to reduce private vehicle use, maximise use of public transport, and maximise the benefits from major infrastructure investment in western Sydney. Opportunities to provide cost-effective and convenient public transport are increased when neighbourhood densities are at least 20 dwellings per hectare (Pushkarev and Zupan 1977 in Commonwealth Department of Housing and Regional Development, 1995).

Based on average residential lot sizes being achieved in urban release areas in the Liverpool local government area of 480 square metres (Department of Urban Affairs and Planning, 1998c), current net neighbourhood densities in these areas are approximately 14 dwellings per hectare.

The ability to achieve a nominated residential density for a planned community at Bringelly, Rossmore or Edmondson Park is questionable given the context of the current housing market, the attitudes of the development industry and having regard to the residential densities currently being achieved for urban development at the fringe. The Task Force for Planning for the Sub-Region Surrounding Sydney West Airport (1996a) suggested that the achievement of higher density development in fringe locations presents a challenge requiring alternatives to be explored relating to joint venture development opportunities, innovative financing mechanisms, setting of minimum development densities and establishing appropriate urban design principles to guide new development.

Timing and Servicing

Another factor to consider is the timing and rate of urban development. It is likely, for instance, that the relevant strategic and statutory planning processes, including concept design for site planning and sub-division, and provision of physical infrastructure, would require a lead time of up to five years or more. Typically, another two years would be required before any of the lots released were taken up for occupation by residents. Studies by Cardew (1994) and Cardew and Cameron (1988) suggest that in metropolitan Sydney areas released under the Urban Development Program take more than 10 years to be fully developed.

In the previous metropolitan strategy, *Cities for the 21st Century* (Department of Planning, 1995) it was indicated that, up to 2021, urban growth would principally occur in areas which are already nominated as being part of the urban development program. The new metropolitan strategy indicates that new greenfield sites might be required by 2016 (Department of Urban Affairs and Planning, 1998b). However, if a rail link to the Second Sydney Airport was operational at an earlier date and having regard for the metropolitan strategy objectives of developing urban areas around transport opportunities, it might be expected that urban development would be facilitated at airport rail link stations coincidental with the start date of rail services.

7.4.4 Relationship Between Transport, Planning and Urban Development

The primary goal in terms of land transport is to provide efficient access to and from the airport. In achieving this it is desirable to moderate the demand for private car journeys, and, by so doing, reduce the associated environmental impacts on the region. Provision of access to the Second Sydney Airport by public transport would be difficult to achieve because of the airport's distance from existing public transport infrastructure and urban development. Access to the airport would necessarily involve relatively long journeys to many of the likely destinations of air travellers, meeters and greeters and employees.

A potential rail connection to the airport site from the Cumberland and East Hills Lines from Glenfield, was investigated by State and Commonwealth Governments and was described in the Draft EIS. An alternative alignment to that described in the Draft EIS has been put forward by Liverpool City Council. This alternative alignment would be partly co-located in the Western Sydney Orbital road corridor. Only preliminary investigations have been undertaken into the engineering and economic feasibility of this alternative. Accordingly, the costs and benefits of this option as perceived by Liverpool City Council have not been subjected to rigorous assessment.

Regardless of the precise location of the rail link two scenarios requiring further consideration. These are:

- constructing an airport rail link to be operational from the first day of airport operation; and
- delaying construction of the airport rail link until a later stage of airport development, perhaps when some threshold of passenger activity is reached.

In relation to the latter, a critical consideration concerns what alternate public transport access might appropriately be provided prior to the provision of the airport rail link. This section focuses on the implications of public transport access at a strategic level. Further discussion of patronage and operational issues is presented in *Chapter 19* of this Supplement. A further consideration raised by the Auditor relates to the implications of third parties operating the rail service to the airport. This issue is also addressed in *Chapter 19*.

Strategic Operational Issues

In order to strategically connect the Second Sydney Airport to Sydney's rail network, at least three types of services would have to be offered, namely:

- direct access to the Sydney Central Business District with the ability for air passengers to transfer between Sydney Airport and the Second Sydney Airport (Second Sydney Airport - Glenfield - Sydney Airport - Sydney Central Business District);
- direct access to Parramatta (Second Sydney Airport - Glenfield - Parramatta); and
- access to a range of regional and sub-regional centres, such as Penrith, Blacktown and Liverpool providing for transfers to other rail or bus services.

Certain minimal levels of service, in terms of travel times and frequency of service would be required irrespective of how the rail services would actually be provided. Travel times for road and rail transport between the Second Sydney Airport and regional and sub-regional centres are described in *Section 19.7.1* of this Supplement. All potential users of the rail link, that is, air passengers, meeter and greeters and employees, would require a reasonably high frequency of service (that is, between four to six trains per hour) from the commencement of rail services.

Public Transport Mode Share

As indicated above there are two scenarios for the timing for the rail link to the Second Sydney Airport; that is, providing a rail link at the commencement of airport operation or deferring provision of a rail link until some future date. The ability to influence travel behaviour for journeys to and from the airport would be partly dependent on the timing of the rail link. Forecasts of how travel would be split across various transport modes for the Second Sydney Airport, both with and without a rail link, are shown in *Table 19.5* of this Supplement.

The groups most susceptible to use of the private car would be employees, with 22 percent of employees considered likely to use public transport with a rail link. Without a rail link this figure would probably fall to about five percent. Once employee travel behaviour is established, this behaviour is extremely difficult to reverse. Therefore, it is unlikely that a mode share of 22 percent in favour of public transport could be achieved if the rail link were introduced later.

The travel behaviour of air passengers is less sensitive to the timing of the provision of a rail link. This is, unlike employees' journey to work patterns, a result of the lack of a regular travel pattern. Significantly higher mode share towards public transport (23 percent for international and 20 percent for domestic passengers) would be achieved with a rail link, compared with a no-rail situation (11 percent for international and eight percent for domestic passengers). Thus the provision of a rail link at some future time would see a swift change in mode share among air passengers. A delayed introduction of a rail link to the airport, however, is likely to reduce the potential to maximise public transport use by airport and airport-related workers.

Public Transport Access in the Absence of a Rail Link

Light rail and buses would be potential alternatives to a heavy rail link to the Second Sydney Airport prior to the provision of a heavy rail link.

A light rail link to the airport would not provide a seamless link with the existing rail network. While the passenger capacity of a light rail system would be better suited to the levels of demand expected to be generated by the airport such trips would necessarily involve an inconvenient change of travel mode. Although the operating cost would be lower than for heavy rail the level of investment required in infrastructure such as track and stations is unlikely to present significant cost savings over a heavy rail system.

In the absence of a rail link servicing the Second Sydney Airport buses would be the main form of public transport. Buses are an established mode in Sydney's south-west and generally do not require special infrastructure, thereby reducing capital costs. Buses are also more flexible than other modes in terms of catering for changing levels of demand. Additional vehicles can easily be introduced and a number of different services can be operated concurrently, such as direct express services, feeder services to rail interchanges and other flexible cross-regional services. Buses, however, would not be able to offer competitive travel times compared with heavy rail, and would involve longer journeys to work even with significant investment in bus priority infrastructure.

Bus travel times could be reduced through a variety of priority measures, including bus lanes, high occupancy vehicle lanes and other localised measures such as signal pre-emption and queue bypasses. In addition, the NSW Government's *Action for Transport 2010 An Integrated Transport Plan for Sydney* (Department of Transport, 1998) identifies a network of transitways for implementation in Sydney. The NSW Government recently announced the development of the Liverpool to Parramatta Transitway as a bus-only roadway available for use by local and dedicated buses to provide high speed truck and feeder services.

The Liverpool to Parramatta Transitway could be integrated into a bus-based public transport system serving the airport to reduce bus travel times and provide faster connections to Parramatta and Liverpool.

In terms of passenger requirements, a bus-based system could be structured to meet the destinations likely to be demanded by users of the airport rail link including:

- direct access to the Sydney Central Business District, as well as access to regional and sub-regional centres such as Penrith, Parramatta and Liverpool;
- transfer between the Second Sydney Airport and Sydney Airport for air passengers; and
- access to main line rail stations, for example Parramatta, Liverpool or Blacktown for transfer to other rail or bus services by employees.

Quality, high speed direct services (with luggage-carrying ability) would be required by passengers transferring between the Second Sydney Airport and Sydney Airport, and for direct access to the Sydney central business district. Use could be made of the M5 Motorway and transitways to reduce travel times. These services would be complemented by coach and minibus services to hotels.

Travellers and workers could make use of bus connections to railway stations at Liverpool, and at Parramatta in the Parramatta central business district, using the Liverpool to Parramatta Transitway. Bus links to Parramatta Station would give access to airport services for workers by providing access to the Sydney rail network.

Additional bus services could be provided to destinations where access to Parramatta would not offer benefits, such as Camden, Narellan, Campbelltown, Penrith and Windsor/Richmond.

Service frequencies for a bus-based public transport connection to the airport would need to be relatively high to minimise waiting time and thereby maximise use. Service levels for bus-based services are able to be more closely matched to expected demand than rail-based services to the extent that minimum frequencies to Parramatta and the Sydney central business district would be approximately four buses per hour. For the remaining services to be attractive alternatives to other modes approximately two to three buses per hour would be required.

However, the expected level of demand for bus services at the early stages of the airport's development, based on forecast daily person trips using *Air Traffic Forecast 2*, is low, with 300 employee trips and 2,200 international and domestic air passenger trips per day. When this trip demand is spread over a day having regard to shift work, air schedules and dispersed destinations, the levels of service described above would represent an over-supply. For instance, the level of demand for services to Penrith may not justify one bus per day. In these circumstances a bus-based transport system would be likely to be considerably less efficient and unlikely to be financially viable. A further difficulty is that lower levels of service more closely matching demand would be unlikely to generate a mode share favouring public transport.

In any event, the provision of a rail link to the airport would have to be complemented by road-based services to those destinations where the rail link would not offer attractive travel times when the need to transfer mode was taken into account. These might include suburbs to the north and south such as Penrith and Camden.

Relationship of Rail Link to Planning for Urban Villages

Additional traffic modelling carried out for the Supplement, and described in *Chapter 19*, has predicted a five to 10 percent increase in traffic volumes on the surrounding road network in the absence of a rail link. No additional road network improvements would be required, although vehicle emissions and travel times would increase. However, the provision of a rail link would generally be consistent with the NSW Government's objectives for reducing car usage in the Sydney region.

The inclusion of a rail link to service the Second Sydney Airport provides a number of potential advantages in relation to metropolitan and regional land use planning. The opportunity to provide residential development concentrated around stations along the rail corridor, and thereby encourage transit-oriented development, has the potential to increase the mode share for public transport use. Issues associated with the optimal village size, density and timing and servicing have been outlined above.

One of the most significant problems encountered in Sydney is the extremely low rates of use of public transport for travel to and from work within the western Sydney region. Typically, the rate of public transport use for trips to industrial estates like Smithfield/ Wetherill Park is less than five percent. This is one of the key factors in transport disadvantage for residents of western Sydney. Poor public transport accessibility to jobs creates difficulties for employees, employers and for traffic and environmental conditions.

The EIS for the New Southern Railway (State Rail Authority of NSW, 1994) showed that airport and related industry employees are in the group with potentially the highest use of public transport for trips to and from Sydney Airport. This assumption was also adopted for the Draft EIS. The benefits that would result from maximising opportunities for people to get to and from work at the Second Sydney Airport by public transport would be likely to have longer term effects than public transport travelled by air travellers and meeters and greeters, including long-term shifts in travel behaviour and efficient allocation of land around the airport. However, as outlined above, the opportunity to capture patronage from employees' journey to work would require the establishment of regular public transport travel behaviour for airport and related workers based on early provision of public transport links with an attractive level of service. Employees, regardless of whether they lived in urban villages or elsewhere, would be the most important market segment for a public transport link.

Summary

The urban form considered by the Task Force on Planning for the Sub-Region Surrounding the Sydney West Airport (1996a) might be regarded as an optimistic interpretation of how provision of a higher density, transit-oriented, development land use might interact with the provision of a rail link because:

- there is currently little evidence that, despite the trend to accept higher density dwelling forms in the inner city and at existing transport nodes (for example, Strathfield, Chatswood, Sutherland and Hurstville), the densities adopted by the Task Force are achievable in a greenfield situation in western Sydney (where typical average neighbourhood densities are closer to 10 to 15 dwellings per hectare);
- the timing and progressive development of the urban villages would limit the economic benefit to the rail line of such urban development, at least in the early years of operation; and
- despite some progress towards redressing the jobs imbalance between eastern and western Sydney the changing characteristics of employment location (that is, the shift to a more dispersed employment pattern) are not necessarily going to provide conditions conducive to increased transit usage.

7.4.5 Conclusions on the Potential Influence of the Second Sydney Airport

The Second Sydney Airport would influence urban development in Sydney. This would primarily occur as a result of the pressure exerted due to the economic benefits of the proposal. Some of the adverse environmental impacts of the proposal, such as noise impacts, would result in restrictions on urban development, but only in the immediate area surrounding the airport.

Some businesses would seek to locate close to the airport because of the particular advantages provided by the services offered by the airport. Evidence also suggests that businesses also tend to establish close to airports to take advantage of well-developed infrastructure (United States Department of Housing and Urban Development, 1974). Urban residential development would also be attracted by the well-developed infrastructure, particularly improved roads and a possible new rail line, and future residents would be attracted by the direct and indirect jobs created by the airport.

While these influences of the Second Sydney Airport proposal should be acknowledged, it is not the case that the proposal requires the reservation of further industrial, commercial or residential land within the South Creek Valley outside the boundaries of the airport sites. As outlined in Chapter 10 of the Draft EIS, there is sufficient vacant employment land within the region surrounding the sites of the airport options to accommodate forecast employment growth caused by the Second Sydney Airport. Further, the NSW Government's urban development program allocates sufficient vacant residential land to cater for demands in the short- to medium-term. The Second Sydney Airport would have little effect on the overall demand for residential land in Sydney.

Whether urban development occurs in the region immediately surrounding the sites of the airport options would be determined by explicit decisions made by State and local governments, presumably in consultation with the Commonwealth Government. A range of advantages and disadvantages to allowing such development to proceed would need to be considered, including:

- the adverse environmental impacts arising from such development;
- the social and economic advantages of taking full advantage of investment in public infrastructure provision;
- the social and economic advantages of developing new communities in conjunction with new rail infrastructure;
- the social, economic and environmental advantages of developing residential communities in close proximity to jobs; and
- the potential for future conflicts with airport operations.

In the further consideration of the proposed urban development in the South Creek Valley area, appropriate recognition must be given to the NSW Government's position. In its submission in response to the Draft EIS, the NSW Government said "*urban villages around the rail line would by no means be the basis for the provision of the line and is not part of the NSW Government's Urban Development Program nor would it be considered even in the long-term in the absence of a rail corridor*".

Determining the economic, operational and environmental viability of a rail link to the Second Sydney Airport is not within the scope of this EIS. Present analysis highlights the advantages of the early provisions of the rail link, such as the reduction in reliance on motor vehicles and the subsequent air quality and traffic advantages this provides. Nevertheless, key issues are raised which would require detailed analysis prior to any decision being made on the form, location and timing of the rail link. They include:

- the feasibility of providing urban development in a timely manner and at sufficient densities around stations of a new rail link to significantly improve its economic feasibility, especially in its early years of operation; and
- whether an appropriate level of rail services could feasibly be provided to the airport in the early years of operation, having consideration to likely patronage and the overall operational advantages to the airport of providing a direct rail service to Sydney Airport and the city.

Chapter 19 of this Supplement provides further discussion of the operational issues that would arise from the provision of a rail link to the airport and *Chapter 22* and *Appendix J1* provide a preliminary analysis of the economic viability of the airport including the provision of off-site infrastructure.

Whatever specific circumstance may develop, it has to be appreciated that issues such as the construction and operation of a rail link to the Second Sydney Airport, the urban development of Edmondson Park and the potential for the complementary construction of urban villages along the rail link would each have to be submitted to the relevant State Government evaluation, legislative and environmental review processes for approval. This process might also include a regional planning co-ordination body as described in *Chapter 25* of this Supplement. These processes are separate from the current environmental assessment process of the Second Sydney Airport. The provision of information related to these other issues in this EIS is intended to provide interested parties with an overview of the associated activities that might occur and which are related to the development of the airport.

7.5 Review of Land Use Planning Assumptions

7.5.1 Overview of Land Use Assumptions

In recognition of the impacts of aircraft overflight noise on the potential urban villages, and in response to issues raised in submissions to the Draft EIS, the land use scenarios developed in the Draft EIS have been refined to ensure that no urban village population located at Bringelly or Rossmore is affected by noise greater than 15 ANEC in 2016. A further scenario involves the location of future residential development concentrated around the Western Sydney Orbital corridor, which would encourage development within already identified urban release areas close to established community services and facilities, and exclude development in the environmentally sensitive South Creek Valley. This scenario is in addition to that in the Draft EIS which adopted a population of 12,000 people in an urban village at either Bringelly or Rossmore, with an additional 14,000 people at Edmondson Park, by 2016. The assessment scenarios are:

- the Draft EIS South Creek Valley urban village scenario;
- the refined South Creek Valley urban village scenario; and
- the exclusion of future residential development from South Creek Valley scenario.

Table 7.3 sets out the assumptions relevant to each of these scenarios compared to the assumptions made in the Draft EIS.

Table 7.3 Assumptions Relating to Land Use Scenarios for 2016

Scenario	Bringelly/ Rossmore	Edmondson Park	Other
South Creek[1] Urban Villages (Draft EIS)	12,000 people	14,000 people	n/a
Refined South Creek[2] Urban Villages	12,000 people	14,000 people	n/a
Exclusion of Future Residential Development from South Creek Valley	n/a	16,500 people	9,500 people[3]

Notes:
1. *Location, area of development and density not spatially defined.*
2. *Approximate area of urban village 280 hectares with urban development at 14 dwellings per hectare (nett neighbourhood density).*
3. *Additional 12,000 people distributed to urban release areas of Aerodrome, Carnes Hill, Edmondson Park and Prestons (the locations of these areas is depicted on Figure 10.6 of the Draft EIS) based on assumption of increased density achievable in transit oriented development associated with a rail link in the Western Sydney Orbital corridor.*

Refined South Creek Valley Urban Village Scenario

The Draft EIS presented three airport master plan options, two of which included cross wind runways (Options B and C). Each option was designed to ultimately cater for 30 million passengers per year. The Draft EIS indicated that up to 7,000 people would be likely to be affected by aircraft overflight noise greater than 20 ANEC in 2016 for any of these options. Up to 15,000 people would be likely to be affected by noise greater than 15 ANEC in 2016.

Submissions on the Draft EIS suggested that a significant proportion of the people affected by aircraft noise would be likely to be located in the potential urban village of Bringelly or Rossmore.

The potential locations of the Bringelly and Rossmore urban villages have been more precisely defined as part of the additional work undertaken for this Supplement using a geographic information system, a composite overlay of ANEC contours, and constraints and opportunities mapping completed by the Task Force on Planning for the Sub-Region Surrounding Sydney West Airport (1996a). A population of 12,000 people has been assigned to both Bringelly and Rossmore at a neighbourhood dwelling density of 14 dwellings per hectare. Sufficient unconstrained land is available around both Bringelly and Rossmore to enable an ultimate development of 30,000 people to be achieved. By using the method described above, it has been possible to take into consideration constraints other than noise impacts in defining the village's location.

Exclusion of Future Residential Development from South Creek Valley Scenario

Liverpool City Council's submission on the Draft EIS objected to the proposed airport rail link corridor through its rural lands. The Second Sydney Airport site is located in the Liverpool local government area, as is much of the area surrounding the airport. Liverpool Council recommended an alternative rail transport corridor that, in its opinion, would avoid many of the perceived problems, including impacts on rural lands, disruption of rural activities and lifestyle, difficulties and costs associated with provision of community facilities remote from existing urban areas and increased pressure for westerly urban sprawl.

Liverpool Council proposed that the rail links be co-located within the Western Sydney Orbital/Elizabeth Drive road corridor. The design for both elements of this access route is, indicatively, for up to six lanes, of which two are intended to be set aside as dedicated public transport lanes (Rust PPK, 1995). The Draft EIS indicated a need for six vehicle traffic lanes on both roads by 2016.

Liverpool Council considered that the development of the rail corridor in the Western Sydney Orbital corridor would provide opportunities for the development of consolidated/intensive urban development at transport nodes, particularly given the potential closure of the Hoxton Park Airport if the Second Sydney Airport is developed. In Council's opinion, the alternative alignment would remain consistent with concepts contained in previous planning related to urban development (Taskforce on Planning for the Sub-Region Surrounding Sydney West Airport, 1996a; 1996a) promoted for the purpose of providing supporting trips for the rail operation's economic viability.

Examination of the engineering feasibility and cost comparability of the proposed co-location of the rail link with the Western Sydney Orbital corridor (Sinclair Knight Merz, 1998) indicates that the proposed co-location is feasible from an engineering viewpoint. The cost would be greater than the cost of developing the airport rail links as detailed in the Draft EIS, but could be off-set by savings in land acquisition and land development costs. A short section of tunnel would be required to pass through the Regional Open Space corridor under the control of the Department of Urban Affairs and Planning. The evaluation is based on a comparison with the Western Sydney Orbital alignment that was used in the Second Sydney Airport Draft EIS.

The outlined concept is potentially more compatible with the NSW Government's metropolitan strategic planning policy than locating urban villages in South Creek Valley providing opportunities for urban infill and the development of urban areas around transport nodes. It could also be developed as part of the current Urban Development Program, rather than have to wait until, potentially, after 2016 when new areas would be developed as part of that Program. Urban development around the rail link in these locations would also have the potential advantage of accelerating the contribution of patronage to the rail link.

7.5.2 Planning Implications

Potential regional land use and transport infrastructure planning scenarios have been discussed above in response to issues that have been raised in submissions to the Draft EIS. Additionally, indications have been given of the high degree of inter-connectivity of all the individual issues that go to make up the totality of integrated land use planning and the sizeable number of stakeholders that are involved in the various processes.

The details provided here and in the Draft EIS are not intended to provide definitive indicators as to which land use planning scenario should be adopted. Indeed, that would be impractical, considering the significant amount of data that would have to be assessed for each element of each regional development scenario and having regard for the very considerable number of projects that would constitute the totality of the regional development to be undertaken. Each of those support activities would need to be assessed under separate assessment processes, as required by the relevant State legislation, and take into account the implications of the development of the airport.

The scenarios outlined above provide a basis for determining the relative impact of aircraft overflight noise. *Chapter* 8 of this Supplement indicates that there is only marginal difference between the populations affected by aircraft noise, basically as a result of purposely excluding residential development from within the 15 ANEC noise contour. The experience of Sydney Airport is that the impacts of aircraft overflight noise would occur in areas situated outside the contour. Therefore, in recognition of concerns raised in submissions regarding over-reliance on noise impacts to determine future land use patterns, *Table 7.4* sets out a range of environmental, planning and transport implications for each scenario.

If the Commonwealth decides to proceed with the development of the Second Sydney Airport, this would have a range of planning implications for the surrounding region that would need to be addressed in a co-ordinated manner with the proposed development of the airport, especially its proposed operations start-date.

Strategic planning issues that would need to be considered by the numerous stakeholders include:

- co-ordinated metropolitan infrastructure planning and funding, including priorities;
- holistic regional planning: establishment of a regional planning co-ordination body with a defined role;

Table 7.4 Summary of Environmental, Planning and Transport Implications

Location of Residential Development	Benefits	Disadvantages
Urban Villages in South Creek Valley	• takes advantage of opportunity afforded by development of the rail link for use of infrastructure • enables establishment of a transit-oriented development encouraging reduced reliance on cars compared to traditional forms of development • contributes to economic viability of rail link • potentially provides greater control over the location, scale and urban expansion at the fringe	• although villages can be sited to avoid 15 ANEC contours, noise impacts beyond this contour are likely • contributes to reduced local air quality and local and regional water quality impacts • requires displacement of rural/ rural residential development and agricultural uses • remotely located in relation to services and community facilities and, therefore, cost of provision is greater • ability to achieve higher urban densities than currently being achieved doubtful in fringe location • long lead times are required to establish viable communities
Exclusion of Urban Villages from South Creek Valley (Liverpool Option)	• provides a rail service to existing and developing urban areas • eliminates the need for urban villages in the South Creek Valley catchment • locates residential development well away from moderately noise-affected areas • contributes to economic viability of rail link and potentially accelerates the contribution of patronage due to existing development • compatible with current NSW Government Metropolitan Planning Strategy and Urban Development Program • proximity to existing services and community facilities	• the scale and form of urban development may have progressed to the point where meaningful changes to travel behaviour and urban form can no longer be realised • less opportunity to mitigate environmental impacts of rail link on existing residents • difficulties associated with co-locating infrastructure within the same corridor • only preliminary engineering and financial feasibility has been undertaken

- consideration of airport rail corridor alternatives and feasibility and financial assessment, including timing of construction, and achievement of metropolitan and regional planning objectives;
- relationship between any transit oriented developments associated with a rail link with planned metropolitan Urban Development Program activity;
- timing, location and rate of development of any transit oriented development within urban villages at: Edmondson Park, Bringelly/Rossmore (including whether such development is suitable) and the implications for regional planning;
- the treatment, location, management and stormwater/sewage; and
- the need for any additional policy responses to address metropolitan air quality issues.

7.6 Response to Other Planning and Land Use Issues

7.6.1 Employment Lands

Purpose and Approach to Assessing Demand for Employment Land

Second Sydney Airport-related employment land is distinguished from other land uses in the region as a result of the extent of land which might be required to accommodate both direct and indirect employment generation and due to its need to be located within or proximate to the airport site. Given the uncertainties and variables associated with the type of employment likely to be generated by individual business with their locational preferences, the employment land assessment in the Draft EIS does not seek to specify the precise nature of employment that might emanate from the development of the Second Sydney Airport. Rather, the exercise seeks to determine, from empirical evidence and projections for employment generation, how much land might be required and what impacts this might have on the supply of and demand for employment land within the western Sydney region.

The Draft EIS assessment of the requirement for employment lands has been questioned by the Auditor, and in a number of submissions. The requirement is based on projections for employment generation within the airport site, vicinity and employment catchment area, as calculated in *Technical Paper No. 15*, for two scenarios:

- 2006: *Air Traffic Forecast 2* (10 million passengers per annum, with subsequent Sydney growth being directed to the Second Sydney Airport); and
- 2016: *Air Traffic Forecast 3* (same as above, but with more international flights directed to the Second Sydney Airport and accommodating approximately 30 million passengers).

Little or no information exists that would enable the land area requirements for individual employment categories related to the development of an airport to be determined with precision. In order to arrive at a reasonable approximation of employment land requirements for the Second Sydney Airport the following steps were taken which are also described in *Technical Paper No. 2:*

- floor space areas required to accommodate employment growth were calculated by reference to specific employment densities for airport-related development. This enabled an average employment density for employment uses in the Sydney region to be derived from various sources including surveys undertaken by the Department of Urban Affairs and Planning (Department of Planning, 1991);

- floor space areas were calculated into land areas by reference to recognised floor space ratios for particular industries. An average floor space ratio for airport-related employment uses was derived by reference to existing floor space ratios for commercial/industrial zones applicable within the local government areas within the sub-regions surrounding the airport; and
- employment land area estimates were then compared to the supply of employment lands within the western Sydney region, determined from the employment lands development program (Department of Urban Affairs and Planning, 1996) to assess if expected employment growth could be accommodated within the region.

The results of this exercise (*Technical Paper No. 2*) indicate that a total of approximately 359 hectares of land might be required to accommodate direct and indirect employment when the airport is handling 30 million passengers per year. Given existing trends and the surplus of employment land, estimated in *Technical Paper No. 2* at 2,138 hectares within the employment catchment area, there is more than sufficient land to meet this demand.

Limitations of Further Analysis

In estimating the demand for employment land arising from the development of a Second Sydney Airport, reference to studies of other major Australian airports, such as Melbourne and Adelaide, were considered. Recognised literature referred to included the *Economic Significance of Sydney (Kingsford Smith) Airport* (Institute of Transport Studies, 1997) and the *Economic Impacts of a Major International Airport on its Region: The Case of Sydney* (Institute of Transport Studies, 1995).

In the case of Melbourne, the extent to which employment is directly attributable to the development of Melbourne's Tullamarine Airport, given the close proximity of Essendon Airport (Melbourne's first airport), cannot be gauged.

Factors that would influence the demand for employment lands, arising from both direct and flow-on employment associated with development of a Second Sydney Airport include:

- volume and type of air traffic and the airport's role within the region/nation;
- the interrelationship of the operational role of two airports within the region;
- the extent to which non-specific employment land in the region accommodates airport-related development; and
- the extent to which individual businesses are at liberty to make decisions about their location in order to facilitate their operation.

The assumptions adopted in the Draft EIS sought to take into account all possible variables in order to estimate the likely land area requirements associated with potential employment generation arising from the Second Sydney Airport.

The extensive supply of existing and potential employment land within the employment catchment area (calculated at approximately 2,138 hectares) and historical take-up rates, indicate that adequate employment land exists to accommodate estimated direct and indirect Second Sydney Airport-related development.

Alternative Assessment of Demand for Employment Lands

An alternative scenario to that adopted in the Draft EIS has been assessed. This scenario, assumes that a more specific mix of employment uses has been used to determine what effect this might have on employment land requirements within the employment catchment area, follows the Auditor's suggestion and assumes that more people are likely to work in the industry/transport related sector than in offices, as follows:

- 35 percent in multi-unit industrial (density 66.7 square metres per employee);
- 35 percent in transportation/freight (density 65.8 square metres per employee);
- 20 percent in high technology industrial (density 34.7 square metres per employee); and
- 10 percent in offices (density 19.6 square metres per employee).

This results in an average floor space required to accommodate the assumed mix of employees of 55 square metres per person (incorrectly calculated in the Auditor's report as 52 square metres per person). Assuming the same industrial mix in relation to floor space ratios results in an average floor space ratio (proportion of built area to site area) of 0.7:1 (incorrectly reported in the Auditor's report as "closer to" 0.6:1). *Table 7.5* shows the results of this assessment based on these assumptions.

Table 7.5 Airport Related Alternative Employment Land Estimates

Area/Year	Forecast Employment Growth[1]	Floor space Area at 55 m^2/person (Square Metres)	Forecast Land Area at FSR of 0.7:1 (Square Metres)	Hectares
Airport Vicinity[2]				
2006	5,092	280,060	400,086	40
2016	12,979	713,845	1,019,779	102
Airport Catchment[3]				
2006	6,097	335,335	479,050	48
2016	18,626	1,024,430	1,463,471	146
Rest of Sydney				
2006	9,772	537,460	767,800	77
2016	29,855	1,642,025	2,345,750	235
Total				
2006	20,961	1,152,855	1,646,936	165
2016	61,460	3,380,300	4,829,000	483

Notes:
1. *Source: Technical Paper No. 15.*
2. *Airport vicinity = on-site or within immediate catchment.*
3. *Airport catchment - employment catchment area comprising local government areas of Liverpool, Camden, Penrith, Blacktown, Fairfield, Campbelltown and Wollondilly.*

Using the approach suggested by the Auditor, it is estimated that the requirement for employment land generated by the airport, both directly and indirectly, would be approximately 483 hectares when the airport is handling 30 million passengers per year. This result is approximately 124 hectares more than that calculated in the Draft EIS. Given the surplus employment land within the employment catchment area of

2,138 hectares, varying the industrial development mix in this manner would not alter the conclusions of the Draft EIS relating to the availability of employment land within this region. These conclusions are that sufficient employment lands exist within the employment catchment area of the Second Sydney Airport to accommodate direct and flow on employment and that the impact on the supply of land within the catchment area would be limited.

Further, it should be recognised that this demand is based on 30 million passengers per year. Because airport development would take place in stages, the influence in the take-up rate of employment lands within the catchment area, would occur incrementally over a period of 20 to 30 years. Recognition also needs to be given to the 185 to 195 hectares of employment land that would be made available on the airport site under Options B and C. This is likely to moderate the demand for off-site employment lands in the early stages of airport development.

7.6.2 Infrastructure

Infrastructure and facilities identified in the Draft EIS to support operation of the Second Sydney Airport include road and rail access, electricity, gas, telephone and water services, waste disposal and aviation fuel supply. The Draft EIS included a description of the facility, its location and potential changes to location resulting from the development of the airport and an indication of the facility's impact on the airport region.

Detailed consideration of the environmental impacts of this off-site infrastructure would be subject to separate environmental impact assessment procedures under Commonwealth and/or State Government legislation, depending on which authority or agency is carrying out the development. Establishment of a sewage treatment plant on the site of the airport would be subject to environmental assessment under the *Airports Act 1996* and the *Environment Protection (Impact of Proposals) Act 1974*.

The largest elements of the infrastructure are the road and the rail links. Details of these links were addressed in Chapter 22 of the Draft EIS. Additional information about the road links, both to cater for background traffic and for airport related traffic, is contained in *Chapter 19* of this Supplement. Apart from the proposed Western Sydney Orbital road, which is justifiable independently of the airport (Roads and Traffic Authority, 1999), all other road network improvements required for the airport options are for upgrades of roads in existing corridors or road reservations.

Submissions on the Draft EIS have raised additional possibilities related to the location of the rail link, supportive urban development and the minimisation of the impact of the rail link on the airport region; refer to *Section 7.4* of this Chapter.

Integral Energy, the principal supplier of electricity in the airport region, indicated that the details relating to the infrastructure required for the airport which were set out in the Draft EIS were incorrect (refer to Figure 10.14 of the Draft EIS). The correct details are shown in *Figure 7.2*. This provides for a new transmission line to the airport site (involving two 132 kilovolt lines) at a cost in excess of $20 million. This new, double circuit transmission line would be connected to the electricity network in the vicinity of Wallgrove Road, north of the intersection with Elizabeth Drive. The new line, likely to be on concrete poles or steel towers, would follow the Wallgrove Road and Elizabeth Drive corridors to the main access point to the airport site in Elizabeth Drive.

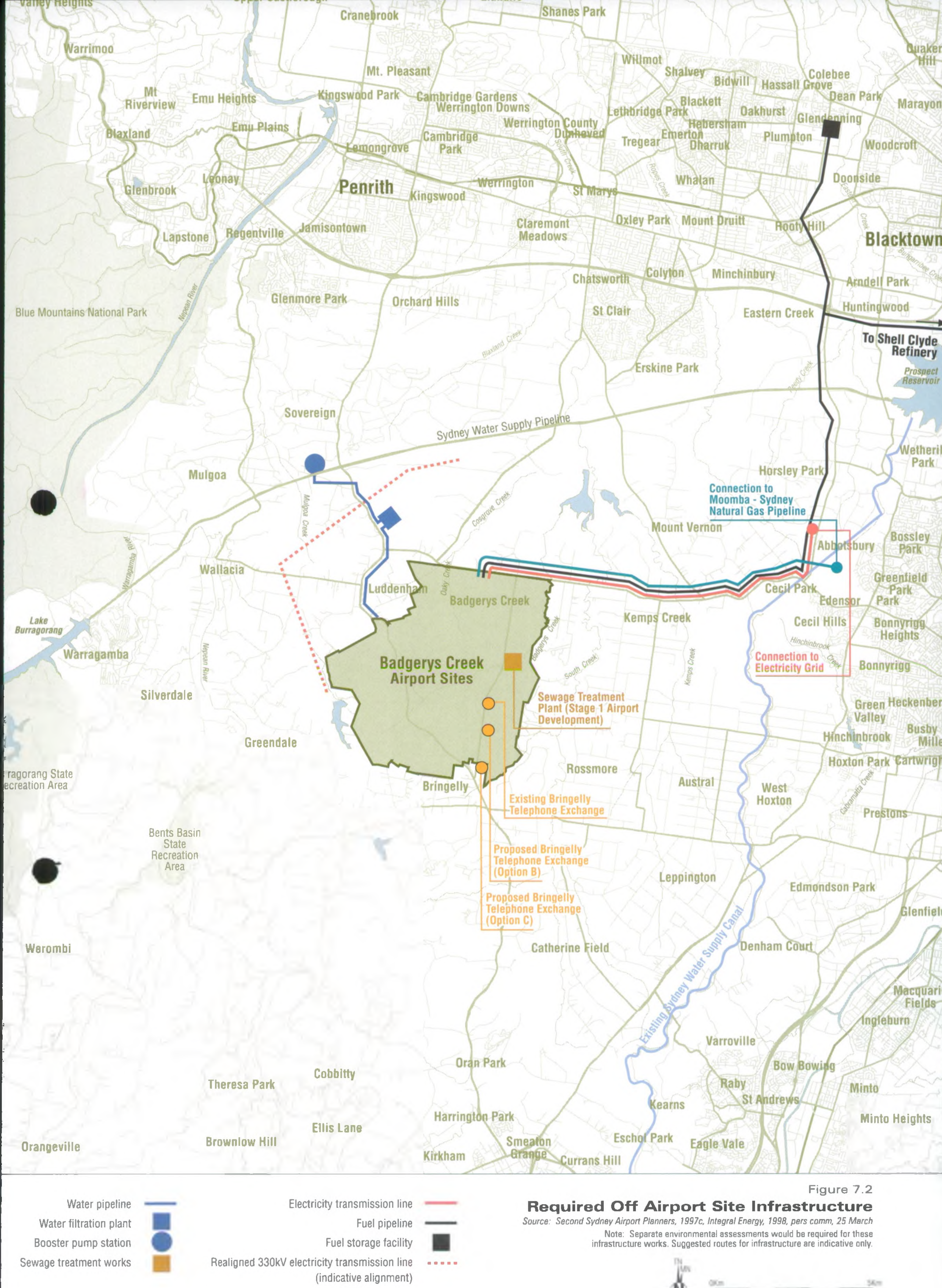


Figure 7.2

Required Off Airport Site Infrastructure

Source: Second Sydney Airport Planners, 1997c, Integral Energy, 1998, pers comm, 25 March

Note: Separate environmental assessments would be required for these infrastructure works. Suggested routes for infrastructure are indicative only.

The development of the airport site would also require the relocation of approximately five kilometres of an existing (330 kilovolt) transmission line which crosses the western portion of the Badgerys Creek Airport site. Details of this were presented in the Draft EIS. However, the submission from the NSW State Government pointed out that the route detailed in Figure 10.14 of the Draft EIS can only be regarded as indicative. Prior to the finalisation of the Draft EIS there had been no formal evaluation of any specific routes, although a feasibility study had been conducted. The NSW State Government indicated that "*the process of transmission line selection is both lengthy and complex and will require an environmental impact statement to be prepared*". The cost of relocating the transmission line would be approximately $25 million (Second Sydney Airport Planners, 1997c).

7.6.3 Other Planning and Land Use Issues

Alternative Uses of the Airport Site

The issue of alternative uses for the Badgerys Creek site if an airport is not developed was not covered in the Draft EIS. Some submissions in relation to this issue provided suggestions for possible alternative uses. The NSW Government and Liverpool Council were particularly concerned over the potential use of the site for urban development; it would be isolated from the metropolitan area and cut off from transport services and community facilities, and potentially this would result in a detrimental impact on regional air and water quality.

Should the area of land currently in Commonwealth ownership not be developed for the purpose of an airport, it is likely that the land would be sold. In this circumstance, the use of land would only be permitted in accordance with State and local land use controls. Having regard to existing NSW Government strategies related to urban development on the metropolitan fringe and agricultural lands, it is likely the land would continue to be used for a variety of agricultural and rural residential purposes.

In the event the Commonwealth Government chooses to pursue an alternative development of the site, other than for an airport, a separate environmental impact assessment procedure would be required under the *Environmental Protection (Impact of Proposals) Act 1974*.

Adequacy of Draft EIS Study Areas

A number of submissions, including that of the NRMA, considered that the Draft EIS study area was inadequate. A variety of study areas have been used in the Draft EIS, depending on the issue, the subject of investigation or analysis. Some of these have included the total Sydney metropolitan area. Further reference to this subject is included in *Chapter 3* of this Supplement.

Alternative Sites for a Second Sydney Airport

In relation to land use planning for western Sydney, the opinion was expressed in some submissions that the new airport should be kept a reasonable distance from urban areas. Further, the submissions indicated that there should be no noise impacts on any of Sydney's urban areas. These submissions suggested that the airport should be located at a site other than Badgerys Creek. The subject of alternative airport locations is discussed in detail in *Chapter 5* of this Supplement, while the impacts of aircraft overflight noise on urban areas are discussed in *Chapter 8*.

Bents Basin Recreation Area

A number of submissions have objected to the possibility of the closure of Bents Basin Recreation Area as a result of the development of the airport. The Draft EIS acknowledged that there would be adverse impacts on Bents Basin due to aircraft overflight noise, but did not suggest that this would lead to its closure. Bents Basin would be impacted by aircraft overflights from Options A and B with up to 150 events greater than 70 dBA in a 24-hour period when the airport is handling 30 million passengers per year. Up to 70 of these events could exceed 80 dBA. Parts of the Bents Basin Recreation Area would be within the 20 ANEC contour under Options A and B, but not Option C. The impacts on Bents Basin are discussed further in *Chapter 24* of this Supplement.

7.7 Overview of Planning and Land Use

Development of western Sydney would be significantly influenced by the airport and its associated infrastructure, providing a catalyst to employment and economic growth, potential residential development and associated human and physical services. Urban planning decisions and the resultant nature of land uses in the region surrounding the airport would also be substantially influenced by development of the Second Sydney Airport. These influences would have major implications for urban planning, both positive and negative.

Land use scenarios prepared for this EIS relate to possible future transit oriented development located on a rail link to the airport. The scenarios described in the Draft EIS involved the development of urban villages at Bringelly or Rossmore, depending on the option, up to a population of 12,000 persons by 2016, with an additional 14,000 persons at Edmondson Park. A revised version of these scenarios has been prepared that more precisely defines the location of the Bringelly/Rossmore urban villages to ensure no population is affected by noise greater than 15 ANEC in 2016. It is acknowledged that the development of such urban villages is not consistent with NSW metropolitan planning strategies (Department of Urban Affairs and Planning, 1998a; 1998b) and would require higher residential densities to be achieved than are currently being achieved in western Sydney, and that regional air and water quality issues would need to be resolved.

An additional scenario assumed no further urban development within the South Creek Valley and a rail link to the airport could be co-located within the Western Sydney Orbital corridor. This scenario would provide a number of potential advantages. These advantages would include avoiding significant urban development within the South Creek Valley catchment and encouraging higher density development within already-identified urban release areas close to established communities and community facilities and services.

The historic imbalance between population and employment growth in western Sydney has meant a reliance on employment outside the region. The Second Sydney Airport is forecast to directly and indirectly generate a significant number of jobs in Western Sydney. Sufficient vacant employment lands exist on the sites of the airport options and within western Sydney to accommodate this growth, regardless of which option is selected.

Other infrastructure and services would be required to support the operation of the Second Sydney Airport such as roads, rail, electricity, gas, telecommunications, water, waste and wastewater disposal and aviation fuel supply. Most of these would follow existing or proposed road corridors and many of the services would be located underground. Management measures would be available to reduce the impacts of both the construction and operation of those services and detailed assessment of those impacts would be carried out through separate environmental impact assessment processes.

The Second Sydney Airport and the off-site infrastructure required to service the airport would create a range of direct and indirect land use impacts. Commercial and agricultural activities operating on land within the sites of the airport options and in some areas immediately surrounding those sites and the people living there would be displaced. Demand for employment land in the region would increase due to the economic activity generated by the airport. Other changes to land uses would occurin response to probable changes to local and metropolitan planning strategies. The details of such changes cannot be precisely determined at this time.

PART E
Noise

Chapter 8

Aircraft Overflight Noise

Chapter 8
Aircraft Overflight Noise

8.1 Summary of the Draft Environmental Impact Statement

8.1.1 Measures of Noise Exposure

Two primary measures of noise exposure were used in assessing the impact of noise from aircraft overflights – the number of noise events per 24-hours exceeding 70 dBA (called N70) and the *Australian Noise Exposure Concept* (ANEC). N70 was chosen as being relatively easy to interpret and meaningful to the general public. The ANEC metric was included as it is required by the EIS Guidelines and is the principal tool used by Government authorities in Australia for assessing aircraft noise. In addition, under *Australian Standard 2021*, ANEC levels would determine future land-use planning decisions around the airport.

Two supplementary metrics were used to describe specific types of noise impact. Impact on teaching in school was described by the number of events per school day (9 am to 3 pm) exceeding 65 dBA. Potential disturbance to sleep was described using the *Sleep Disturbance Index*, a new measure proposed in recent research (Bullen et al, 1996).

At specific locations, a number of other measures were also provided, including number of events per 24-hours exceeding various noise levels, number of night-time events exceeding these levels, and the Equivalent Continuous Sound Level, or Leq, due to aircraft noise.

For all these measures, the values presented were for an 'average' day during the year. Information on likely seasonal variation in runway usage was presented in *Technical Paper No. 3*. In addition, the Draft EIS showed 70 dBA maximum noise level contours for a single 747-400 aircraft operating on any flight track.

8.1.2 Calculation Procedures

The number of aircraft per year which would use each runway was estimated, based on available meteorological data, under various assumptions regarding airport operating policy. Variation in runway usage with season was indicated in *Technical Paper No. 3*. However, consistent with the chosen measures of noise exposure, noise exposure itself was calculated on an annual average basis.

Calculation of noise levels was performed using the Integrated Noise Model (INM), developed by the United States Federal Aviation Administration, which is the standard model used in most countries for aircraft noise prediction. To provide the detailed information required for the Draft EIS proposal, significant additional processing of the INM output data was necessary.

The effect of local topography was included in calculations, in that the distance to an aircraft was adjusted to take account of the local ground height. More complex effects, including reverberation and shielding by topography, were not included, since standard predictive models are not generally capable of taking these into account. The impact of these on overall noise levels was considered to be small.

Similarly, while the effect of meteorological conditions on runway usage was explicitly calculated and accounted for, more complex effects including noise enhancement or attenuation due to wind and temperature inversions were not included. Once again, standard predictive models for aircraft noise are not capable of taking these effects into account, but their impact on overall noise levels was considered to be small.

8.1.3 Assessment Methodology

Residential and Educational Impacts

Three basic tools were used to describe the potential impacts of aircraft overflight noise on residential populations and educational facilities. These were noise contours, describing impacts on specific communities and summary tables.

Noise Contours

Noise contours were provided in the Draft EIS to indicate the geographical extent of various levels of noise impact. These included examples of the extent of 'single event' contours for a straight approach and departure for Boeing 747-400, 767-300 and 737-300 aircraft (refer Photographs 5, 6 and 7 of the Draft EIS). Figures 12.5, 12.6 and 12.7 of the Draft EIS provided an indication of the height of these aircraft at a range of distances from the end of a runway and the range of noise levels that would be experienced by a person standing directly under the flight path.

For single event noise level information to be meaningful it should be accompanied by some indication of how often each of these single event noise levels occur. Contours showing estimates of how many aircraft noise events exceeding 70 dBA would occur on, average, each 24-hours in 2016 for each type of airport operation assessed are reproduced as *Figures 8.1 to 8.8* of this Supplement.

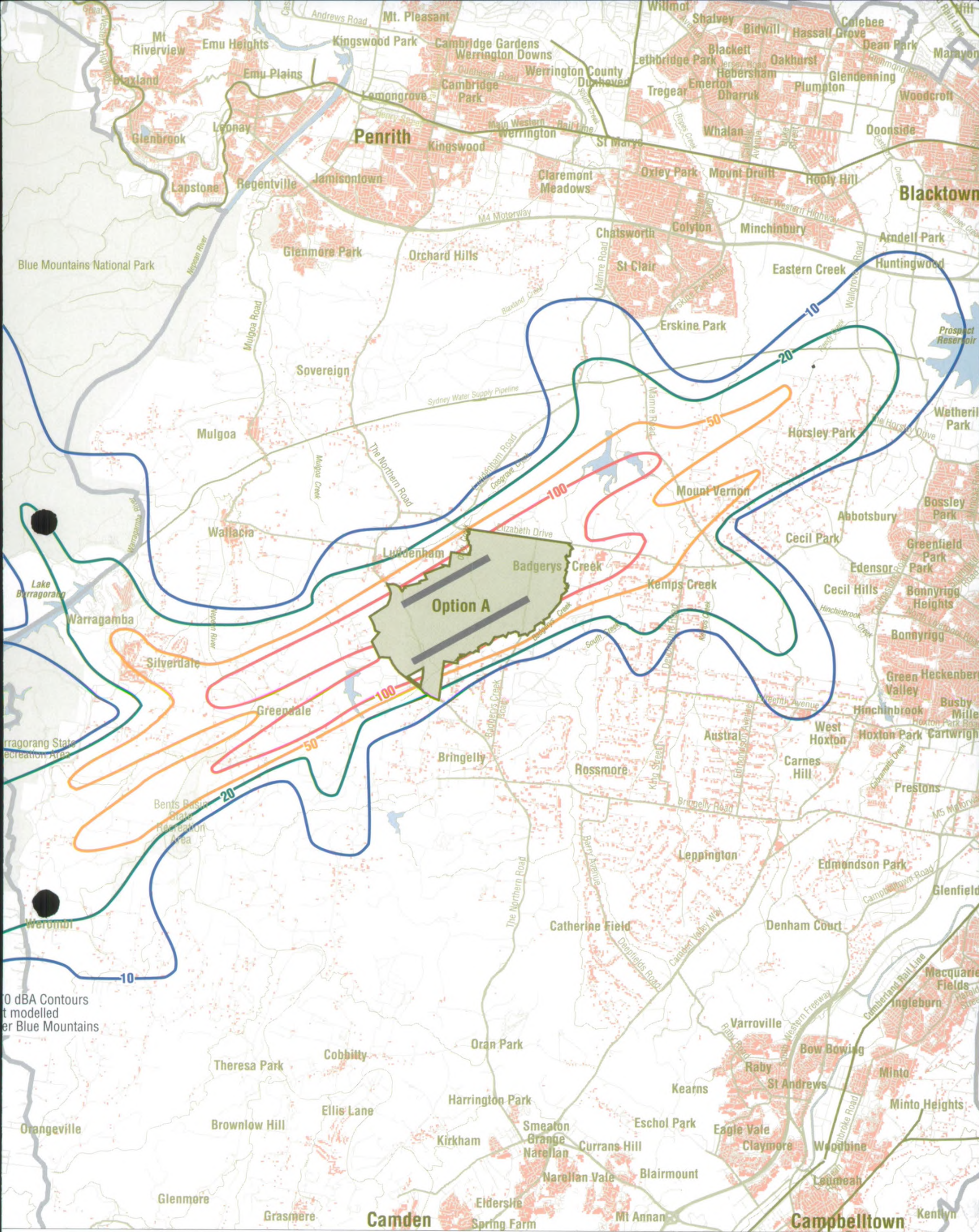
The Draft EIS also provided contours that showed the area over which maximum noise levels greater than 70 dBA could occur due to a 747-400 aircraft, fully loaded, performing any operation on any runway. These contours indicated the area over which disturbance to indoor communication might occur on some occasions, but with no indication of the frequency with which such disturbance might take place.

The number of events over 70 dBA (or N70) over a 24-hour period indicates the degree of disruption to normal domestic communication such as conversation and listening to television. At external noise levels below 70 dBA, internal noise levels would generally be below approximately 60 dBA, even with windows open. Such a level of noise would be unlikely to disrupt communication. For external noise levels above 70 dBA some interruption to communication is likely. The same comment applies to communication in schools, except that in this case the critical external noise level is approximately 65 dBA.

The maximum modelled extent of the ANEC contours were also provided in the Draft EIS. These contours showed the outside extent of the range of ANEC levels resulting from the three air traffic forecasts and three airport operations analysed. They were derived by firstly plotting the noise contours for each of the air traffic forecasts and airport operations.

Specific Noise Levels in Community Assessment Areas

In an attempt to provide residents and others with as much information as possible on their potential noise exposure, an appendix was provided to the Draft EIS, listing 13 indicators of noise exposure for 85 Community Assessment Areas surrounding the airport sites, as shown in *Figure* 8.9. Predicted noise levels were presented for each of



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA on an average day —10— —20—

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA on an average day —20— —50—

Extent of dwelling data

Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70 dBA on an average day —50— —100—

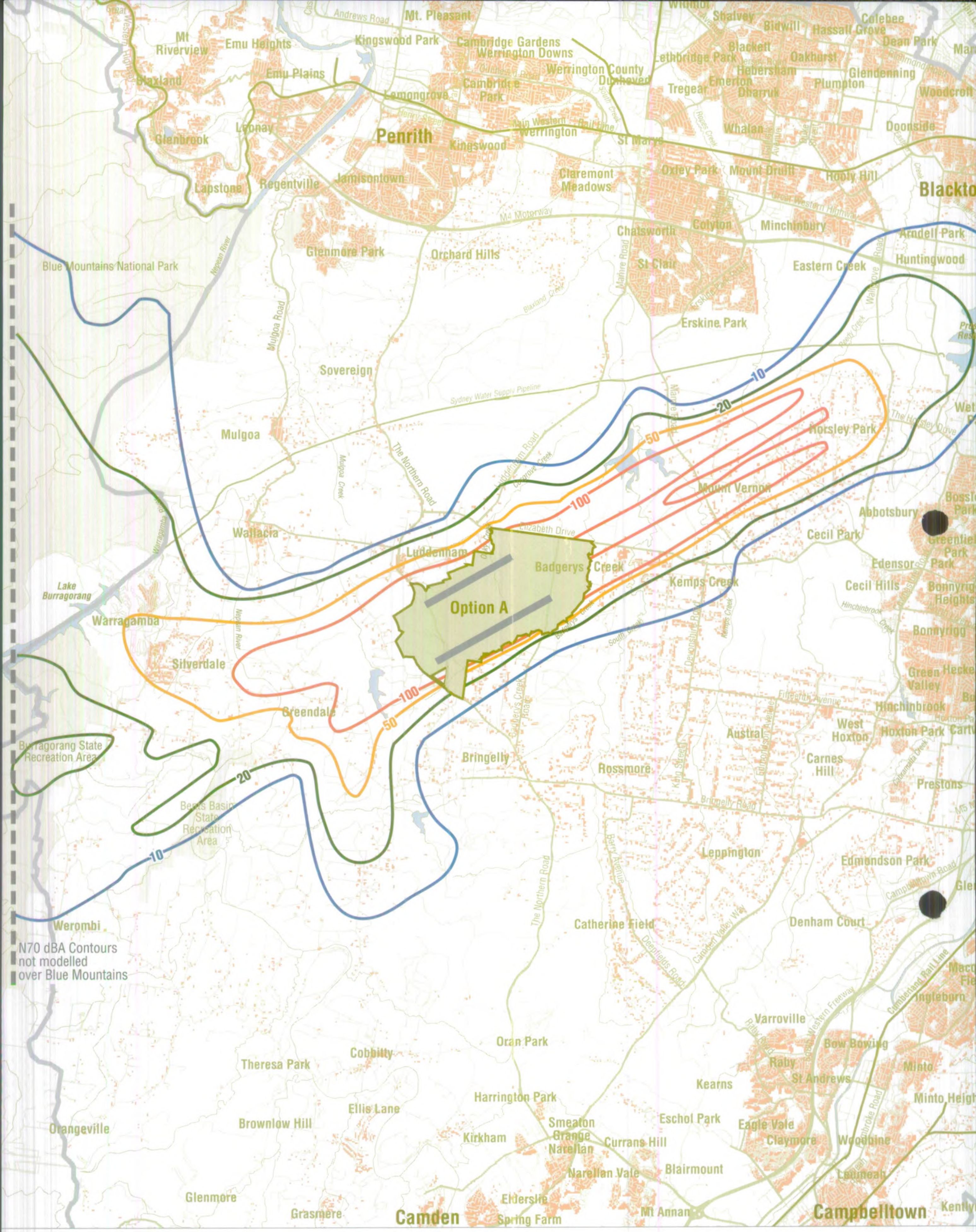
Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA on an average day —100—

Indicates density of dwellings in 1996

Figure 8.1

N70 dBA Contours for Option A Operating at 30 Million Passengers Per Year (Airport Operation 1)

0Km 5Km



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA on an average day —10— —20—

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA on an average day —20— —50—

Extent of dwelling data

Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70 dBA on an average day —50— —100—

Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA on an average day —100—

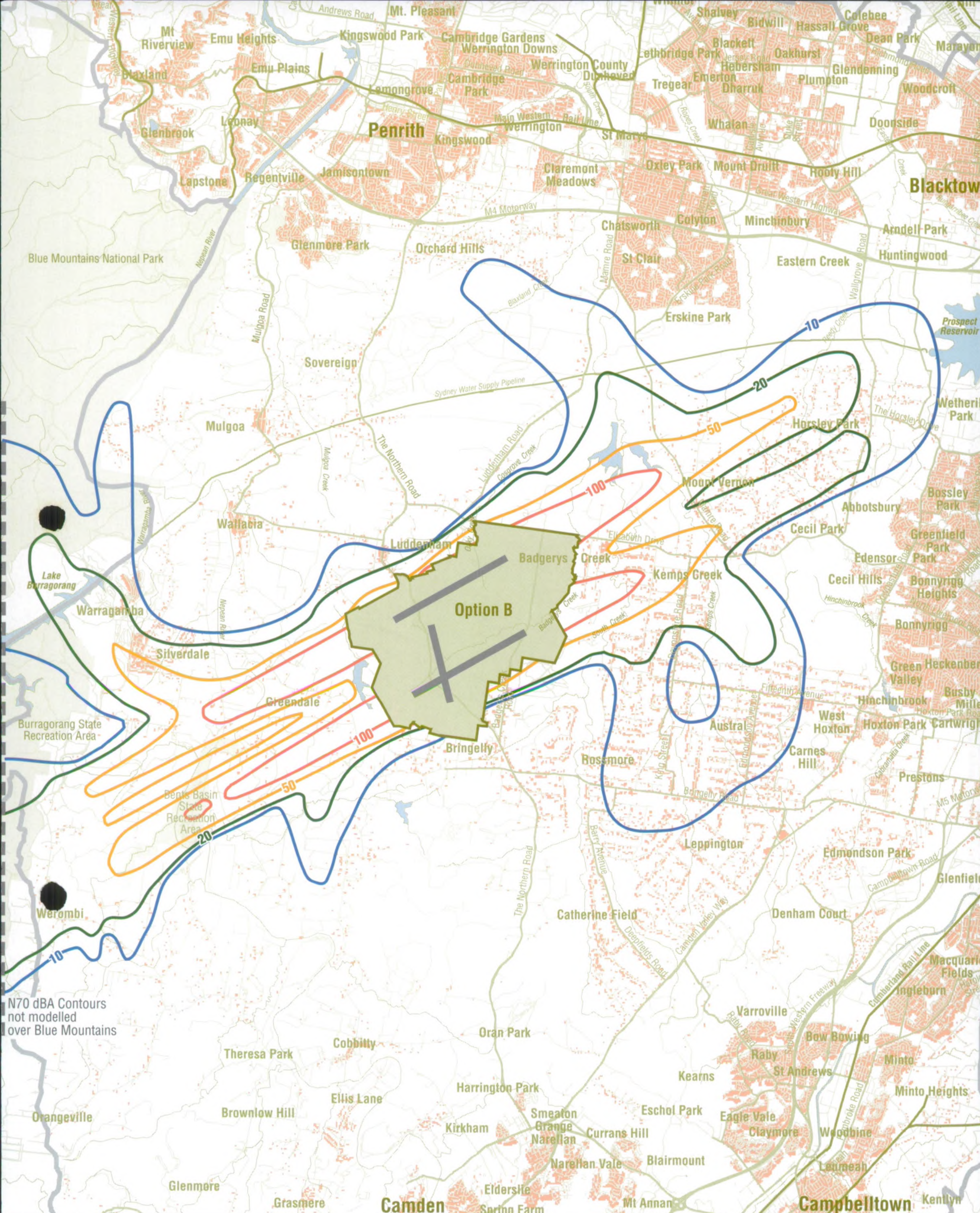
Indicates density of dwellings in 1996

Figure 8.2

N70 dBA Contours for Option A Operating at 30 Million Passengers Per Year (Airport Operation 2)

TN MN N

0Km 5Km



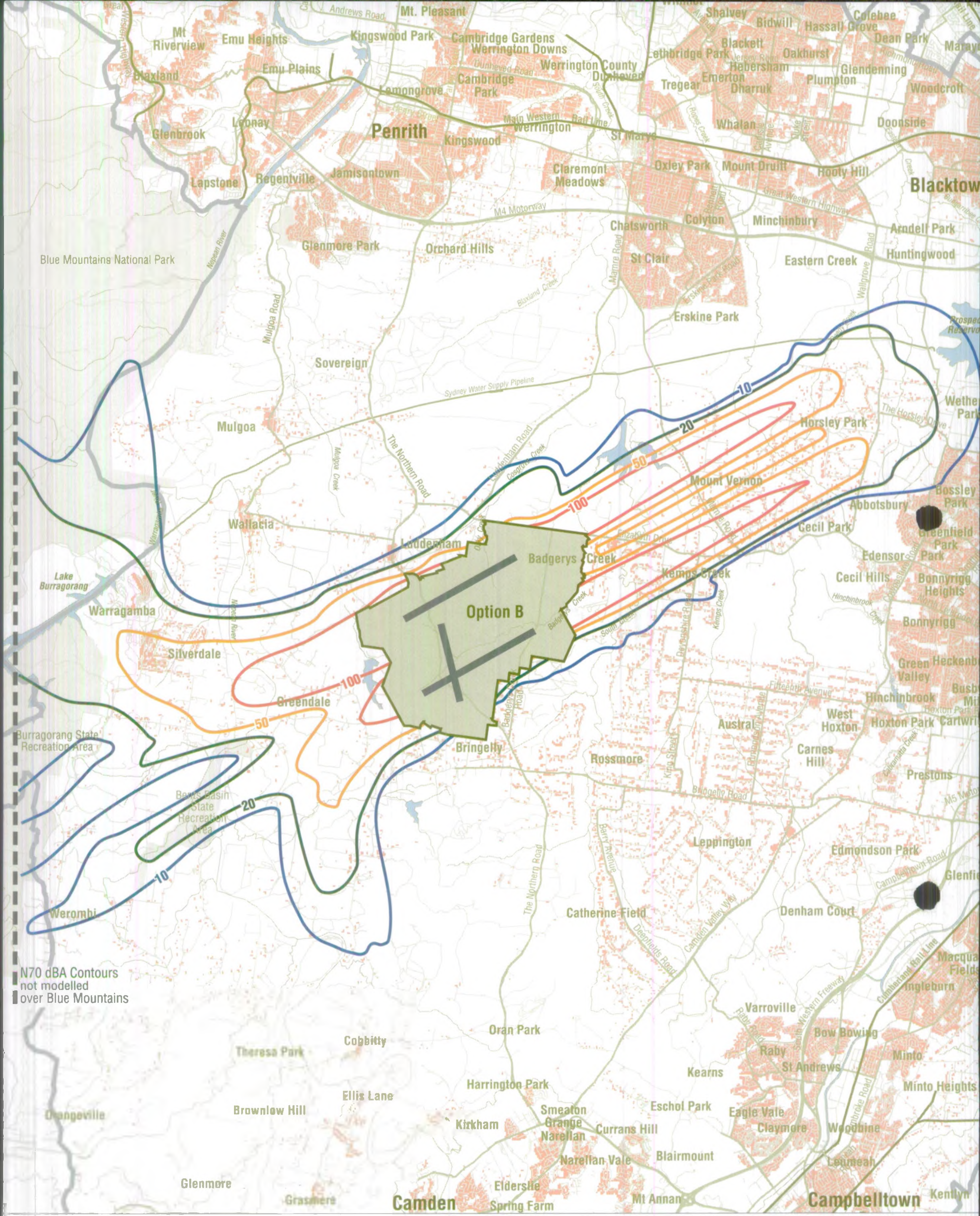
Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA on an average day	—10— —20—	Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70 dBA on an average day	—50— —100—
Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA on an average day	—20— —50—	Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA on an average day	—100—
Extent of dwelling data		Indicates density of dwellings in 1996	

Figure 8.3

N70 dBA Contours for Option B Operating at 30 Million Passengers Per Year (Airport Operation 1)

TN MN N

0Km 5Km



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA on an average day —10— —20—

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA on an average day —20— —50—

Extent of dwelling data

Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70 dBA on an average day —50— —100—

Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA on an average day —100—

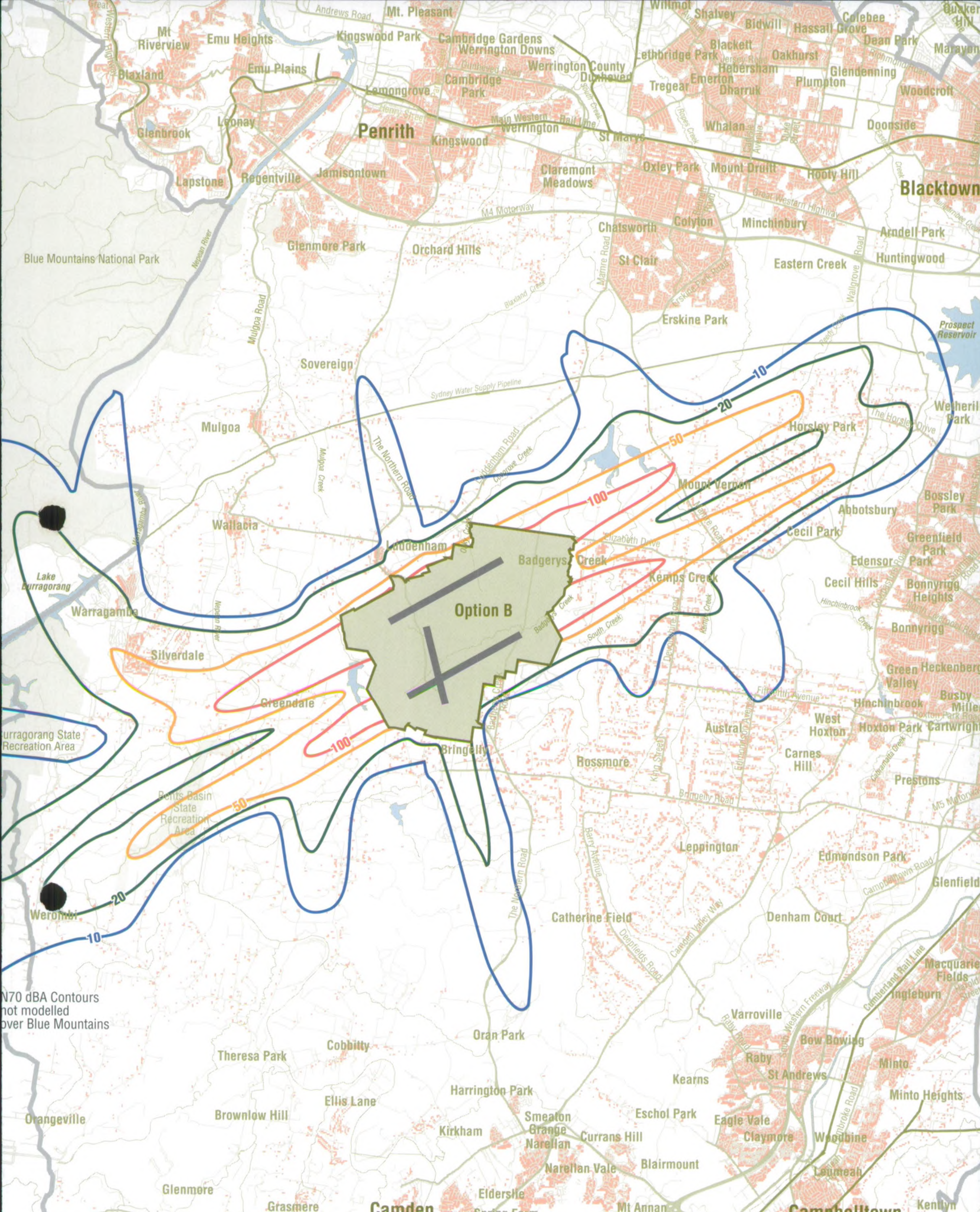
Indicates density of dwellings in 1996

Figure 8.4

N70 dBA Contours for Option B Operating at 30 Million Passengers Per Year (Airport Operation 2)

TN MN

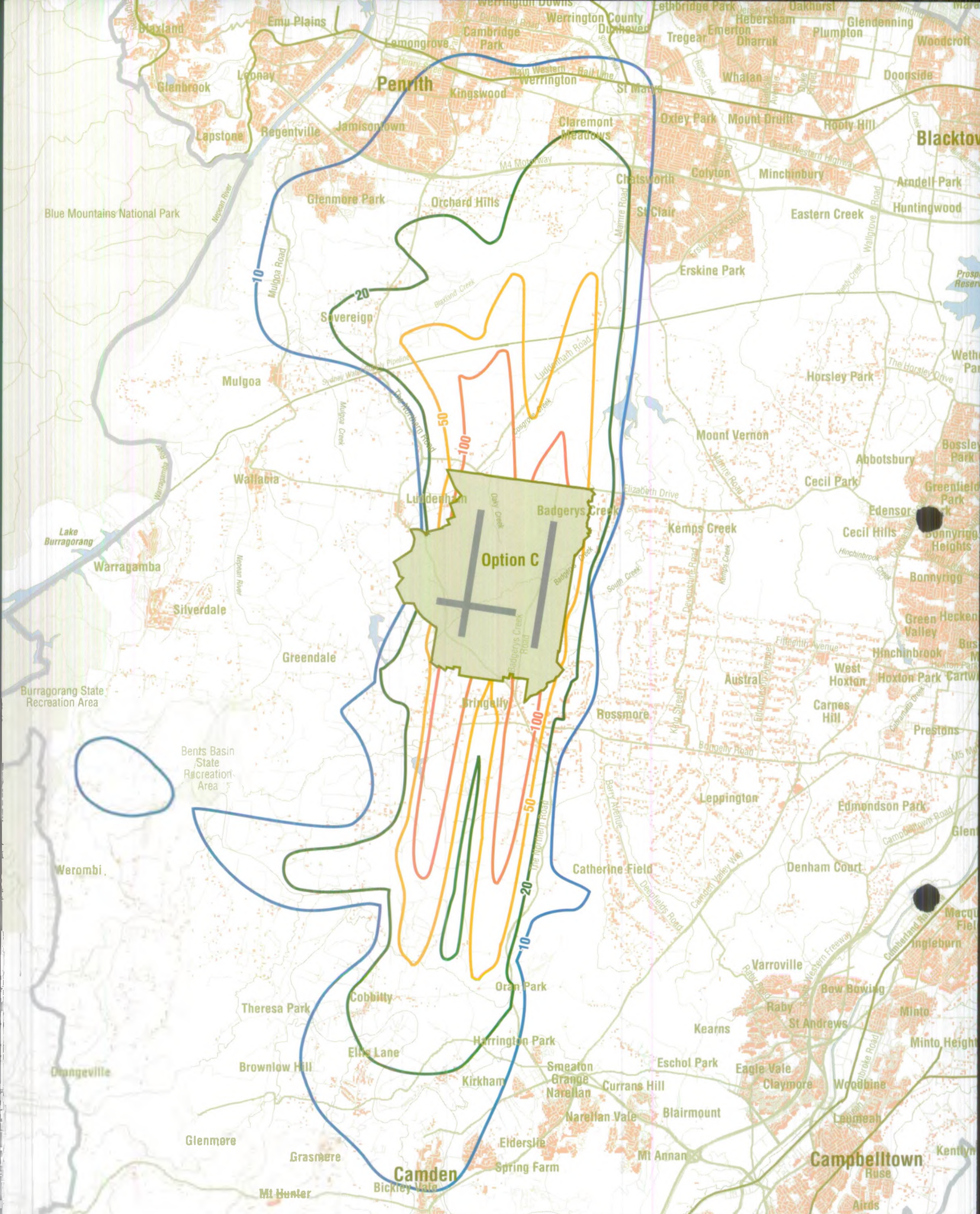
0Km 5Km



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA on an average day	—10— —20—	Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70 dBA on an average day	—50— —100—
Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA on an average day	—20— —50—	Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA on an average day	—100—
Extent of dwelling data		Indicates density of dwellings in 1996	

Figure 8.5

N70 dBA Contours for Option B Operating at 30 Million Passengers Per Year (Airport Operation 3)



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA on an average day — 10 — 20

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA on an average day — 20 — 50

Extent of dwelling data

Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70 dBA on an average day — 50 — 100

Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA on an average day — 100

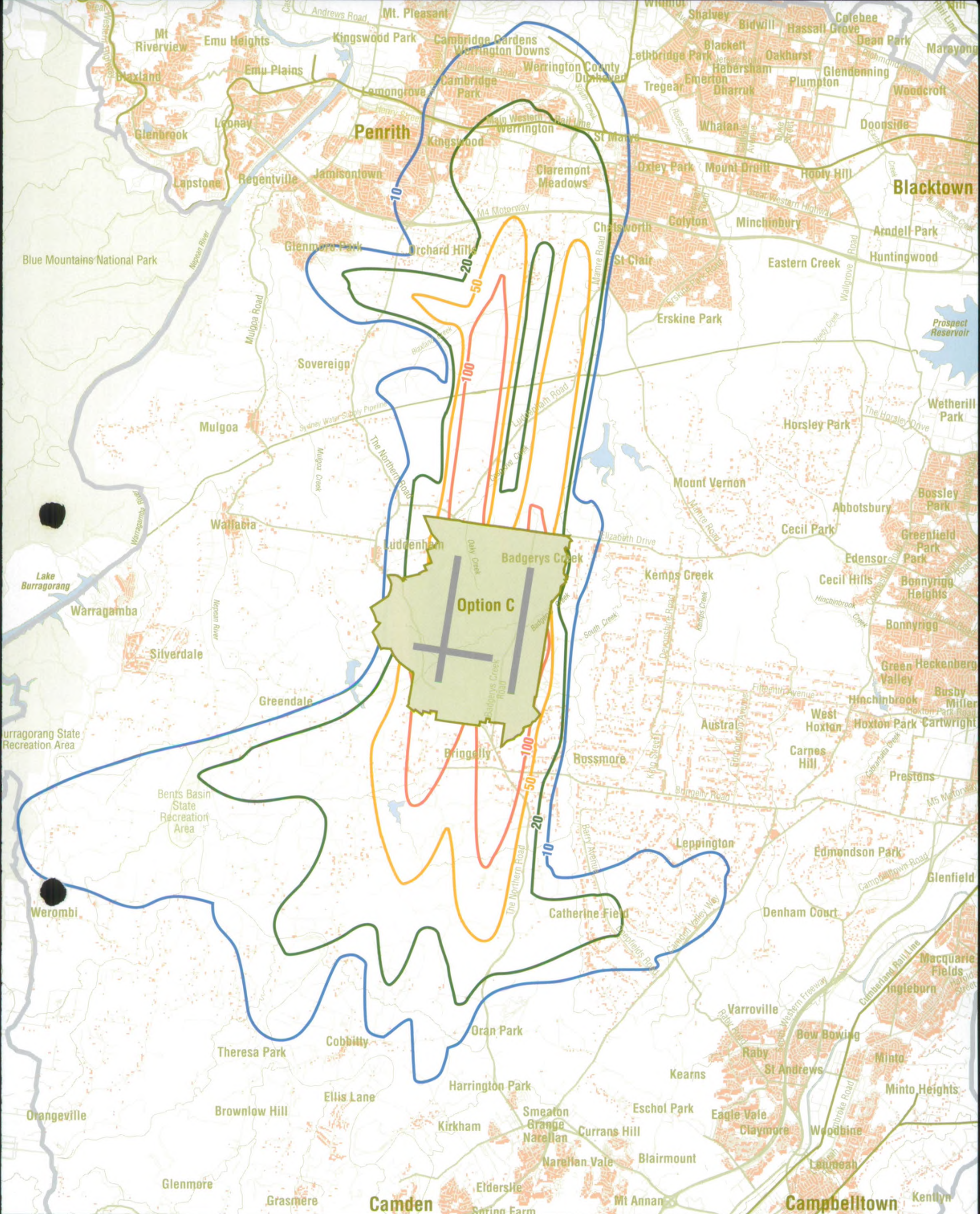
Indicates density of dwellings in 1996

Figure 8.6

N70 dBA Contours for Option C Operating at 30 Million Passengers Per Year (Airport Operation 1)

TN MN

0Km 5Km



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA on an average day —10— —20—

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA on an average day —20— —50—

Extent of dwelling data

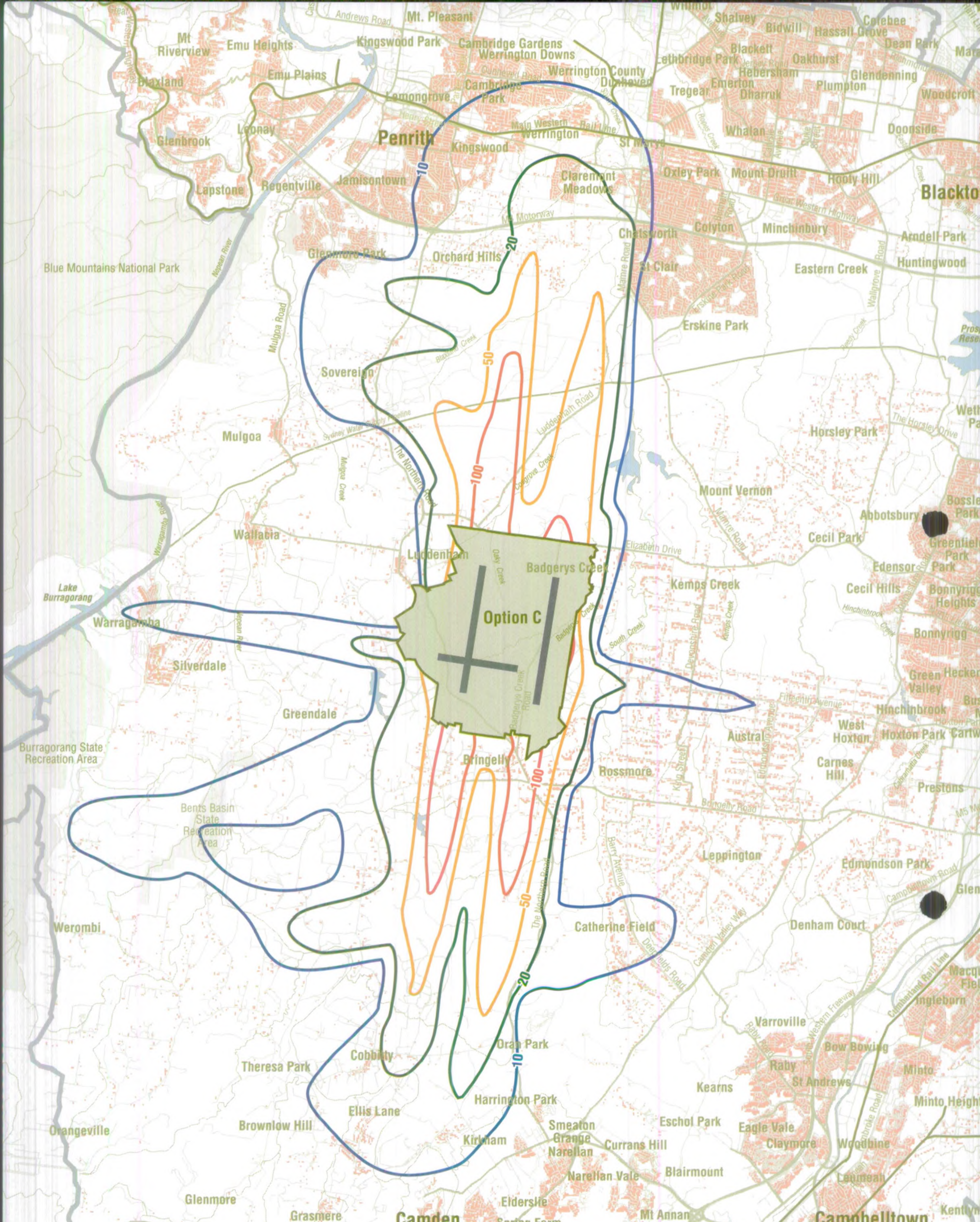
Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70 dBA on an average day —50— —100—

Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA on an average day —100—

Indicates density of dwellings in 1996

Figure 8.7

N70 dBA Contours for Option C Operating at 30 Million Passengers Per Year (Airport Operation 2)



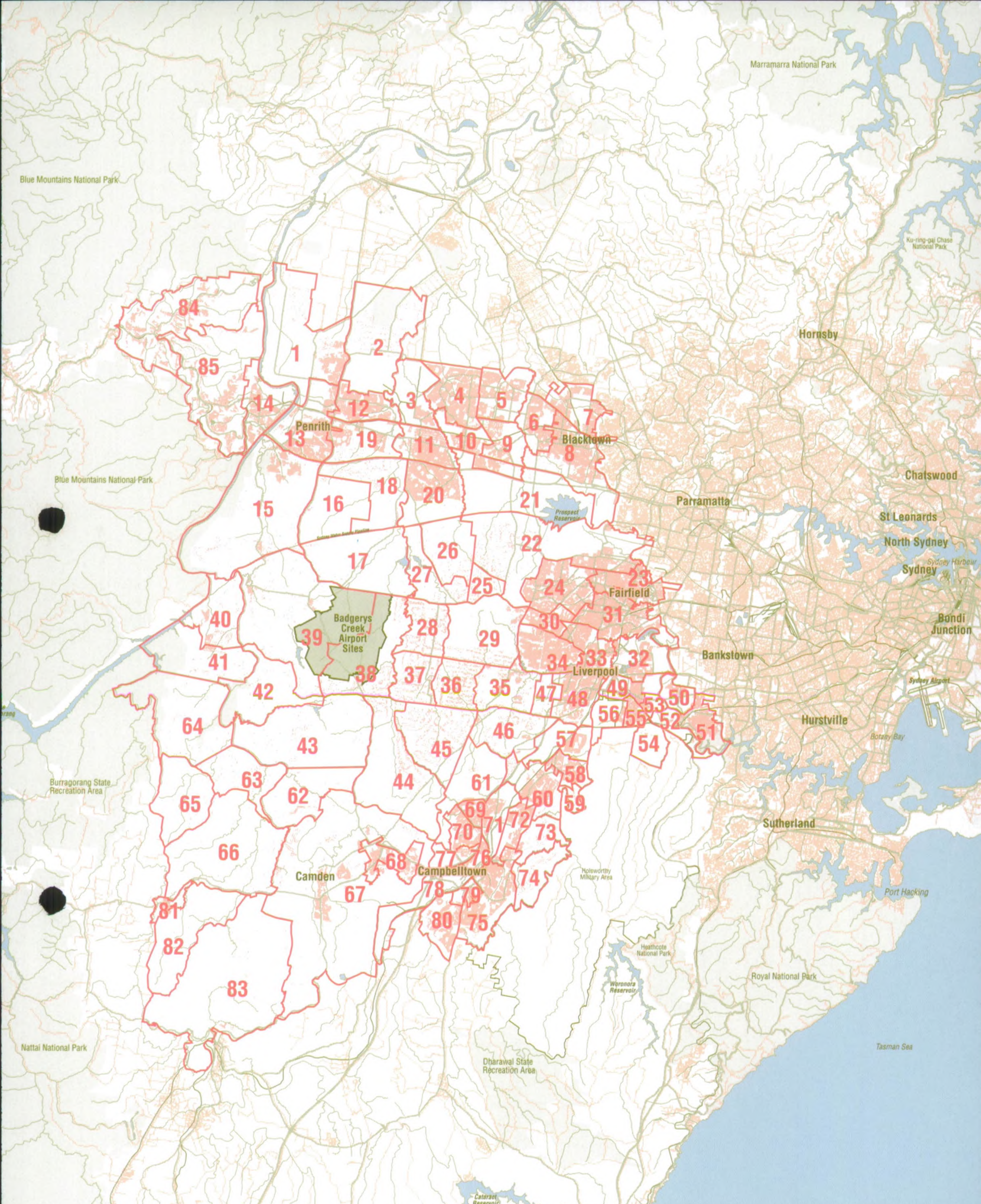
Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA on an average day	10 / 20	Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70 dBA on an average day	50 / 100
Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA on an average day	20 / 50	Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA on an average day	100
Extent of dwelling data		Indicates density of dwellings in 1996	

Figure 8.8

N70 dBA Contours for Option C Operating at 30 Million Passengers Per Year (Airport Operation 3)

TN MN N

0Km 5Km



Urban Areas (indicated by local roads)

Indicates density of dwellings in 1996

Figure 8.9

Community Assessment Areas

the three airport options. Because air traffic forecasts and airport operating conditions were defined in the Draft EIS, a range of possible values is given for each exposure indicator. Noise levels were calculated at one point within the Community Assessment Area, which was chosen to be as representative as possible of noise levels throughout the whole of the area.

Summary Tables

Tables were presented in the Draft EIS summarising the estimated numbers of people, and educational facilities, experiencing various levels of noise impact in 2006 and 2016, for the highest air traffic forecast of 30 million passengers per year (*Air Traffic Forecast 3*).

Other Overflight Noise Impacts

Other overflight noise impacts considered included:

- effects on communication in noise-sensitive spaces other than residences and educational facilities;
- effects on enjoyment of natural areas;
- effects on wildlife and commercial animals; and
- effects on property values.

In the first three cases, the impact assessment was generally qualitative in nature, and was based largely on indicative maximum noise levels. Numbers of noise-sensitive facilities in each Community Assessment Area were listed in Appendix D of the Draft EIS, together with maximum noise levels and their frequency. For impacts on natural areas and on animals, available information was insufficient to draw quantitative conclusions, and discussion was limited to the likely impact of single events of a given maximum level.

Effects on property values were described based on available data, with noise exposure classified by ANEC. Total devaluation was calculated as a range of values for each airport option.

8.1.4 Impacts of Aircraft Overflight Noise

Residential and Educational Impacts

The overall impact of aircraft noise assessed in the Draft EIS, was summarised in Tables 12.5 and 12.6 of that document. These tables were prepared on the basis of Air Traffic Forecast 3, which represents the highest level of aircraft movements. The results were provided in the form of a range because of the different ways in which the airport may operate.

As described above, the number of noise events exceeding 70 dBA over a 24-hour period tends to indicate the degree of disturbance to normal domestic communication. Depending on the airport option and operational scenario, between 200 and 1,000 people were predicted, on average, to experience more than 100 events per 24-hour period greater than this noise level, when the airport is operating at 30 million passengers per year. Between 12,000 and 49,000 people were predicted, on average, to experience more than 10 such events per 24-hour period. Disturbance to communication in a classroom situation would occur for events exceeding 65 dBA. Between six and 40 educational facilities were predicted to experience more than 10 such events per school day (9.00 am to 3.00 pm) when the airport is operating at 30 million passengers per year.

The Draft EIS found that the impacts of the three airport options vary depending on which noise indicator is examined. For many of the indicators only small differences between the potential impacts of the options would exist. For example, the impacts would be similar for the higher and mid range noise levels modelled (say above 15 ANEC or more than 20 noise events per 24-hours greater than 70 dBA). At the lower noise levels modelled (10 noise events per 24-hours greater than 70 dBA), however, it can be concluded that Option C is likely to impact more people than Options A and B. The Draft EIS concluded that when all levels of noise impacts were taken into consideration, it was not possible to provide a definitive ranking between the airport options.

Other Impacts of Aircraft Overflight Noise

Property Values

Research has shown that noise from overflying aircraft can reduce residential property values in areas affected by high levels of aircraft overflight noise. Analysis of previous research and additional surveys carried out for the Draft EIS allowed forecasts to be made of potential changes in property values that might result from the operation of the proposed Second Sydney Airport.

The effect of aircraft noise on residential property values provided a basis for comparing the airport options. It did not, however, provide a precise measure of possible devaluation for individual properties. The analysis addressed only the direct impacts on dwellings in areas potentially affected by noise greater than 15 ANEC. There would also be likely to be indirect impacts on property values such as changes to the future development potential of land in the region surrounding the airport.

The estimated net direct residential property devaluation for each airport option calculated for the Draft EIS is shown in *Table 8.1*.

Table 8.1 Estimated Net Direct Residential Property Devaluation[1]

Airport Option	2016 Net Devaluation[2]
Option A	$49 million to $67 million
Option B	$52 million to $60 million
Option C	$25 million to $31 million

Notes: 1. All results are expressed in real 1996 dollars.
2. Figures rounded to nearest $ million.

Impacts on Wildlife

Investigations carried out for the Draft EIS found that knowledge about the effects of noise on wildlife is limited. This is because of the diverse reaction that could occur across different species, and the different levels and character of noise that might be experienced. It was therefore not possible to quantify the relationship between the levels of aircraft overflight noise and impacts on wildlife.

Noise associated with the airport options has the potential to affect wildlife in the Blue Mountains National Park and the natural areas south of Lake Burragorang. However, in these areas the predicted noise levels were found to be generally relatively low, and overflights would be infrequent.

Predictions made in the Draft EIS indicated that Options A and B might generate up to 25 aircraft overflights per 24-hours exceeding 70 dBA, and up to five exceeding 80 dBA in some areas of the Blue Mountains National Park. South of Lake Burragorang, fewer overflights would occur, with about 15 exceeding 70 dBA and one or two exceeding 80 dBA. At these levels, the Draft EIS concluded that it would be unlikely that there would be significant effects on wildlife in these areas.

The Draft EIS found that Option C would have a lower effect than Options A and B. Within the two natural areas it is expected that no overflights would exceed 80 dBA, while up to seven or eight overflights daily would exceed 70 dBA. The Draft EIS concluded that at these levels of noise the airport would be unlikely to have an adverse effect on wildlife.

Although the likely effect of aircraft noise on domestic animals and birds is not clearly understood, the Draft EIS identified evidence that some animals located under flight paths, such as horses and chickens, might be affected. This is particularly so in areas close to the airport boundaries.

8.2 Summary of Aircraft Overflight Noise Issues

8.2.1 Issues Raised in Submissions

Methodological Issues Related to Impacts on Schools and Students

Methodological concerns related to the assessment of noise impacts on educational activities were raised in a number of submissions. Most comment was directed at two specific points. These are discussed below, as well as other related issues.

Number of Schools Affected by Noise

A number of submissions claimed that the number of schools quoted in the Draft EIS as being affected by noise was grossly under-estimated. Many comments referenced information released by the NSW Environment Protection Authority during the exhibition period claiming that up to 300 schools would be affected by aircraft noise, compared with a maximum of 28 to 40 shown in the Draft EIS. Some submissions estimated that up to 300 schools and colleges would be within the 70 dBA maximum noise level contours shown in the Draft EIS.

Some submissions made the point that the value of 28 to 40 educational facilities quoted in the Draft EIS referred only to the number experiencing at least 10 events per school day greater than 65 dBA. The justification for the 'cut-off' of 10 events per day was questioned.

Requests for Information on Specific Facilities

Many submissions requested that individual facilities which would be potentially affected by aircraft noise be listed, and details of their noise exposure provided. This generally applied not only to educational facilities but also to other noise-sensitive receivers such as health care facilities. Many submissions indicated that this was a requirement of the EIS Guidelines.

Other Issues

Some submissions commented that disruption to communication may occur at noise levels below those considered in the Draft EIS, particularly for susceptible groups such as the hearing impaired, the elderly, young children, and people for whom

English is not their first language. The submissions implied that external noise events at a level lower than 65 dBA should be considered in describing impacts on educational facilities.

Submissions also questioned whether the value of 10 dB, assumed as the difference between external and internal noise levels, is appropriate for demountable school buildings.

Methodological Issues Related to Impacts on Sleep

Approximately 10 percent of submissions raised concerns regarding the potential impact of aircraft noise on sleep. In relation to the assessment in the Draft EIS, a number of specific methodological concerns were raised. Most of these were set out in their most complete form in a detailed submission from the Western Sydney Alliance. They included the concerns that:

- *the Sleep Disturbance Index is not widely accepted by the professional acoustic community*. This comment is taken to indicate that other, more accepted assessment methodologies should have been used. One submission requested more analysis in terms of the NSW Environment Protection Authority's recommendation that maximum noise levels should not exceed 'background plus 15 dB', including mapping of the area over which this level would be exceeded;
- *assessment of sleep disturbance considers only awakenings, rather than other effects*. This comment was a response to the methodology underlying the Sleep Disturbance Index, which is based on prediction of the probability of awakening due to a noise event. Submissions claimed that the Sleep Disturbance Index levels provided in the Draft are misleading, since events which do not produce awakening reactions may cause other reactions, notably changes in sleep state and difficulty in falling asleep. The total number of times that sleep is disturbed is likely to be much higher than the number of awakenings, and it is this value which should be reported;
- *assessment of sleep disturbance does not consider shift workers*. Assessment of sleep disturbance in the Draft EIS considered only predicted night-time noise exposure. Some submissions commented that impacts on shift workers (and others who may sleep during the day time) require particular attention. Analysis of impacts on sleep should be based on the 24-hour noise exposure, that is, the impact on a hypothetical person who sleeps 24-hours a day; and
- *specific calculations of sleep disturbance impact*. The Western Sydney Alliance submission contained detailed calculations of sleep disturbance impact in two areas. The calculations were of the number of sleep disturbances of any form for a hypothetical 24-hour-per-day sleeper. They were based on the assumption that all aircraft are 'B747', 'B767' or 'EA34'. The calculated number of sleep disturbances was greatly in excess of the Sleep Disturbance Index values quoted in the Draft EIS. This result was referred to in many other submissions.

Methodological Issues Related to Reaction to Aircraft Noise

A number of submissions questioned the discussion in Section 11.3.2 of the Draft EIS regarding adaptation to aircraft noise. Evidence for the estimated enhancement in noise reaction of approximately eight ANEF points for a newly-exposed community, compared with a community experiencing 'steady-state' noise exposure, was questioned, because it was based on studies of road traffic noise. Some submissions suggested that experience following the opening of the third runway at Sydney Airport indicates that a higher enhancement is appropriate.

Methodological Issues Related to Noise Level Descriptors

Use of the ANEC Descriptor

A large number of submissions objected to the use of the ANEC noise descriptor in the aircraft overflight noise assessment. The objections were on the basis that it represents an 'average' measure which does not represent actual noise exposure; that it is difficult to interpret and cannot be easily verified by field measurements; and that its use has been discredited through the *Falling on Deaf Ears* report from the Senate Select Committee on Aircraft Noise in Sydney (1995). Many submissions asserted that noise assessment in the Draft EIS was primarily based on the ANEC descriptor, and is therefore fundamentally flawed.

Nevertheless, many submissions requested presentation of the 15 ANEC contour in noise exposure diagrams, on the basis that it provides a more realistic indication of the extent of noise impact than the 20 ANEC contour, which was the lowest level presented on noise contour figures presented in the Draft EIS. Some submissions also requested presentation of the five and 10 ANEC contours.

Lack of Information on Daily and Seasonal Variation

A large number of submissions requested information on the likely variation in noise exposure by day and by season. It was pointed out that both N70 and ANEC, the two major indicators of noise exposure used in the Draft EIS, were based on noise exposure for an 'average day'. This was stated to be misleading in determining actual noise reaction.

Some submissions pointed out that discussion of the degree of seasonal variation in noise levels is a requirement of the EIS Guidelines, indicating that insufficient information was provided in the Draft EIS. On the other hand, one submission from Qantas indicated a belief that the guidelines were followed in this respect.

Other Methodological Issues Related to Noise Level Descriptors

Some submissions indicated that a specific comparison should be made between existing noise levels and levels with aircraft overflight.

A number of submissions suggested that other descriptors of noise exposure should have been used in addition to those provided in the Draft EIS. The only alternative descriptors which were specifically mentioned in this regard are the 'Time Above' metric, which indicates the average time during a 24-hour period for which a specified noise level is exceeded, and the NEF metric, from which the ANEF unit was originally derived.

One submission, by Mr Graeme Harrison, gave details of a proposed methodology for calculating 'total' noise impact, based on summing a function of the ANEC level over all affected residents. This is very similar to the calculation of numbers of people 'seriously affected' by aircraft noise, as performed in the EIS for the Third Runway at Sydney Airport, which was also requested in a small number of submissions.

Methodological Issues Related to Impacts on Property Values

A number of submissions questioned the appropriateness of applying a discount factor to property prices that has been derived from impacted house prices within existing urban areas (that is, suburbs surrounding Sydney Airport and/or those affected by the changed flight paths from the Third Runway) to areas surrounding Badgerys Creek. The contention was that these areas are generally rural in nature and have little background noise at present. Therefore, residents would suffer a greater impact through the introduction of aircraft noise than residents living in inner-city areas already exposed to higher levels of ambient noise.

It was also suggested that the lower value of dwellings in the outer areas of Sydney reflected their generally lower level of locational amenity and access compared to those in the inner areas of Sydney. Therefore, their value would be affected to a greater degree by the same level of noise as they had fewer other compensatory attributes.

Methodological Issues Related to Noise Calculation Procedures

Many submissions asserted that the INM model used for noise level prediction is inaccurate, either overall or under certain specific conditions. Alternatives were generally not suggested, with the exception of the NSW Government submission which indicated that below 20 ANEC, *"models developed by Peter Peploe at the National Acoustics Laboratory"* should be used.

Other issues related to noise calculating procedures were:

- maximum noise level contours shown in the Draft EIS should have used the 747-200B aircraft rather than the 747-400, which has lower maximum noise levels;
- the effects of temperature inversions and/or topographical features would result in higher noise levels than are predicted by the INM model;
- further justification should be provided for the assumption that under a deliberate noise-sharing policy only seven percent of aircraft movements would use the cross wind runway in Options B and C; and
- the introduction of an airport at Badgerys Creek would result in changes to aircraft flight-paths at Sydney Airport, and hence change noise exposure around that airport. Assessment of the potential impact of these changes on noise exposure around Sydney Airport was requested.

Although a number of submissions asserted that noise level calculations reported in the Draft EIS are in error, few were specific with regard to purported errors. However, the Western Sydney Alliance submission quoted three examples of 'errors' (Page 49). In addition, one submission questioned why no aircraft events greater than 70 dBA are shown for one Community Assessment Area even though it is within the amalgamated 70 dBA contour for 747-400 operations.

Issues Related to Assessment of Aircraft Overflight Noise Impacts

Many submissions commented on the acceptability of predicted noise impacts from the proposal. These comments are summarised below.

Impacts on Schools and Students

In submissions, by far the most commonly raised issue in relation to aircraft noise was concern at the impact of aircraft overflight noise on the education and general well-being of school students. This issue was raised in some form in over 30 percent of all submissions. Submissions relating specifically to this issue were received from the NSW Teachers Federation, the Parramatta Dioscean Schools Board, University of Western Sydney Nepean and a number of individual schools.

Many submissions described the potential for disruption to teaching activities which would be associated with frequent aircraft overflight. Some referred to research documenting the potential for aircraft noise to disturb communication within classrooms, and resulting deficits in students' performance on various measures. Some submissions also described the level of interference caused at schools which are currently affected by noise from Sydney Airport, and concluded that schools close to a Second Sydney Airport would be similarly affected.

Impacts on Sleep

A number of submissions raised concerns regarding the potential impact of aircraft noise on the sleep of residents. Many made a similar claim to that made by the Western Sydney Alliance that the Sleep Disturbance Index values quoted in the Draft EIS were underestimated.

Submissions also indicated concern that the airport would operate without a curfew, generally describing the impact of any noise during sleeping periods as unacceptable. In some cases the submissions objected to the fact that no specific noise contours were produced showing night-time noise levels.

Annoyance

Several submissions commented that if, as suggested in the Draft EIS, the difference between 'newly-exposed' and 'steady-state' reactions is due to noise-sensitive individuals moving away from the area over time, this process would involve some cost to the individuals concerned. It was also pointed out that individuals in lower socio-economic groups would find it more difficult to move away.

The NSW Government submission suggested that current Australian Standards for land use around airports may not be sufficiently stringent for a new airport.

Other Overflight Noise Impacts

Several submissions were concerned with the impact of noise on National Parks and other recreation areas. These included submissions from the Colong Foundation for Wilderness and the National Trust. Some suggested that flight paths should be oriented away from National Parks, avoiding any tendency to use these as a 'dumping ground for noise'. Submissions also commented that the Draft EIS did not assess the impact of noise on users of National Parks. Some suggested that surveys of park visitors should be conducted to determine the number of people likely to be affected. It was also suggested that noise modelling should be extended over the Blue Mountains National Park.

Many submissions commented that the predicted loss in property values due to aircraft noise is unacceptable, and some suggested that there would be impacts at noise exposure levels below 20 ANEC.

Unspecified concerns were raised about potential reductions in property values. Some submissions, however, suggested that the effect of aircraft noise on property values may be counteracted by a general increase in values due to development associated with an airport. Submissions also requested a specific assessment of the impact of aircraft noise on non-residential property values.

Several submissions suggested that further information is required on the effects of noise on wildlife. Some indicated that aircraft overflight noise might interfere with various aspects of wildlife behaviour. In addition, a number of submissions expressed concern regarding potential effects on agricultural production, notably poultry farming, and requested details of possible compensation or acquisition arrangements.

Submissions raised concern regarding vibration due to aircraft overflight noise. In particular, concern was expressed that vibration due to overflight noise might affect the structural integrity of Warragamba Dam.

Other Issues Raised in Submissions

Several submissions requested information on noise impacts in areas not covered by the Community Assessment Areas in the Draft EIS, notably within Parramatta. Requests were also made for detailed mapping of facilities such as hospitals, public buildings and places of worship which might be affected by noise levels above the relevant communication criteria as described in Table 11.1 of the Draft EIS. Information on noise impact was requested for specific facilities and, in some cases, information on required noise insulation.

A number of submissions objected to the fact that noise exposure in the Draft EIS was estimated without consideration for possible ameliorative measures, notably alterations to flight-paths and operating procedures designed to minimise noise over residential areas. In some cases it was suggested that if such procedures had been considered, the relative ranking of the three airport options in terms of noise impacts would have differed from that portrayed in the Draft EIS.

A number of submissions indicated that costs of a noise insulation program might be significantly underestimated in the Draft EIS, because they are based on experience at Sydney Airport. They suggest that because those affected by noise from Second Sydney Airport would be newly exposed to aircraft noise, insulation would need to be undertaken over a wider area and/or provide lower internal noise levels.

8.2.2 Issues Raised by the Auditor

The Auditor concluded that the issue of airport noise was generally adequately addressed. However, the Auditor raised a number of concerns regarding whether the Draft EIS complied with the requirements of the EIS Guidelines. They included:

- the examination of average impacts only and the need to examine variations caused by seasonal and meteorological patterns and flight path management;
- the Draft EIS should have utilised and compared the results of several noise descriptors, and included a detailed discussion to support the final choice of noise descriptors used to assess impacts;
- the sleep disturbance index used is not an index widely accepted by the professional acoustic community. Sleep disturbance should be used in accordance with Griefahn (1992) and the NSW Environment Protection Authority sleep arousal noise objective;
- the 15 ANEC level should have been provided in noise contour maps;
- major noise-sensitive facilities such as hospitals, schools and other community facilities, should be individually identified and their likely impact individually assessed;
- the Draft EIS did not assess the effects of noise on users of affected National Parks and recreation areas. The numbers and types of users are not discussed and the computer modelling did not extend over the Blue Mountains. The effects on wildlife were cursorily addressed;

- the discussion and assessment of potential noise insulation should take account of the increased sensitivity to noise among unexposed populations;
- the potential change in ambient noise should be expressed by comparing existing ambient noise levels with total future noise levels;
- there should be reference to experience at Sydney Airport following the opening of the third runway and to the extent of noise impacts experienced by surrounding communities; and
- the lack of any frequency contours on figures showing amalgamated 70 dBA maximum contour limits their interpretation.

8.3 Response to Issues Related to Methodology

8.3.1 Methodology Used to Assess the Impacts on Schools and Students

Literature Review

Technical Paper No. 3 contained a detailed survey of existing research on the impacts of noise on education and learning. However, in response to submissions questioning the number and level of noise events at which a significant disturbance to learning activities may occur, a further literature search was conducted. This used the electronic data bases at the library of the University of New South Wales, the two most important data bases searched being Psycinfo and ERIC. A number of publications relevant to the topic were identified, including some very recent studies which are not included in the review contained in *Technical Paper No. 3*. The more pertinent studies are:

- *Cohen et al, 1980*. The main aim of this study was to determine whether effects of noise on cognitive abilities, which are seen in the laboratory, are evident in real situations. A number of schools under aircraft flight paths at Los Angeles Airport were compared with schools in quiet areas. The mean maximum noise level in the noisy classrooms was 74 dBA (highest 95 dBA) and the mean in the quiet classrooms was 56 dBA. It was found that children from noisy schools are generally less capable of performing a cognitive task than children from quiet schools, and more likely to give up before completing it. There was some indication that while school children were initially less affected by noise, increased length of exposure (beyond four years) seemed to result in greater distractability. There was no evidence that aircraft noise at this level affects reading and maths skills. An increase in blood pressure was also found for children in the noisy schools, as discussed in Chapter 23;
- *Evans et al, 1995*. This study compared children living near Munich Airport with children living in quieter areas of Munich. In the noisy areas, the average LAeq, 24hr level was approximately 68 dBA (roughly equivalent to 30 - 35 ANEF), and maximum noise levels from aircraft were approximately 80 dBA. In the quiet areas, LAeq, 2hr was approximately 59 dBA and the maximum was approximately 69 dBA. In regard to cognitive measures, the study found that children chronically exposed to noise had reduced working memory spans and made more errors in standard reading tests. They also persisted less with insoluble puzzles;
- *Evans and Maxwell, 1997*. These authors studied children living and attending schools in New York within the 65 dBA LAeq noise contour (approximately

30 ANEF) to determine the cause of the identified effects of noise on reading ability. Maximum levels in the study area were up to 90 dBA. It was found that the association between noise exposure levels and reading is due to chronic exposure to noise and not simply interference by noise during the actual testing session;

- *Goldberg, 1991.* This study analysed the response of teachers affected by varying levels of aircraft noise, using a self-administered questionnaire. The questions were:

  - Do you have to pause during a lesson because of aircraft noise?
  - During a lesson is any part of your speech not properly heard by any student as a result of an aircraft flyover?
  - Has any student ever needed to pause in response to you because of an aircraft flyover?
  - Have you noticed whether the class fidgets or has ever been apparently distracted by aircraft overflights?
  - Does aircraft noise ever cause you to modify a lesson or activity either indoors or outdoors?

  Correlation was found between the external ANEF level assigned to each school and the percentage of teachers responding often and very often to the questions. The mean ANEF value at which 10 percent of teachers reported effects often and very often were as follows:

  - ANEF 18;
  - ANEF 20;
  - ANEF 20;
  - ANEF 22.5; and
  - ANEF 22.5.

  While the methodology used in this study may tend to over-estimate the proportion of teachers giving positive responses, it would at least provide a conservative estimate of impacts. On balance, it may be reasonable to assume that a significant effect on teachers occurs at around ANEF 20. At ANEF 15, the percentage of teachers responding 'often' or 'very often' was found to be negligible for Questions 2 to 5 and very low for Question 1. It may therefore be reasonable to assume that a noise level of ANEF 15 could represent a conservative lower limit for these reported impacts; and

- *Crook and Langdon, 1974.* This paper reported the effects of aircraft noise on teaching and classroom activity at schools close to Heathrow Airport. The principal changes in observed behaviour resulted from interference with speech. The proportion of overflights during which a teacher was forced to pause, or adjust the lesson to avoid speaking, was found to depend strongly on the maximum internal noise level. At internal levels less than about 60 dBA (equivalent to an external level of approximately 70 dBA with windows open), very little effect was noted. At internal levels of 65 dBA, approximately one in ten flyovers caused the teacher to pause while speaking, while at 70 dBA, approximately one in four flyovers caused this effect. When talking to individuals or small groups, teaching was found to be less vulnerable to interference by noise and was not seriously affected by flyovers with maximum levels below 75 dBA.

The research indicates that aircraft noise can affect activity within the classroom. Such noise can cause interference to speech communication, and can also affect task performance. Tasks that demand continuous and sustained attention to detail, or that require large working memory capacity, tend to be adversely influenced by noise.

Noise Levels and the Effect on Learning

Most of the literature cited above (and in *Technical Paper No. 3*) does not quantify the relationship between noise level and the effect of that noise, nor indicate a threshold above which the effect occurs. The exceptions are Goldberg (1991), which related the effect to the ANEF level, and Crook and Langdon (1974), which related the effect to the maximum noise level of an aircraft flyover. Both these papers referred to the effect on speech communication and classroom behaviour, rather than performance.

The findings of Goldberg have been compared with the approach adopted in the Draft EIS, where numbers of affected educational facilities were listed down to an exposure of 10 noise events per school day greater than 65 dBA (external). Goldberg's analysis involved the ANEF measure, which can only be approximately related to the number of events greater than 65 dBA. An analysis of the three airport options was carried out to determine this relationship for the specific airport options considered. The results are shown in *Figure 8.10*, which indicates ANEC and N65 (9am to 3pm) noise levels for each Community Assessment Area for the Second Sydney Airport operating at 30 million passengers per year (all operational scenarios).

From *Figure 8.10*, an ANEC level of 15 is approximately equivalent to 10 events per school day greater than 65 dBA. For Airport Options A and B, this conclusion is slightly conservative. Hence, the finding by Goldberg (1991) that there is an insignificant effect in the classroom below ANEF 15 is equivalent to the assumption in the Draft EIS that only relatively minor effects occur outside the zone of 10 events per school day exceeding 65 dBA.

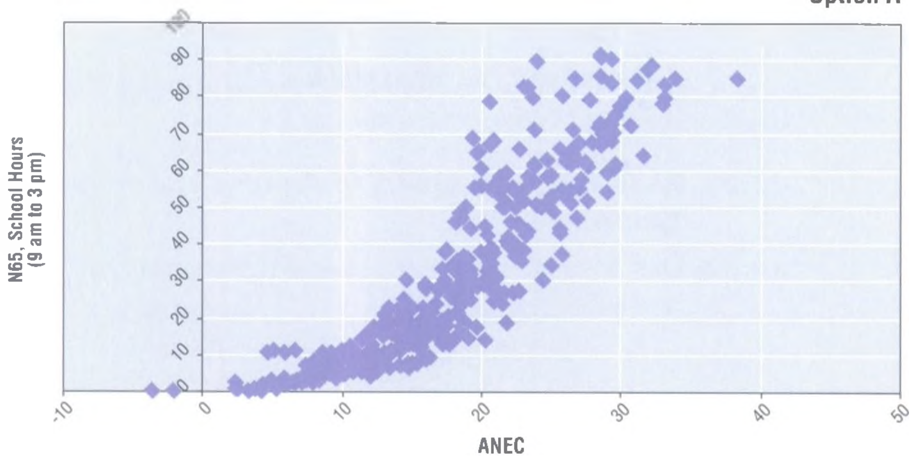
The findings of Crook and Langdon have also been compared with the assessment method adopted in the Draft EIS. The 'cut-off' value of 65 dBA (external) adopted in the Draft EIS analysis is below the equivalent value of approximately 70 dBA derived from their study. If ten events per school day have a maximum level of, for example, 10 dBA above the cut-off, then one would expect a teacher to pause, on average, once per day during teaching. This provides some indication of the level of disruption which is associated with this level of exposure (note that the question of day-to-day variation in noise levels is discussed in detail in *Section* 8.6.6.)

Neither of the two quantitative studies described above considers reaction to a newly-introduced noise source. There are no data to indicate whether impacts on learning may be more significant in these circumstances. However, intuitively the difference due to a newly-introduced source would be expected to be lower for impacts such as communication disturbance which depend directly on physical properties of the noise, than for impacts such as annoyance reactions.

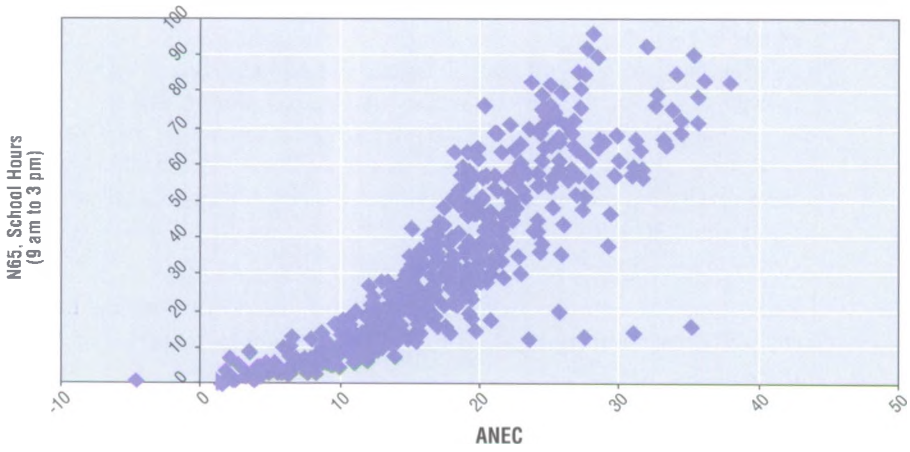
Some submissions on the Draft EIS did not recognise the difference between internal and external noise levels, assuming that because communication may be disrupted at an internal noise level of 55 dBA, aircraft noise levels of 55 dBA should be considered. The aircraft noise levels referred to in the Draft EIS are levels outside a building, and it has been assumed that in most cases the difference between external and internal levels, with windows open to a normal extent, is approximately 10 dB.

The difference of 10 dBA is based on measured noise levels for a large number of building types, and does not depend significantly on the construction of the building,

Option A



Option B



Option C

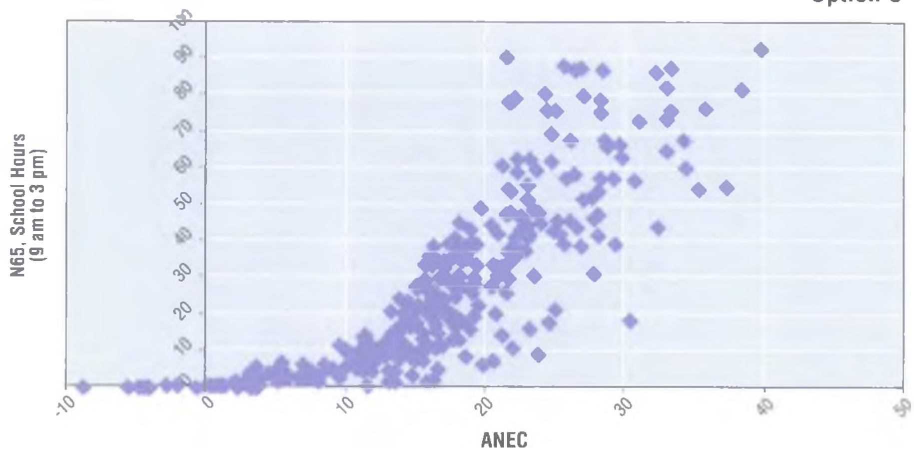


Figure 8.10

Relationship Between ANEC and Number of Operations Per Day Exceeding 65 dBA (30 Million Passengers Per Year)

since for almost any building construction, internal noise levels with an open window would be dominated by noise entering through the window.

8.3.2 Methodology Used to Assess the Impacts on Sleep

Suggested Alternative Assessment Procedures

Two established methodologies for assessment of sleep disturbance are suggested by the Auditor. The first methodology mentioned is based on Griefahn (1992) – a paper which provides criterion curves representing 'awakening reactions' and 'no reactions' in terms of the number of noise events per night and their maximum level. The 'awakening' curve is described as "*the upper risk which must not be exceeded in order to avoid long-term effects on health*", while the 'no reactions' curve is described as "*the preventative goal, which should be realised if possible*".

One major problem in using these curves directly is that they apply only to noise events which all have the same level, and there is no obvious way in which they can be applied to a series of events during the night having a range of noise levels. However, following further analysis conducted during the preparation of this Supplement, it was found to be possible to re-formulate the criteria in a way which retains the original concept but allows them to be applied to a range of noise levels from various aircraft operations during the night. Details of the procedure used are provided in *Appendix C1*.

The second alternative methodology suggested by the Auditor is the NSW Environment Protection Authority's sleep arousal noise objectives. A paragraph in the NSW Environment Protection Authority's Environmental Noise Control Manual states:

> *Noise control should be applied with the general intent to protect people from sleep arousal. To achieve this, the L1 level of any specific noise source should not exceed the background noise level (L90) by more than 15 dBA when measured outside the bedroom window (19-3).*

The NSW Environment Protection Authority (1998d) has recently released a *Draft Stationary Noise Source Policy*, containing revised noise criteria which would in most cases effectively supersede those in the above mentioned *Environmental Noise Control Manual* (Environment Protection Authority, 1985a). The new draft document does not contain any reference to sleep disturbance. However, another recently released Environment Protection Authority document, the *Draft Environmental Criteria for Road Traffic Noise*, contains a discussion of sleep disturbance which includes reference to the above criterion, pointing out practical limitations to its application. That document indicates that existing data are insufficient to provide a definitive recommended procedure for assessing sleep disturbance, but concludes (Environment Protection Authority, 1998c:33) that:

- maximum internal noise levels below 50 to 55 dBA are unlikely to cause awakening reactions; and
- one or two noise events per night, with maximum internal noise levels of 65 to 70 dBA, are not likely to significantly impact health and well being.

The above discussion provides three criteria derived from the NSW Environment Protection Authority for assessment of sleep disturbance, namely:

- C1: the older 'background plus 15 dB' level designed to "*protect people from sleep arousal*";

- C2: a level which is "*unlikely to cause awakening reactions*"; and
- C3: a higher level which is "*not likely to significantly impact health and well being*".

None of the above criteria was intended by the Environment Protection Authority to apply to aircraft noise, although the data on which C2 and C3 are based include studies of aircraft noise.

In addition to the above methodologies, mentioned by the Auditor, the Western Sydney Alliance submission provides a table listing six criteria, derived from various sources and expressed in terms of a maximum number of noise events which may exceed a specified noise level. The most stringent of these criteria requires that not more than 10 events per night should exceed an internal noise level of 48 dBA.

Assessment of sleep disturbance impacts using each of the above measures, including details of the procedures used, is described in *Appendix C1*. It is concluded that NSW Environment Protection Authority criteria C1 and C2, which take no account of the number of night-time noise events, do not give a useful indication of noise impacts. Locations which would experience very infrequent noise events, often as little as one event per year, are treated as being just as affected as locations which experience much more frequent overflights, and hence the total area of affectation is very large.

Under the other four criteria, the number of people affected ranges from 7,000 to 200,000 for Option A; 5,500 to 120,000 for Option B; and 3,000 to 210,000 for Option C. The degree of variation in population impact under the different criteria emphasises the diversity of views as to what constitutes an appropriate criterion for assessment of possible noise impacts on sleep. Although, as stated by the Auditor, the Sleep Disturbance Index used in the Draft EIS is "*not an index widely accepted by the professional acoustic community*", no other measure would fulfil that requirement. The use of Sleep Disturbance Index does have the advantage that it allows impacts to be assessed on a quantitative scale, rather than through a simple pass/fail test as in the alternative methodologies described.

Calculating Sleep-State Changes

The use of the Sleep Disturbance Index for assessment of sleep disturbance in the Draft EIS attracted criticism for being based on awakenings only and thereby underestimating the level of impact. Although mentioned in a number of submissions, this issue is described in its most detailed form in the Western Sydney Alliance submission, and the response is directed largely to the discussion in that document.

Volume 2 of *Technical Paper No. 3*, provides a review of the known impacts of noise on sleep. It explains that these impacts are not confined to awakenings and includes discussion of the following impacts:

- effects on sleep latency;
- body movements;
- changes in sleep stage distribution;
- awakening;
- vegetative responses during sleep; and
- use of sedatives, sleeping pills and earplugs.

To assess noise impacts for a specific proposal, it is necessary to quantify the relationship between these impacts and noise exposure, using some measure of noise exposure which can be related reasonably well to the impacts considered. *Technical Paper No. 3* (page 5-48 of Volume 2), contains a discussion of possible measures of noise exposure which could be used for this purpose. The Sleep Disturbance Index is identified as providing the most complete description of noise exposure for assessment of impacts on sleep, although other measures are also considered.

As pointed out in the submission by the Western Sydney Alliance, the Sleep Disturbance Index was originally formulated by considering the probability of awakening due to aircraft noise, and values of the index were related directly to the predicted number of awakenings per night. Volume 1 of *Technical Paper No. 3* provides a comparison with other recently published results which indicates that the Sleep Disturbance Index does provide a reasonable measure of this particular impact.

The Sleep Disturbance Index unit can also be related to other indicators of sleep disturbance, provided that these can be quantified. Apart from awakenings, the indicator which is most susceptible to quantification, based on available data, is the probability of sleep-stage changes. This refers to changes from a deeper to a lighter stage of sleep, caused by a noise event, and is described in *Technical Paper No. 3* (pages 5-51 of Volume 2). The Western Sydney Alliance submission is critical of the fact that numbers of sleep-state changes due to aircraft operations were not explicitly calculated in the Draft EIS.

Other impacts on sleep quality are much more difficult to quantify. For example, quantitative data on the effect of intermittent noise on sleep latency (time to get to sleep) are not available from any known studies. In addition, this impact would depend not on the number of events during a night-time period, but on the number within a specific time interval, generally between 10.00 pm and midnight. Predictions of numbers of aircraft operations in such a restricted interval, many years into the future, would be subject to very large uncertainties.

The most comprehensive available analysis of the probability of both awakening and sleep-state changes is provided by Pearsons et al (1995). *Appendix C1* describes a method of relating the number of awakenings and sleep-state changes (as predicted by Pearsons et al) to Sleep Disturbance Index. Results are summarised in *Figure 8.11*.

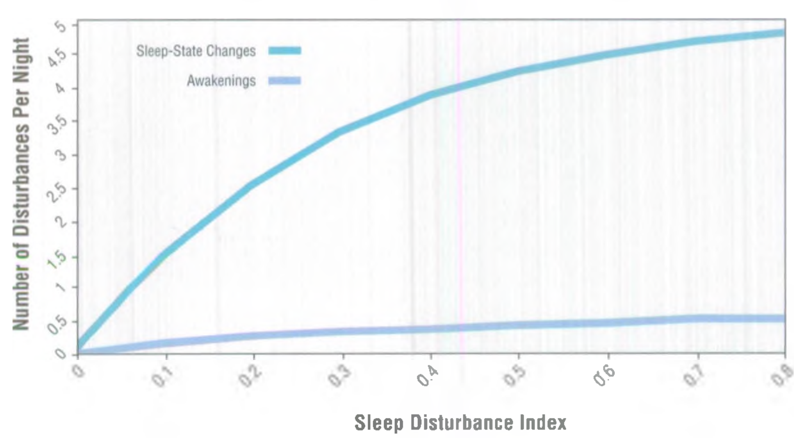


Figure 8.11

Relationship Between Sleep Disturbance Index and Expected Number of Disturbances (using Pearsons et al, 1995)

Using *Figure 8.11*, Sleep Disturbance Index values quoted in the Draft EIS can be related both to predicted numbers of awakenings per night and the predicted number of sleep-state changes. For example, at a Sleep Disturbance Index of 0.4, one could expect an average of approximately 0.4 awakenings per night (two awakenings per five nights), and approximately four changes to a lighter stage of sleep per night.

Impacts of Sleep-State Changes

Being woken up by noise is an experience to which most people can relate, and the statement that a person can expect to be awoken a certain number of times per night or per week can be readily understood. This is the major reason that this interpretation of Sleep Disturbance Index was used throughout the Draft EIS. It was acknowledged that awakenings were not the only impact on sleep (refer to Section 5.3.1 of Volume 2 of *Technical Paper No. 3*).

In studies including various indicators of subjective sleep quality, an increase in total number of awakenings is generally found to be at least as sensitive an indicator of deterioration in sleep quality as variables such as time to fall asleep, reported difficulty in falling asleep and overall rated sleep quality (see, for example, Ohrstrom et al, 1990 – *Table 4*). One very recent study (Ohrstrom et al, 1998), however, finds a difference in self-rated alertness in the morning between two areas in which the number of awakenings does not differ significantly, and suggests that there may also be differences in sleep quality and time for falling asleep.

The significance of sleep-state changes induced by noise is far less clear. While changes in sleep state can definitely be caused by noise events, the total number of sleep-state changes during a night may actually decrease in a noisy environment. This was found by Eberhardt et al (1987: 429) in a study involving reducing the noise exposure of adults sleeping in their normal (noisy) environment. They comment that "*... deteriorated sleep can, besides a lower percentage of SWS [slow-wave sleep] and a higher number of awakenings during the first half of the night, imply a lower number of sleep stage changes per night.*"

Due to the uncertainty about the implications of sleep-state changes, it must be cautioned that while the number of changes per night due to individual aircraft noise events can be estimated (using *Figure 8.11*), the significance of the values calculated is open to question.

Researchers and authorities have approached the question of whether awakenings or sleep-state changes should be used in an overall measure of sleep disturbance in number of ways, including:

- the United States Federal Inter-Agency Committee on Aviation Noise (FICAN) which released a report (1997) recommending a new curve relating aircraft noise levels to the proportion of people awakened by the noise. The report concluded:

  > *Continuing efforts to identify other dose-response relationships are being undertaken by standards-setting organisations, such as the American National Standards Institute. FICAN will evaluate proposed relationships developed by such groups as they are published; until that time, FICAN recommends the use of the curve presented here [accounting for awakenings only] for assessing potential sleep disturbance caused by aircraft noise;*

- Schuller et al (1992) who proposed a measure of overall noise impact on sleep which is similar in principle to the Sleep Disturbance Index, based on awakenings, and referred to as Annual Number of Noise-induced Awakenings;

- Carter (1996), who argued;

  Arousals/awakenings are more easily measured than other aspects of sleep, constituting a powerful argument for using this measure in field studies aimed at evaluating noise effects on sleep in large populations. However, other effects may occur in individuals at lower noise levels than the starting point for arousals/awakenings. It may be prudent to use the more sensitive measure of change to a lighter stage of sleep as the outcome variable in dose/response curves .... and

- Griefahn (1992) who summarised the issues:

  ... the awakening reactions are the only ones which are – according to our present knowledge – possibly significant for the presumed health disorders. They are recalled in the morning, they determine mood and well-being and the resulting psychosocial stress may contribute to the genesis of multifactoral diseases.

  The significance of the alterations to sleep depth is completely unknown. No correlations exist between these reactions and the assessment of sleep in the morning. Nevertheless, it may be desirable to avoid even these reactions and to maintain normal sleep. The establishment of limits based on this criterion reduces at least the number of those very sensitive subjects who awake if [a criterion curve based on awakenings only] is regarded.

A conclusion may be drawn that it would be useful to provide predicted numbers of sleep-state changes, as well as awakenings, due to aircraft noise in a complete assessment of all potential noise impacts, but there are limitations to using such data for impact assessment purposes. The Sleep Disturbance Index can be used for both purposes, using *Figure 8.11*, and results of this analysis are presented in *Section 8.6.4*.

The use of the Sleep Disturbance Index in the Draft EIS represents a sound methodology for impact assessment. While the assessment can be expanded (refer *Section 8.6*), the data provided in the Draft EIS is valid and provides a fair assessment of sleep disturbance impacts.

Assessment of Sleep Disturbance Impacts for Vulnerable Groups

The additional sleep disturbance impact which would be experienced by various vulnerable groups in the community, including shift workers, young children and the elderly, is noted in a number of submissions. As indicated in *Technical Paper No. 3* (5-61, Volume 2), in most cases there is insufficient data to provide a quantitative assessment of the additional impact for these groups.

The Western Sydney Alliance submission suggests that: "*The conclusion from this work is that shift workers are likely to be more at risk than the rest of the exposed population. Assessment of sleep disturbance must therefore be based on a 24-hour period.*" (55) The assessment of sleep disturbance in that submission is based on the number of disturbances experienced by a person who sleeps for 24-hours a day.

The use of this procedure for assessment of sleep disturbance is unprecedented. All assessment methodologies, including those referenced in the Western Sydney Alliance submission, refer to noise events during an assumed sleep period which occurs during the night. A noise assessment methodology based on the assumption that day time sleep disturbance is just as important as night-time disturbance appears incongruous, and leads to inappropriate conclusions. For example, a conclusion could be drawn that the current curfew at Sydney Airport is ineffective as it only moves aircraft noise events from the night-time period to the day time or evening period, where sleep disturbance is just as important. This is clearly not the case.

While it is important to acknowledge the additional disturbance which is caused to shift workers and others who need to sleep during the day time, assessment of the sleep disturbance potential of a proposal should concentrate on the night-time period, when the vast majority of residents wish to sleep.

Total predicted 24-hour aircraft movements for the Second Sydney Airport operating at 30 million passengers per year are approximately 12 times the predicted movements in the night-time period (10 pm to 6 am). In terms of numbers of events above a given threshold, the ratio tends to be higher, as a greater proportion of predicted night-time movements are light aircraft. Hence, the number of sleep disturbances during the night-time period would be at most one-twelfth of the values predicted in the Western Sydney Alliance submission.

Predicted 24-hour sleep disturbance values in the Western Sydney Alliance submission have been misinterpreted in many submissions, beginning with the Western Sydney Alliance submission itself, as night-time values. The Executive Summary of that submission states:

> *[The Draft EIS] claims, for example, that night-time noise impact on a typical community 10 kilometres from the airport might cause a typical resident to be woken by aircraft one night in ten. The truth appears to be that a typical resident would suffer actual sleep disturbance between 6 and 20 times each night! (emphasis in original)*.

While the exact source of the values six to 20 is unclear, they are similar to values in *Figure 6.13* of the same report, which gives "*[n]umber (rounded) of sleep disturbing events in 24-hours*".

This quotation is repeated in a number of other submissions, including those from the Silverdale, Warragamba Action Group and Communities Against an Airport in Western Sydney. If the values quoted are divided by 12 (based on the rationale described above), a more realistic assessment of night-time noise impacts is approached.

Of course, shift workers and other daytime sleepers would experience a much larger number of overflights during their sleep period, and could therefore expect significantly higher levels of sleep disturbance. Based on usage at Sydney Airport, a person sleeping during the 'worst' eight hours of the day would experience approximately 55 percent of the predicted 24-hour movements during their sleeping period. Noise levels from other sources are also higher during the day time (measured day time LAeq levels in Community Assessment Areas are typically five to 10 dBA higher than night-time levels) and hence disturbance from these sources would also be higher.

8.3.3 Methodology Used to Assess Reaction to Aircraft Overflight Noise

A number of submissions question the validity of an assumed eight ANEC point differential in noise reaction between a 'steady-state' and 'newly-exposed' community, as described in Section 11.3.2 of the Draft EIS. In some submissions this is questioned on the grounds that the studies used to derive this correction involve traffic noise rather than aircraft noise.

There is always uncertainty when results related to one form of noise exposure are applied to another. However, a literature review indicates that no studies of reaction to a change in aircraft noise exposure are available which allow a good, quantitative estimation of the resulting change in reaction for the affected community.

The Western Sydney Alliance submission refers to one study (Goldberg, 1995a; 1995b) of reaction to aircraft noise conducted in Kurnell, soon after the opening of the parallel runway at Sydney Airport. This involved comparison of ratings of annoyance due to current noise levels with retrospective ratings of annoyance before the opening of the parallel runway. The study found a very large difference between these two ratings. However, a study by Brown (1987) indicates that current and retrospective ratings of annoyance are not directly comparable. In Brown's study, annoyance ratings made before a change in traffic noise level were compared both with ratings of present annoyance made after the change, and with retrospective ratings of previous annoyance. There was found to be a very large difference between annoyance ratings before the change and retrospective ratings of previous annoyance, made after the change. While the reason for this finding is open to question, it does indicate that retrospective and current annoyance ratings cannot be directly compared.

8.3.4 Methodology Used to Describe Estimated Noise Levels

Use of the ANEC Descriptor

Although criticised in many submissions, presentation of noise levels in terms of the ANEC descriptor (as well as a number of others) was required by the EIS Guidelines. This requirement is considered appropriate, as ANEC is the standard descriptor used by all Australian Government authorities for assessment of aircraft noise impacts, and its omission would have provided a much less comprehensive assessment. The ANEC unit is the only measure of aircraft noise which has been shown to be related in a quantifiable way to noise reaction, in an Australian context (Hede and Bullen, 1982). As discussed in the Draft EIS, the results of that study do not reflect the likely additional reaction due to the introduction of a new noise source. It is also possible that individuals' reactions to a specific noise may change over time, depending on changing community attitudes and beliefs. Both these factors need to be considered in interpreting the meaning of ANEC noise levels, but neither makes these levels irrelevant, particularly as no alternative unit is available which has a clearer interpretation in terms of noise reaction.

In addition, as pointed out in the Draft EIS, ANEC levels are directly relevant to at least one form of noise impact, the impact on potential property development, which is generally controlled using the recommendations of *Australian Standard 2021* and guidelines released by the NSW Department of Urban Affairs and Planning.

The Draft EIS commented on the applicability of *Australian Standard 2021* to future land use planning around the site of the second airport. Further analysis of this issue is contained in *Chapter 7* of this Supplement.

ANEC levels are also currently used in determining eligibility for property acquisition and, around Sydney Airport, acoustic treatment of residences and other buildings. While some submissions suggested either that other exposure units should be used, or that current policy should not be applied to a new airport at Badgerys Creek, it is considered important that at least the area of eligibility under current policies should be presented.

Contrary to a number of submissions, noise impact assessment in the Draft EIS was not based around the ANEC descriptor. Impacts are presented in terms of several other descriptors, notably N70 for general noise exposure and N65 (school hours) for impacts on educational facilities. These were chosen as being both understandable by the general community and directly relevant to the specific impacts considered. Alternative units are used in all three assessment methods – noise contours, detailed information by Community Assessment Area and summary tables of population affected – and results in these terms are given at least as much weight as results in terms of ANEC.

Noise Level Variation and Comparison with Existing Noise Levels

In response to submissions, a number of additional indicators of aircraft noise exposure have been calculated. These are described in an expanded noise impact assessment, in *Section* 8.6 of this Supplement. They include contours showing predicted daily and seasonal variation in noise levels, and a comparison between measured existing noise levels and predicted levels of aircraft noise.

Other Noise Exposure Metrics

The focus of the above discussion has been on presentation of information in a form which is considered genuinely informative, although in some cases significant qualifications need to be considered when assessing the meaning of the data. However, in the case of two alternative metrics requested in submissions, TX and NEF, the additional information which would be provided by a detailed analysis in terms of these metrics is considered very limited.

The TX metric, the total time per 24-hours during which a noise level of X dBA is exceeded, is closely related to NX, the number of events per 24-hours exceeding X dBA – but is considered less easily interpretable, and likely to give an unduly low impression of the total noise impact. For example, an exposure of 20 events per 24-hours greater than 70 dBA (N70) is likely to correspond to a T70 value of approximately two minutes per 24-hours, which appears quite low until it is realised that this time is distributed over 20 separate events.

The Noise Exposure Forecast (or strictly as would be applied in this case, the Noise Exposure Concept) metric differs from ANEC only in the weightings applied to noise events occurring at different times of the day. It is subject to the same objections as ANEC, is not used for land use planning purposes in Australia, and is not associated with Australian data on noise reaction or property values. Hence, there appears no reason to present further analysis based on this metric, the conclusions of which would be exactly as presented above using ANEC.

Methods to Compare Airport Options

A methodology is suggested in one submission involving computing a mathematical function of the ANEF level at all affected residences, and summing this to give a 'total noise impact' which can be compared directly between alternative airport options. This type of approach is useful for making broad 'first cut' comparisons between differing airport scenarios where there are significant differences (for example in comparing Sydney Airport with the Second Sydney Airport - see *Section* 8.8).

The total noise load generated by the three Second Sydney Airport options is broadly similar and therefore a more detailed analysis of the noise exposure patterns of the options is required than would be produced by using some form of single figure 'total impact' index.

One method of providing such a 'total impact' index is to calculate the total number of people 'seriously' or 'moderately' affected by aircraft noise. This was done in the EIS for the Third Runway at Sydney Airport (Kinhill, 1990), and the methodology was widely criticised. Reasons for not adopting this strategy are described in Section 12.9.2 of the Draft EIS. Briefly, they are:

- estimates of the 'total impact' would depend very strongly on the assumed level of reaction at low impacts, particularly the point, if any, where the reaction is assumed to be zero, because of the very much larger population exposed. Comparisons of total impact under these conditions are considered unreliable;
- if an attempt were made to introduce a 'correction' for a newly-introduced noise source, this would be subject to great uncertainty. If not, comparisons between impacts at different times would be misleading; and
- a single-number index is not considered sufficient to adequately describe the range of impacts caused by aircraft noise, or to provide guidance in the selection of appropriate mitigation measures.

8.3.5 Methodology Used to Assess Impacts on Property Values

Many submissions on the Draft EIS comment that the predicted loss in property values due to aircraft noise is unacceptable. Based on previous studies and surveys carried out for the Draft EIS it was concluded that housing prices would devalue by between three percent for properties within the 15 to 20 ANEC band, and up to 20 percent for properties within the 30 to 35 ANEC band. The results of the survey carried out for the Draft EIS indicated that surrounding Sydney Airport there was little or any change in property values below 15 ANEC.

The property value impacts identified in the Draft EIS addressed the direct impact on the value of dwellings caused by a reduction in the residential amenity of those dwellings. There would be a range of other property value impacts caused by the operation of a Second Sydney Airport. These include impacts that could have both positive and negative effects on property values and include:

- potential adverse impact on existing rural production or the capacity to carry out rural production in the future (refer *Chapter 15*);
- the potential for noise effected rural or rural residential lands to be precluded from future urban development;
- the potential for rural or rural residential lands to be included in a program for urban development such as those lands that may surround a potential rail link to the airport; and
- lands that may experience an increase in value as a result of improvements in employment prospects, infrastructure and transportation.

Current knowledge does not allow the potential impacts of aircraft overflight noise on agricultural production to be quantified (refer *Chapter 15*). While it is likely that the airport would preclude some existing rural and rural residential lands from being developed for more intensive residential development, it should be noted that the estimated noise impacts from the three airport options would not preclude the development of any land currently designated by the NSW Government for future urban development up until 2016 (assuming application of *Australian Standard 2021*).

The potential for increases in land values due to increased development potential could also not be quantified as planning for the region surrounding the Second Sydney Airport would not be finalised until after a decision is made on whether the proposal should proceed. Nevertheless, it can be concluded that significant increases in property values would occur should the NSW Government or local governments modify present land use zonings to allow more intensive land uses such as employment activities or residential development surrounding potential transport links to the airport.

Concern was also expressed in submissions suggesting that areas surrounding Badgerys Creek are generally rural in nature and have little background noise at present. Therefore they would suffer a greater impact through the introduction of aircraft noise than inner-city areas already exposed to higher levels of ambient noise. It was also suggested in submissions that the lower value of dwellings in the outer areas of Sydney reflected their generally lower level of locational amenity and access compared to those in the inner areas of Sydney. Therefore, their value would be affected to a greater degree by the same level of noise as they had fewer other compensatory attributes. The property devaluation factors adopted in the Draft EIS were based on a number of studies which calculated average devaluation across various levels of aircraft overflight noise. These studies included areas to the north of Sydney, such as Pymble and West Lindfield, which are generally considered to be relatively quiet areas.

Any disadvantage pertaining to locational amenity or access would be reflected in the current value of the property. Although it is possible that for any devaluation of an individual property to be proportionally greater in outer areas than inner city areas, it is more likely that the devaluation would be influenced by the nature of the property's improvements. Rural residential dwellings might experience greater devaluation than dwellings of lower value, for which evidence suggests the value affectation might be less.

It should be noted that the assessment carried out for the Draft EIS does not provide a precise measure of possible devaluation for individual properties, rather it provides a potential average devaluation for all properties potentially affected by noise of greater than 15 ANEC. It is considered unlikely that the general conclusions of the Draft EIS would be significantly influenced by the different values attributed to semi-rural compared to inner-city living.

8.3.6 Methodology Used for Noise Calculation Procedures

Accuracy of the INM Model

The NSW Government submission suggests that the INM noise prediction model may be inaccurate for exposure levels below 20 ANEF, and that models developed by Peter Peploe at the National Acoustics Laboratory should be used in these cases. Peploe has developed a tentative model for attenuation of noise to the side of an aircraft, based on measurements around Sydney Airport. The model is currently based on limited data, and has not been published. At present it predicts only the Sound Exposure Level (SEL) from an aircraft overflight, rather than the maximum noise level in dBA as has generally been used in this assessment.

Figure 8.12 shows a comparison between SEL values from a 747-400 aircraft on approach and on a Stage 7 departure, as predicted by INM and by Peploe's model (Peploe, 1998, *pers. comm*). The comparison is at a distance of eight kilometres from the nearest end of a 4,000 metre runway, for various distances to the side of the track centre-line.

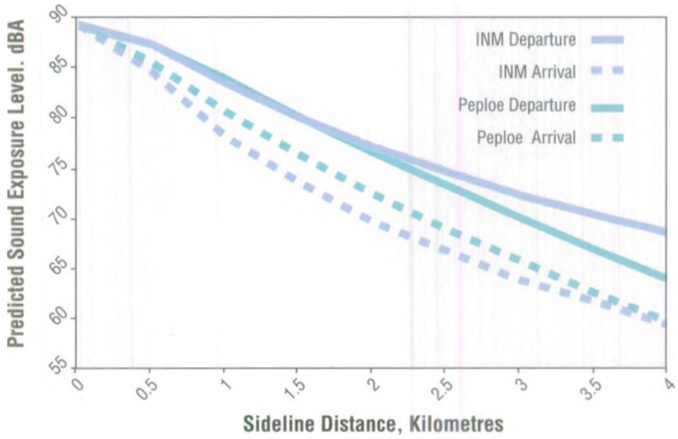


Figure 8.12

Comparison Between INM and Peploe Model Predictions - 747-400 Aircraft at 8 Kilometres from End of Runway

For the aircraft on departure, Peploe's model predicts noise levels very close to INM's predictions up to approximately two kilometres to the side of centre-line, after which INM predicts higher levels. On approach, Peploe's model predicts levels up to three dBA higher at sideline distances of approximately two kilometres, coming more into agreement with INM predictions at larger distances.

Peploe suggests that his model is still in its developmental stage, and does not recommend its use for predictive noise modelling at an airport other than Sydney, where all data used in the model's development were recorded. For this reason it is appropriate that INM model results, which are based on extensive data gathered at numerous airports around the world, continue to be used in noise calculations for the Second Sydney Airport.

Use of 747-400 Aircraft in Maximum Noise Level Modelling

To provide an indication of the area over which noise levels exceeding 70 dBA could be expected at any time, the Draft EIS presented 70 dBA noise level contours for a 747-400 aircraft performing a Stage 7 departure (representing maximum loading of the aircraft). A number of submissions point out that other aircraft, notably the 747-200B, which are included in the model projections, have higher noise levels on departure.

Ignoring operations by the Concorde (or equivalent) and military aircraft, which have projected movement numbers less than 10 per year, there are two aircraft operations for which modelled maximum noise levels may exceed those of a 747-400 Stage 7 departure. These are Stage 7 departures by the 747-200B and the New Large Aircraft (probable successor to the current B747 Series of aircraft). Noise levels are typically two to three dBA higher for the 747-200B, and are assumed to be two dB higher for the New Large Aircraft.

In the case of the New Large Aircraft, modelled levels are higher only because it was decided that for cumulative effects modelling a conservative estimate would be made of the noise emission from these future aircraft types. While the estimate is conservative, it is considered unlikely to occur in practice. Qantas have advised (W. Bourke, 1998, *pers. comm.*) that the most recent information from both Boeing and Airbus Industries indicates any new large aircraft would achieve noise levels which meet at least the standards of a 747-400. Qantas have also advised that they would not purchase aircraft with higher noise levels, due to landing restrictions at various airports which would limit their accessibility. Hence, while for cumulative effects modelling it may be advisable to adopt a higher noise level for a New Large Aircraft, for maximum-level presentations its use is considered misleading.

Currently, only a small proportion of B747 aircraft are 747-200B. These older aircraft are being progressively phased out, and information from Qantas (W. Bourke, 1998, *pers. comm.*) indicates that by 2006 there would be very few, if any in operation. Nevertheless, a small number of these aircraft were included in modelling, as a conservative approach to noise emission. While the use of a conservatively high noise designation may be appropriate for cumulative impact modelling, in practice these aircraft, or others with equivalent noise levels, are unlikely to be operating at a Second Sydney Airport, and hence their use in maximum-level presentations would have been misleading.

Meteorological and Topographical Effects

The potential effect of meteorological conditions on received noise levels is identified in many submissions. One submission questions the discussion of these factors in *Technical Paper No. 3*, on the basis of experience of variable noise levels from existing aircraft overflights in the area. The Auditor suggests the use of either the ENM or SoundPlan models to estimate this effect. It is noted in *Technical Paper No. 3* that neither of these models has been validated for sources at the elevation of an aircraft (see, for example, Tonin, 1997).

Figure 8.13 indicates some of the problems associated with using such models in this case. This shows calculated maximum noise levels from a 747-400 aircraft at eight kilometres from the runway, on departure, using the ENM model. Under standard conditions (no wind or temperature gradient), ENM predicts maximum noise levels which are generally consistent with INM's predictions. With a vertical temperature gradient of three degrees Celsius per 100 metres, the predicted levels are one to two dB higher directly beneath the aircraft, with this difference reducing to the side. This behaviour is contrary to theoretical expectations, since directly beneath the aircraft the sound speed gradient is in the same line as the direction of sound propagation, and in this case there should be no enhancement.

Under wind conditions, ENM's predictions are clearly unreliable. It predicts a very large sudden change in noise level on passing beneath the aircraft from the downwind to the upwind side, which neither theory nor measurement corroborates. It should be emphasised that this is not a problem with the ENM model per se, but results from applying it in conditions for which it was not designed.

At very large sideline distances, the predicted variation of plus or minus six to seven dBA in maximum noise level for a wind speed of plus or minus three metres per second may be realistic. At such distances, the maximum noise level would generally be below 60 dBA. From available meteorological data, a wind speed of three metres per second or more, blowing in any given direction, would occur between approximately five percent and 15 percent of the time, with greater likelihood during the day.

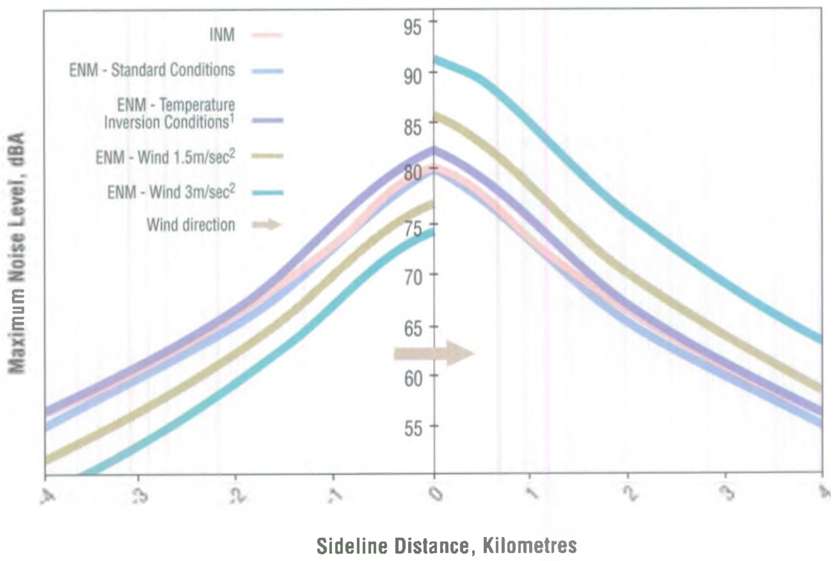


Figure 8.13
Comparison Between INM and ENM Model Predictions - 747-400 Aircraft at 8 Kilometres from End of Runway on Departure

Notes: 1 Three degree Celcius per 100 metres
2. Metres per second

Validation data from Sydney Airport, as presented in Section 4.6.2 of Volume 1 of *Technical Paper No. 3*, provide some confirmation that under the range of meteorological conditions prevailing around that Airport, noise levels do not vary widely from their predicted values. However, most of these monitoring positions are close to the aircraft centre-line, where meteorological effects are predicted to be least important. In addition, meteorological patterns around Badgerys Creek would differ from those around Sydney, wind effects would be less prominent, but temperature inversions may be more so.

Reports that enhancement of existing aircraft noise levels is sometimes experienced around the proposed site under certain meteorological conditions are considered reliable. However, as noted above, theoretical considerations and experience at other airports suggest that this would be confined to aircraft at large distances from the receiver.

In summary, it does not appear possible, using available modelling tools, to predict precisely the impact of temperature inversion and wind conditions around the proposed Second Sydney Airport on sound propagation from aircraft in the air. However, the following tentative conclusions can be drawn:

- significant increases in noise level would be restricted to cases where the absolute noise level is low;
- such increases are more likely to be due to wind than to temperature inversion conditions; and
- significant adverse wind conditions occur relatively infrequently, and more often during the day.

Effects such as reverberation due to multiple reflections from hills or other topographical features are even more difficult to deal with in a precise way. However, in this case any increase in noise levels due to these effects would be confined to areas with low population, apart from recreational users of National Parks and natural areas. Aircraft over these areas would be relatively high, and direct ground reflections from features other than cliffs would generally be directed upwards, without causing further reverberation. Locations close to sheer cliffs could expect an increase of up to three decibels in noise levels from aircraft at certain positions in the sky. This is expected to be the limit of any enhancement due to such effects around the proposed site.

Use of the Cross Wind Runway

For noise modelling purposes, it was necessary to make an assumption about the proportion of time the cross wind runway would be used under a 'noise sharing' scenario. At this stage in the development of the airport it is not possible to accurately predict this parameter as it would be determined by policy as well as by technical considerations. After consultations with Airservices Australia and the airport planners, it was assumed that seven percent of aircraft movements would use the cross wind runway in a 'noise sharing' scenario.

Noise Impacts from Changed Operations at Sydney Airport

Chapter 20 discusses the impacts on aviation of the Second Sydney Airport proposal. This includes a discussion of aviation issues that arise from operations in a multi-airport environment. It identifies a number of scenarios where cross-overs of flight paths from Sydney Airport and the Second Sydney Airport would occur.

It is acknowledged that all of the scenarios identified would necessitate some aircraft maintaining relatively low altitudes between about 3,000 feet (914 metres) and 6,000 feet (1,829 metres) until the aircraft are clear of crossing tracks to and from the other airport. This change in altitude would result in adverse noise impacts for residents under the flight paths and can be regarded as a potential cumulative impact of the Second Sydney Airport proposal.

At this stage of the development of the Second Sydney Airport proposal, that is prior to the finalisation of an operating plan, it is not possible to quantify the specific impacts of the proposal on the operations of Sydney Airport. Therefore, it is not possible to quantify potential alterations in the noise environment that would arise from the modified operations of Sydney Airport.

Errors in Calculations

Of the three 'errors' listed on Page 49 of the Western Sydney Alliance submission, the first two appear to result from misinterpretation of the range of ANEC and N70 values quoted for each Community Assessment Area. This represents the range of possible values at one selected point within the Community Assessment Area, over all operational scenarios. The submission appears to interpret the quoted range as representing the range of values under one scenario across all points within the Community Assessment Area. The third 'error' asserts that base maps in Figures D14 and D15 are incorrectly drawn, although in exactly what way is not stated.

In addition, the same submission indicates that an explanation is required for the lack of certain graphs in Appendix D to the Draft EIS. Graphs are not shown for sub-divided Community Assessment Areas to maintain the document at a manageable size. All data which would be shown on these graphs are included in the tables.

Submissions also mention a possible inconsistency between amalgamated 70 dBA maximum contours and data contained for Community Assessment Areas in

Appendix D of the Draft EIS. In this regard reference should be made to Note 2 of the table of noise indicators which states that values less than 0.5 events per day are rounded down to zero. The 70 dBA maximum contours show an amalgamation to 70 dBA contours that would be generated by a 747-400 aircraft on all defined flight paths. Only a small part of the area shown would be affected by a single movement of a 747-400 aircraft movement. As indicated by the data provided for each Community Assessment Area, some areas would rarely experience this level of noise.

During the process of reviewing data provided in the Draft EIS, one calculation error was found. Its effect is described in *Section 8.6.1*.

8.4 Response to Issues Related to Aircraft Overflight Noise Impacts

8.4.1 Impacts on Schools and Students

Many submissions raised concerns regarding disruption to teaching activities and other impacts on schools and students. It is agreed that significant impacts would occur to some schools, however, as discussed in *Section 8.3.1*, only relatively minor effects would occur outside the zone of 10 events per school day exceeding 65 dBA. The estimated maximum number of noise events exceeding 65 dBA for each school is provided in *Appendix C2*.

8.4.2 Impacts on Sleep

A number of submissions made the claim that the sleep disturbance index values quoted in the Draft EIS were underestimated. A comprehensive discussion of the methodology used and alternatives available is provided in *Section 8.3.2*.

Submissions also indicated concern that the airport would operate without a curfew, generally describing the impact of any noise during sleeping periods as unacceptable. In some cases the submissions objected to the fact that no specific noise contours were produced showing night-time noise levels. The EIS has examined the impacts of the airport operating without a curfew. If the airport is to proceed, a decision on whether a curfew would be imposed would be made during the preparation of a Noise Management Plan for the airport (refer *Chapter 25* of this Supplement). Further analysis of night-time noise impacts, including night-time N60 contours, is provided in *Section 8.7.6* of this Supplement.

8.4.3 Annoyance

Several submissions commented that if, as suggested in the Draft EIS, the difference between 'newly-exposed' and 'steady-state' reactions is due to noise-sensitive individuals moving away from the area over time, this process would involve some cost to individuals concerned. This impact was acknowledged in Chapter 25 of the Draft EIS.

The NSW Government submission suggested that current Australian Standards for land use around airports might not be sufficiently stringent for a new airport. A basis for these current standards is the level of annoyance caused by aircraft overflight noise. The application of these land use controls is discussed in *Chapter 7* of this Supplement.

8.4.4 Impacts on Natural Areas

There is limited information on the reaction of people visiting natural areas to aircraft noise. The most meaningful information, from the United States Department of

Agriculture and Forest Service (1992), was referred to in the Draft EIS. This document indicates that people visiting natural areas are approximately 10 dB more sensitive to aircraft noise than those in residential settings.

One natural area not discussed in the Draft EIS was the Bents Basin State Recreation Area which is located approximately 10 kilometres south-west of the airport sites. This area would be subject to a significant number of aircraft overflights, particularly under Options A and B. For these options, it is expected that up to 130 overflights with noise levels greater than 70 dBA could occur per 24-hours with the airport operating at 30 million passengers per year. Up to 70 of these overflights per 24-hours could exceed 80 dBA.

Given the increased sensitivity to noise of people using natural areas for purposes such as camping and bushwalking, noise levels such as these would be likely to result in very significant reaction. Under Options A or B, many people would find Bents Basin State Recreation Area unsuitable for these activities due to the impact of aircraft noise. Under Option C, impacts would be lower, particularly for *Airport Operation 1*. However, a proportion of people might still find this area unsuitable for such activities.

While the noise contours for aircraft overflights in the Draft EIS did not extend far into the Blue Mountains National Park, separate calculations of noise levels had been carried out at a number of selected locations within the park. These calculations allowed an estimate of the range of noise levels to be expected in the park from aircraft overflights. The results are discussed in general terms in *Section 12.4.2* of the Draft EIS for each airport option. It is not possible to present a more specific discussion of the noise impacts in these areas in view of the limited knowledge of the impact of noise in natural areas.

While it would be possible to modify the flight paths assumed in the Draft EIS to reduce the noise impact on natural and recreation areas, such a course of action might increase the number of flights over residential areas. Possible mitigation options are described in *Section 8.7*, but in most cases the options discussed would result in higher noise exposure over natural areas in the Blue Mountains, in order to reduce exposure in residential areas, particularly Silverdale and Warragamba.

8.4.5 Impacts on Wildlife and Agricultural Production

The findings of studies into the impacts of noise on wildlife researched for the Draft EIS (Section 11.5) did not provide any clear relationship of behaviour to quantified noise levels. It is therefore not possible to be specific regarding the overall impact of overflight noise associated with a Second Sydney Airport on wildlife in surrounding bushlands and the discussion in the Draft EIS is the most comprehensive available. Since the aircraft noise would be intermittent, any effect on wildlife is likely to be limited.

There is a greater potential for an effect on wildlife in the Bents Basin State Recreation Area than the parks referred to in the Draft EIS . The noise levels likely to affect this area are discussed above in regard to natural areas.

There is a greater potential for aircraft overflight noise to affect horses and poultry, since there are a number of horse training business around the airport sites and a poultry multiplication farm to the south. These facilities would be affected by noise levels higher than those likely to affect wildlife and, while the direct relationship between noise level and effect cannot be precisely quantified, there is a potential for an impact on these industries from the airport. This issue is discussed further in *Chapter 15*.

8.4.6 Vibration Impacts

A number of submissions questioned whether vibration induced by noise from aircraft overflights may cause damage to structures, notably Warragamba Dam.

The Australian and New Zealand Environment Council sets criteria for vibration levels in building structures, which are designed to protect human comfort and are below the levels required to prevent structural damage. For residences, the maximum acceptable vibration level is set at a peak vibration velocity of five millimetres per second. Standards designed to protect against structural damage typically set higher criterion levels. For example, the internationally-recognised German standard DIN 4150 sets a criterion of 40 to 50 millimetres per second for vibration frequencies of 50 to 100 hertz (typical of loud aircraft noise) for commercial, industrial and similar buildings.

At very high noise levels, the energy carried by a sound wave can be transmitted to a solid object, resulting in vibration of the object. This occurs most commonly for very low-frequency noise, and a typical manifestation would be rattling of window glass in a frame. The level of vibration transmitted depends on the level of the noise, the frequency, and the mass and other characteristics of the object.

For example, for typical light window glass, aircraft noise at a level of 100 dBA may result in a vibration velocity of approximately 1.5 millimetres per second, enough to cause rattling in a loose-fitting frame, but not sufficient to cause breakage or other structural problems. For a 300 millimetre concrete slab, the resulting vibration velocity would be approximately 0.05 millimetres per second.

It is clear that even for a maximum aircraft noise level of 100 dBA, which is unlikely to occur at the location of sensitive buildings, the levels of vibration generated within structures would be well within appropriate criteria, and would not result in structural damage.

Vibration due to aircraft noise is often confused with the phenomenon of wake vortices, in which air movements associated with the passage of an aircraft at low altitude have been known to cause damage to buildings, generally by lifting roof tiles. This has occurred at a number of residences around Sydney Airport, and in these cases reparation has been made by Airservices Australia.

8.5 Response to Other Issues

8.5.1 Impacts Beyond the Area Covered by the Community Assessment Areas

Potential impacts of aircraft overflight noise were described in detail for each of 85 Community Assessment Areas located around the airport site (Draft EIS, Appendix D). These were initially chosen to cover all populated areas within 20 kilometres of the airport sites, as experience around Sydney Airport indicated that significant impacts may be experienced out to approximately that distance. This choice was also determined by the distance from the airport at which aircraft flight paths could be assumed with reasonable confidence.

The area covered by the Community Assessment Areas is approximately the same as the populated areas within the 70 dBA single-event noise contours shown in Figures 12.16 to 12.18 of the Draft EIS. The largest populated area within the single-event contours which is not covered by the Community Assessment Areas is an area between approximately Parramatta and Blacktown. A number of submissions questioned why this area appeared to be omitted.

An indication of the extent of impacts in areas not covered by Community Assessment Areas can be gained by considering the noise exposure on the boundaries of this area. This varies at different points around the boundary, depending on the airport option and operational scenario chosen. *Table 8.2* indicates the points at the boundary of the Community Assessment Areas where noise exposure is greatest, and the extent of the exposure at these points. Exposure at other points beyond this boundary would be lower than the levels shown.

Table 8.2 Maximum Noise Exposure at the Boundary of the Area Covered by Community Assessment Areas for Second Sydney Airport Operating at 30 Million Passengers Per Year

Location on Boundary of Community Assessment Areas	Airport Option and Operating Scenario Giving Highest Exposure	Number of Noise Events[1]	
		N70	ANEC
Shanes Park - Northern Edge of Area 3	Option C, Airport Operation 2	8	10
Seven Hills - North-Eastern Edge of Area 8	Option A or B, Airport Operation 2	3	9
Bankstown - Eastern Edge of Area 50	Option C, Airport Operation 2	< 0.5	5
Razorback - Southern Edge of Area 67	Option C, Airport Operation 1	8	10

Note: 1. These impacts are based on the maximum number of events for each noise descripor as described in Appendix D of the Draft EIS.

From *Table 8.2*, areas beyond the Community Assessment Areas would all experience less than eight events per day exceeding 70 dBA, and would have ANEC levels less than 10, under any airport option or operating mode.

A number of submissions specifically requested information on predicted exposure in the Parramatta area. This information is provided in *Table 8.3*. The point chosen for calculations was at the centre of Wentworthville, representing a heavily populated area lying approximately beneath the assumed aircraft flight paths in this area. It should be recognised, however, that the accuracy of these exposure estimates is questionable, since at this distance from the airport the likely aircraft flight paths cannot be predicted with certainty.

Table 8.3 Predicted Noise at Wentworthville for Second Sydney Airport Operating at 30 Million Passengers Per Year

Noise Indicator	Range of Noise Events/Exposure		
	Option A	Option B	Option C
Number of Events over 60 dBA per 24-hours	2 to 4	10 to 41	0 to 1
Number of Events over 70 dBA per 24-hours	0	0 to 2	0
Number of Events over 60 dBA per night (10pm to 6 am)	0	1 to 3	0
Number of Events over 65 dBA 9am to 3pm	-	0 to 5	0
ANEC	-3 to 1	4 to 9	-12 to -2

8.5.2 Noise Insulation

The adequacy of costings for the assumed program of noise insulation of dwellings and other buildings around the airport sites was questioned in a number of submissions. This was generally on the basis that additional treatment would be required to take account of the fact that the airport would represent a new noise source.

In the Draft EIS, costings were based on the application of current Commonwealth Government policy at Sydney Airport. It has not yet been determined whether or not this policy would be applied at a Second Sydney Airport, and if not, what policy would be adopted. Any policy for the provision of noise insulation would form part of a noise management plan for the airport, which would take account of many factors including possible alternative measures, the overall benefits of such a program and the total costs. Hence, the costs provided in the Draft EIS must be regarded as indicative only, and subject to further detailed analysis as part of the preparation of a noise management plan.

8.6 Further Analysis of Impacts of Aircraft Overflight Noise

8.6.1 Correction of Error in Draft EIS Calculations

Before describing the results of further analysis of the impacts of aircraft overflight noise, correction is required for one data processing error in noise level calculations presented in the Draft EIS. This was located during detailed cross-checking of all calculations. All other data presented were found to be accurate. The error relates to individual noise level estimates for Option C, in 2006, in subdivided Community Assessment Areas. Noise level contours (as distinct from estimates in individual Community Assessment Areas) are unaffected, and no other options or years are affected.

The data which are affected are estimated noise levels for 2006, in Community Assessment Areas which are subdivided under Option C. In these cases, all noise levels (ANEC, Leq, NX and Sleep Disturbance Index) are affected. In most cases, the resulting change in noise level is relatively minor, with the largest changes occurring in subdivided Community Assessment Areas immediately to the north of the airport. Most noise indicators are increased by the alteration.

Some population counts in Table 12.5 of the Draft EIS, and Table 3 of the Draft EIS Summary, are affected by this change, as well as some counts of educational facilities in Table 12.6 of Volume 1 and Table 2 of the Summary. The alterations are set out in *Tables* 8.4 and 8.5.

In some cases, the revised estimates of population and numbers of facilities with a specified noise exposure are significantly higher than the previous estimates, although the actual estimated exposure in each area changes only slightly. However, in all but one case the new values for 2006 remain below the 2016 estimates, and hence do not represent the worst case for noise impact. The one exceptional case relates to the number of people experiencing ANEC levels of 15 or greater, for Option C. Here the maximum estimated number is 24,000 for year 2006 (unchanged by the above correction) and 11,000 for 2016. The higher level for 2006 is due to the concentration of operations on the western runway, causing this contour to extend into heavily-developed areas near Werrington. Under Option C, to the north of the airport, the 15 ANEC contour runs close to the line dividing urban and rural land. This means that the number of affected people changes very rapidly with the cut-off noise level, and also that population estimates based on Community Assessment Area-level data are less reliable (see *Section* 8.6.2).

Table 8.4 **Adjusted Populations Affected by Aircraft Overflight Noise - Table 12.5 of Draft EIS and Table 3 of the Summary "Cumulative Aircraft Overflight Noise Impacts on Estimated Populations in 2006"[1,2]**

Noise Indicator	Option C: Population Affected[3] Previous Value	Option C: Population Affected[3] Revised Value
People that may experience the following ANEC levels in 2006[4]:		
greater than 30	less than 100	Unchanged[5]
greater than 25	100 to 300	Unchanged[5]
greater than 20	300 to 600	Unchanged[5]
greater then 15	1,500 to 24,000	2,500 to 24,000
People that may experience, on average, the following number of noise events over 70 dBA a day in 2006:		
greater than 100 events	less than 100	200
greater than 50 events	200 to 300	300 to 800
greater than 20 events	400 to 23,000	1,500 to 37,000
greater than 10 events	24,000 to 38,000	39,000
People that may, on average, be awoken the following times in 2006[6]:		
once a night	less than 100	less than 100 to 100
once every 2 nights	less than 100 to 200	200
once every 5 nights	200 to 400	400 to 700

Notes:
1. *Based on Air Traffic Forecast 3*
2. *The noise impacts provided in this table are for standard airport operational conditions which have not been optimised with the objective of reducing noise impacts. Optimising runway use and flight paths would likely significantly reduce the numbers of people affected.*
3. *There are limitations on the accuracy of predicting future populations and predicting future aircraft noise levels. Estimates of population greater than 10,000 have been rounded to the nearest 1,000; estimates of population between 1,000 and 10,000 have been rounded to the nearest 500; and estimates of populations less than 1,000 have been rounded to the nearest 100. Estimates of populations less than 100 are expressed as less than 100.*
4. *Impacts of levels of ANEC assume all residential properties within the 35 ANEC contour would be acquired.*
5. *These values were calculated from contours, which are unchanged.*
6. *Worst case situation as it does not assume use of any of the noise management measures available to minimise noise at night.*

Table 8.5 **Adjusted Numbers of Educational Facilities Affected by Aircraft Overflight Noise - Table 12.6 of Draft EIS and Table 2 of the Summary "Cumulative Aircraft Overflight Noise Impacts on Estimated Educational Facilities in 2006"[1]**

Noise Indicator	Option C: Educational Facilities[2] Previous Value	Option C: Educational Facilities[2] Revised Value
Educational facilities that may experience, on average, the following number of noise events over 65 dBA[3] between 9am and 3pm in 2006:		
greater than 100 events	0	0
greater than 50 events	0	0
greater than 20 events	0 to 7	0 to 21
greater than 10 events	7 to 22	22 to 23

Notes:
1. *Based on Air Traffic Forecast 3*
2. *Estimates of the number of educational facilities in 2006.*
3. *65 dBA is the level at which communication within educational buildings would be disturbed.*

Discussion of the various options in the text of the Draft EIS is largely centred around noise exposure in year 2016 (being generally the worst case), and would be unaffected by the above corrections.

8.6.2 Refinement of Population Experiencing Various Levels of Noise Exposure

Most estimates of population in Table 12.5 of the Draft EIS (Table 3 of the Summary) are based on estimated populations within Community Assessment Areas, assuming all residents within the Community Assessment Area experience the same level of noise exposure. While this procedure can generally be expected to provide results with sufficient accuracy for comparative noise assessment, there are cases when more precise results should be used for assessment purposes. This is particularly true when, as in the case of some areas considered, the population is very unevenly distributed, with densely-developed areas lying directly adjacent to undeveloped land.

On considering this issue, it was determined that more accurate estimates should be provided in this Supplement. These are based on the use of contours for each noise descriptor, and involve considerably more analysis time than the use of Community Assessment Area-level data. Revised estimates are provided in *Table* 8.6 for the number of people experiencing ANEC and N70 levels exceeding various cut-off values, with the airport operating at 30 million passengers per year using *Air Traffic Forecast 3*. The Draft EIS assumed that this forecast of air passengers would be reached in 2016. As described in *Chapter 4* of this Supplement this volume of passenger movements would not be likely to be reached until much later. Accordingly, because the populations affected by aircraft overflight noise are based on population projections to 2016, the noise impacts described in this Supplement are considered to be conservative worst case impact.

The estimates of impacts are shown separately for the airport operating modes adopted in the Draft EIS, namely:

- *Airport Operation 1*: Aircraft movements would occur on the parallel runway(s) in one specified direction (arbitrarily chosen to be the direction closest to north), unless this is impossible because of meteorological conditions. That is, take-offs would occur to the north from the parallel runways while aircraft coming in to land would approach from the south, travelling in a northerly direction. Second priority is given to operations in the other direction on parallel runways, with operations on the cross wind runway occurring only when required because of meteorological conditions;
- *Airport Operation 2*: As for Operation 1, but with the preferred direction of movements on the parallel runways reversed (to the south); and
- *Airport Operation 3*: Deliberate implementation of a 'noise sharing' policy under which seven percent of movements are directed to occur on the cross wind runway (with equal numbers in each direction) with the remainder distributed equally between the two parallel runway directions.

Since a cross wind runway is not proposed at Option A, only *Airport Operations 1* and *2* were considered for that option.

Table 8.6 shows that the calculation of populations affected by aircraft overflight noise made in the Draft EIS using data derived from Community Assessment Areas provides a reasonably accurate analysis of potential impacts. Nevertheless, the use of contours refines that analysis and provides a more accurate assessment.

Table 8.6 Refined Estimates of Aircraft Overflight Noise Impacts of Second Sydney Airport Operating at 30 Million Passengers Per Year[1]

Noise Indicator	Airport Operating Mode	Population Affected [2,3] Option A	Option B	Option C
People that may experience the following ANEC levels[4]:				
Greater than 30	Operation 1	200	less than 100	less than 100
	Operation 2	200	200	300
	Operation 3	N/A	100	200
	Range shown in Draft EIS	200	less than 100 to 200	less than 100 to 300
Greater than 25	Operation 1	700	500	300
	Operation 2	1,000	800	700
	Operation 3	N/A	600	500
	Range shown in Draft EIS	700 to 1,000	500 to 800	200 to 700
Greater than 20	Operation 1	4,500	3,500	900
	Operation 2	6,000	5,000	1,500
	Operation 3	N/A	4,500	1,500
	Range shown in Draft EIS	4,500 to 7,000	3,500 to 5,000	200 to 1,500
Greater than 15	Operation 1	14,000	11,000	15,000
	Operation 2	11,000	14,000	19,000
	Operation 3	N/A	12,000	15,000
	Range shown in Draft EIS	11,000 to 15,000	13,000 to 15,000	9,000 to 11,000
People that may experience, on average, the following number of noise events over 70 dBA a day:				
Greater than 100 events	Operation 1	400	300	400
	Operation 2	900	700	500
	Operation 3	N/A	300	300
	Range shown in Draft EIS	500 to 1,000	200 to 700	300 to 400
Greater than 50 events	Operation 1	2,500	2,000	700
	Operation 2	5,000	4,000	1,000
	Operation 3	N/A	2,500	700
	Range shown in Draft EIS	2,500 to 5,000	2,000 to 4,500	800 to 1,000
Greater than 20 events	Operation 1	8,500	7,000	6,000
	Operation 2	9,500	9,500	17,000
	Operation 3	N/A	8,000	7,500
	Range shown in Draft EIS	8,000 to 9,500	6,000 to 7,000	3,000 to 17,000
Greater than 10 events	Operation 1	15,000	17,000	72,000
	Operation 2	15,000	17,000	63,000
	Operation 3	N/A	16,000	60,000
	Range shown in Draft EIS	14,000 to 15,000	12,000 to 14,000	46,000 to 49,000

Notes:

1. *The noise impacts provided in this table are for standard airport operational conditions which have not been optimised with the objective of reducing noise impacts. Optimising runway use and flight paths would likely significantly reduce the numbers of people affected.*
2. *Based on population projections for 2016.*
3. *There are limitations on the accuracy of predicting future populations and predicting future aircraft noise levels. Estimates of population greater than 10,000 have been rounded to the nearest 1,000; estimates of population between 1,000 and 10,000 have been rounded to the nearest 500; and estimates of populations less than 1,000 have been rounded to the nearest 100. Estimates of populations less than 100 are expressed as less than 100.*
4. *Impacts of levels of ANEC assume all residential properties within the 35 ANEC contour would be acquired.*

Another way to view this data is shown in *Figures 8.14 and 8.15*. These figures show number of people affected by noise levels greater than a specified ANEC or N70 value, for the three airport options. The values shown are based on the maximum ANEC and N70 noise levels for any airport operating scenario for the Second Sydney Airport operating at 30 million passengers per year – that is, the worst case from the range of scenarios considered. Populations are based on Community Assessment Area data, and hence are approximate only. Exposure values are plotted down to approximately the values at the edge of the area covered by Community Assessment Areas (refer *Section 8.5.1*). Note that the vertical scale is logarithmic – differences between the curves higher up this scale represent many more people than differences lower on the scale.

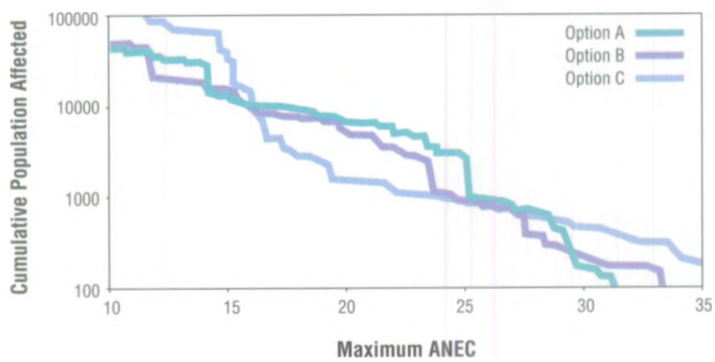


Figure 8.14
Aircraft Overflight Noise Impacts (30 Million Passengers Per Year) on Estimated Populations - ANEC (24-Hour)
Note: 1. 2016 estimate of population

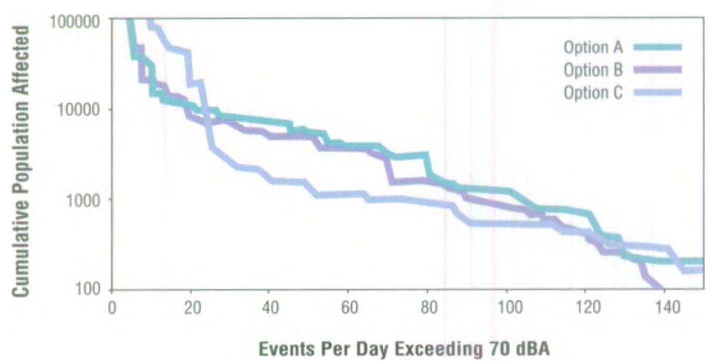


Figure 8.15
Aircraft Overflight Noise Impacts (30 Million Passengers Per Year) on Estimated Populations - N70 (24-Hour)
Note: 1. 2016 estimate of population

From these figures, the basic comparisons between the three airport options become clear. The relative ranking of these options depends on the criterion noise level adopted. At high exposure levels – greater than approximately 25 ANEC, or 120 events per 24-hours exceeding 70 dBA – the impact of all options is similar. At intermediate exposures, above approximately 15 ANEC or 20 events per 24-hours exceeding 70 dBA, Options A and B result in more people being affected than Option C. At lower exposures, many more people are affected under Option C. Finally, at very low exposures the impact of all options tends to become similar, being generally related simply to distance from the site. Options A and B are virtually indistinguishable in this analysis, and more detailed investigation of flight tracks, as discussed in *Section 8.7* below, would be required to provide a comparative assessment.

8.6.3 Refinement of Noise-Sensitive Land Uses Experiencing Various Levels of Noise Exposure

Estimates in the Draft EIS, of the number of educational facilities with specific noise exposure, were based on calculated noise levels at one point within each Community Assessment Area, in a similar way to the population estimates described in *Section 8.6.2*. For this Supplement a full listing of all facilities counted is provided.

Appendix C2 provides listings of the following noise sensitive land uses:

- educational facilities which may be affected by the following noise levels:
  - ANEC greater than 25;
  - more than 20 noise events (on average) greater than 65 dBA between 9 am and 3 pm; and
  - between 10 and 20 noise events (on average) between 9 am and 3 pm;
- other noise sensitive land uses which might experience the following noise levels:
  - more than 20 noise events (on average) greater than 70 dBA; and
  - between 10 and 20 noise events (on average) during a 24-hour period.

The noise level assumes the worst-case situation of *Air Traffic Forecast 3* and the operating mode presenting the highest noise level for each particular land use.

Under the existing noise management policy applying to Sydney Airport, educational facilities within 25 ANEC are proposed to be insulated. For Options A and B three educational facilities might be eligible for insulation, should a similar policy apply to the Second Sydney Airport, while under Option C two might be eligible. Two of these facilities are tertiary research facilities. McGarvie Farm operated by the University of Sydney would be within the 25 ANEC under all options, while the University of Western Sydney facility would be within the 25 ANEC only under Option A. They are used for agricultural research and student radio telescope research, respectively.

Table 8.7 provides overflight noise impacts on existing educational facilities for the Second Sydney Airport operating at 30 million passengers per year. The figures provided in this table differ from figures provided in Tables 12.6 and 27.1 of the Draft EIS and Tables 2 and 9 of the Summary because the calculations made for *Table 8.7* are more accurate. They are based on contours rather than calculated from Community Assessment Area data. Childcare centres have been included within the definition of educational facilities and they are based on existing facilities rather than predicted future facilities.

Table 8.7 Aircraft Overflight Noise Impacts on Existing Educational Facilities of Second Sydney Airport Operating at 30 Million Passengers Per Year[1]

	Educational Facilities		
Noise Indicator	**Option A**	**Option B**	**Option C**
Educational facilities that may experience, on average, the following number of noise events over 65 dBA[2] between 9 am and 3 pm:			
greater than 20 events	15	13	25
greater than 10 events	20	20	75

Notes: 1. *Definition of educational facilities has been expanded to include childcare centres.*
2. *65 dBA is level at which communication within educational buildings would be disturbed.*

Appendix C2 provides churches and aged care facilities affected by nominated noise levels. The impacts on these facilities is shown in *Table 8.8.*

Table 8.8 Aircraft Overflight Noise Impacts on Other Noise Sensitive Facilities of Second Sydney Airport Operating at 30 Million Passengers Per Year[1]

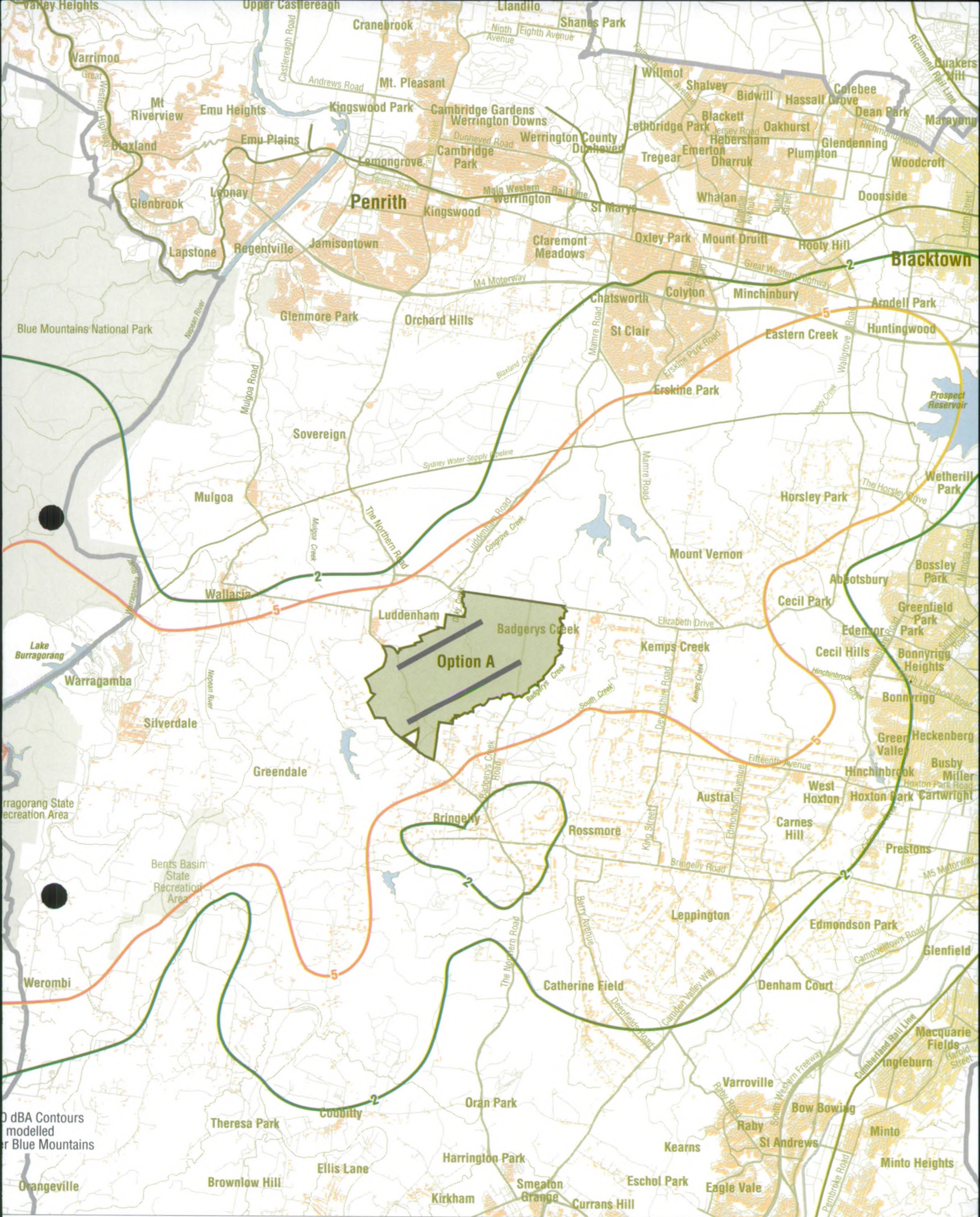
	Other Noise Sensitive Facilities		
Noise Indicator	**Option A**	**Option B**	**Option C**
Other noise sensitive facilities that may experience, on average, the following number of noise events over 70 dBA[2] per 24-hours:			
greater than 20 events	4	9	1
greater than 10 events	7	13	36

Notes: 1. *Estimates include churches and aged care facilities.*
2. *70 dBA is level at which communication within these facilities would be disturbed.*

8.6.4 Further Analysis of Sleep Disturbance Index

As a number of submissions raised the issue of night-time noise exposure, and sleep disturbance in particular, other methods of presenting relevant data are included in this Supplement. *Figures 8.16 to 8.18* show contours representing the 'worst case' prediction of the number of aircraft noise events exceeding 60 dBA during the night-time period 10.00 pm to 6.00 am. An external noise level of 60 dBA approximates an internal level of 50 dBA with windows open, which is within the range generally accepted as the point at which sleep disturbance impacts may arise (refer *Section* 8.3.2).

As an indication of the extent of impact at the 50 dBA level, *Table* 8.9 shows the estimated population that could be potentially affected by noise levels shown as contours in *Figures 8.16 to 8.18*. A relatively large number of people might experience night-time noise events which have the potential to cause sleep disturbance on some occasions. It should be noted that the noise impacts indicated in *Table* 8.9 represent



Area within these two contours is estimated to receive between two and five aircraft overflights louder than 60 dBA on the worst case night —2— —5—

Area within this contour is estimated to receive more than five aircraft overflights louder than 60 dBA on a worst case night —5—

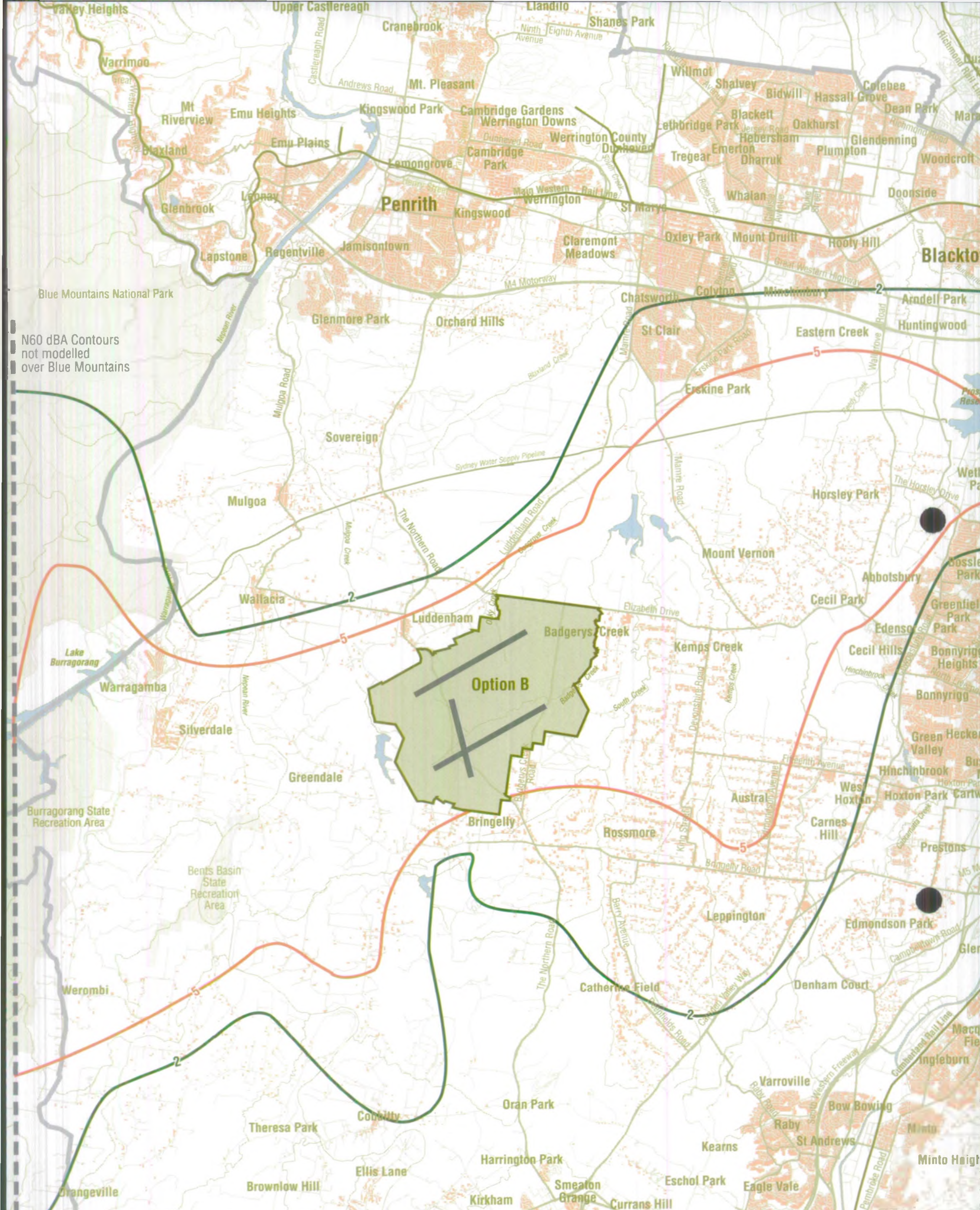
Indicates density of dwellings in 1996

Extent of dwelling data

Figure 8.16

N60 dBA Night-Time Contours for Option A Operating at 30 Million Passengers Per Year - Worst Case Night Operation

0Km 5Km



Area within these two contours is estimated to receive between two and five aircraft overflights louder than 60 dBA on the worst case night —2— —5—

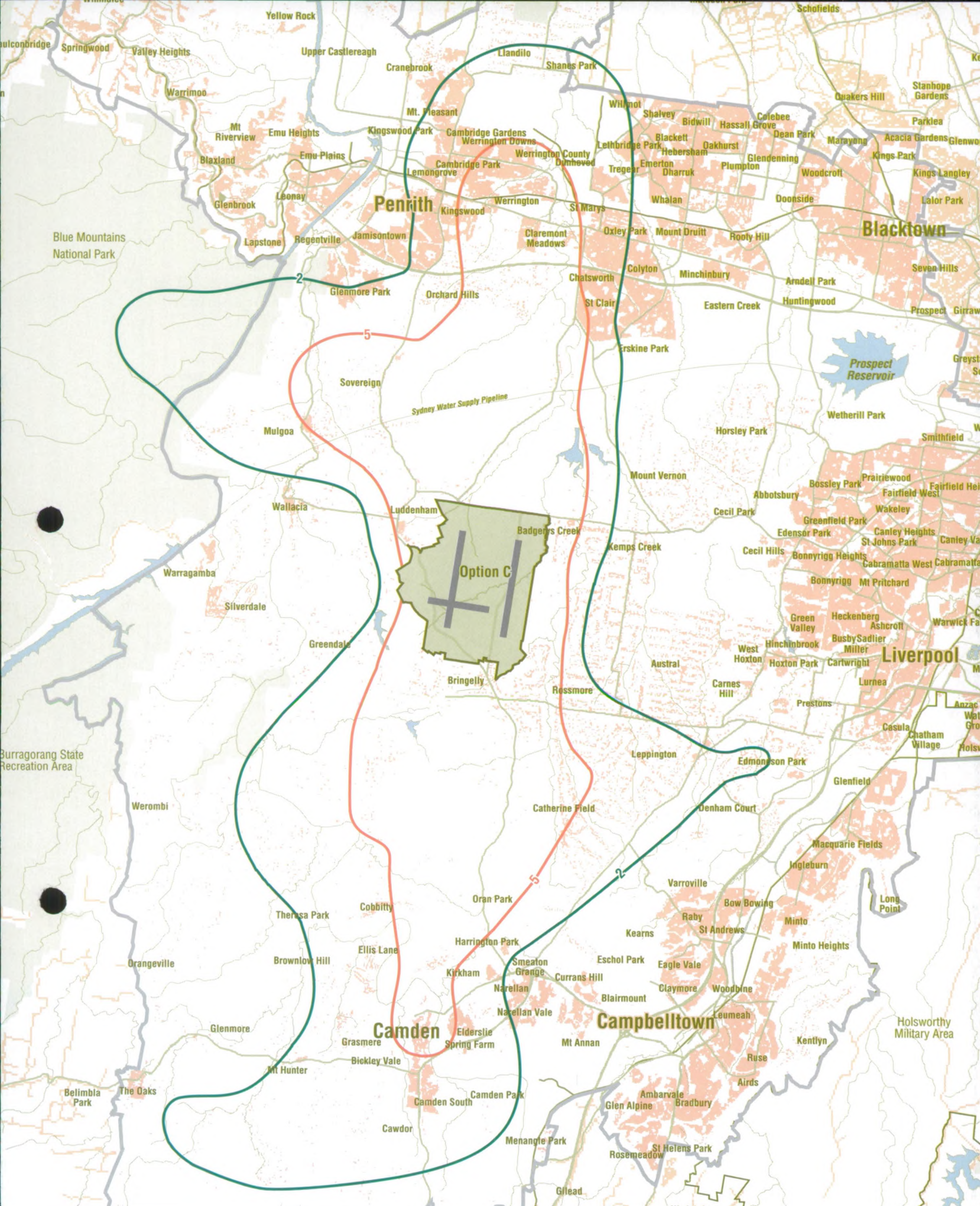
Area within this contour is estimated to receive more than five aircraft overflights louder than 60 dBA on a worst case night —5—

Indicates density of dwellings in 1996

Extent of dwelling data

Figure 8.17

N60 dBA Night-Time Contours for Option B Operating at 30 Million Passengers Per Year - Worst Case Night Operation



Area within these two contours is estimated to receive between two and five aircraft overflights louder than 60 dBA on the worst case night —2— —5—

Area within this contour is estimated to receive more than five aircraft overflights louder than 60 dBA on a worst case night —5—

Urban areas (indicated by local roads)

Indicates density of dwelling in 1996

Extent of dwelling data

Figure 8.18

N60 dBA Night-Time Contours for Option C Operating at 30 Million Passengers Per Year - Worst Case Night Operation

TN MN N

0Km 10Km

a worst case night. For both more than five events and more than two events over 60 dBA during a worst case night, Option C would impact on the greatest number of people. This is primarily due to the impacts on urban residential communities located to the north of the airport.

Table 8.9 Aircraft Overflight Noise Impacts During Night-Time on Estimated Population of Second Sydney Airport Operating at 30 Million Passengers Per Year (Draft EIS Land Use Scenarios)

Noise Indicator	Population Affected[1,2] Option A	Option B	Option C
People that may experience the following number of noise events over 60 dBA during the worst case night:			
Greater than 5 events	18,000	19,000	47,000
Greater than 2 events	124,000	108,000	178,000

Note: 1. Based on projections for 2016.
2. There are limitations on the accuracy of predicting future populations and predicting future aircraft noise levels. Estimates of population greater than 10,000 have been rounded to the nearest 1,000; estimates of population between 1,000 and 10,000 have been rounded to the nearest 500; and estimates of populations less than 1,000 have been rounded to the nearest 100. Estimates of populations less than 100 are expressed as less than 100.

For comparison of numbers of people affected, a similar procedure to that used in *Section 8.6.2* can also be adopted and is shown in *Figures 8.19 and 8.20*. As previously, the population affected by various noise levels, expressed in terms of number of events above 60 dBA and Sleep Disturbance Index, was calculated for the Second Sydney Airport operating at 30 million passengers per year, the worst-case airport operating mode. Note once again that the vertical scale is logarithmic – differences between the curves higher up this scale represent many more people than differences lower on the scale.

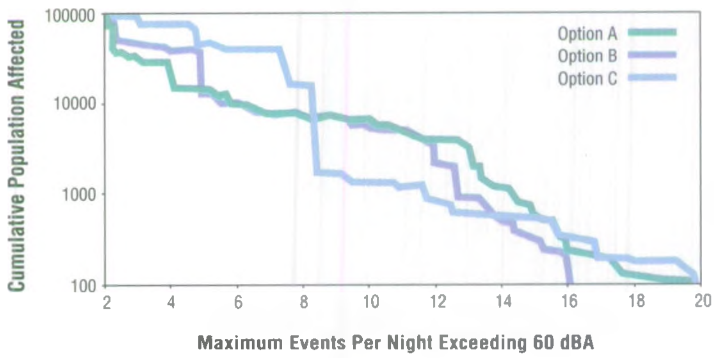


Figure 8.19
Aircraft Overflight Noise Impacts (30 Million Passengers Per Year) on Estimated Populations - N60 dBA (Night-time)
Note: 1. 2016 estimate of population

Comments on the relative impact of the options for day time noise exposure apply equally to night-time exposure. At higher exposures, more people are generally affected under Options A and B, whereas at lower exposure levels more are affected

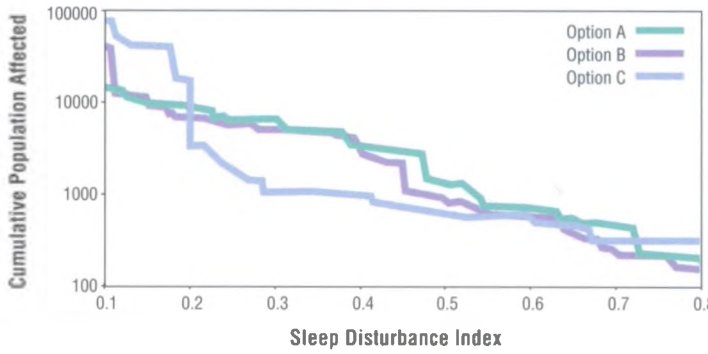


Figure 8.20
Aircraft Overflight Noise Impacts (30 Million Passengers Per Year) on Estimated Populations - Sleep Disturbance Index
Note: 1. 2016 estimate of population

under Option C. The 'cross-over' between Options A and B (which are effectively indistinguishable) and Option C occurs at approximately eight events per night exceeding 60 dBA, or a Sleep Disturbance Index of approximately 0.2. This represents an average of one awakening every five nights, and 2.5 changes in sleep-state per night.

8.6.5 Presentation of Extended ANEC Contours

In response to submissions, ANEC contours have been calculated out to a value of 15 ANEC for each option, operating up to 15 million passengers per year and at 30 million passengers per year and are provided in *Figures 8.21 to 8.26*. Assumptions in the calculation of these contours are exactly as described for other exposure metrics in the Draft EIS.

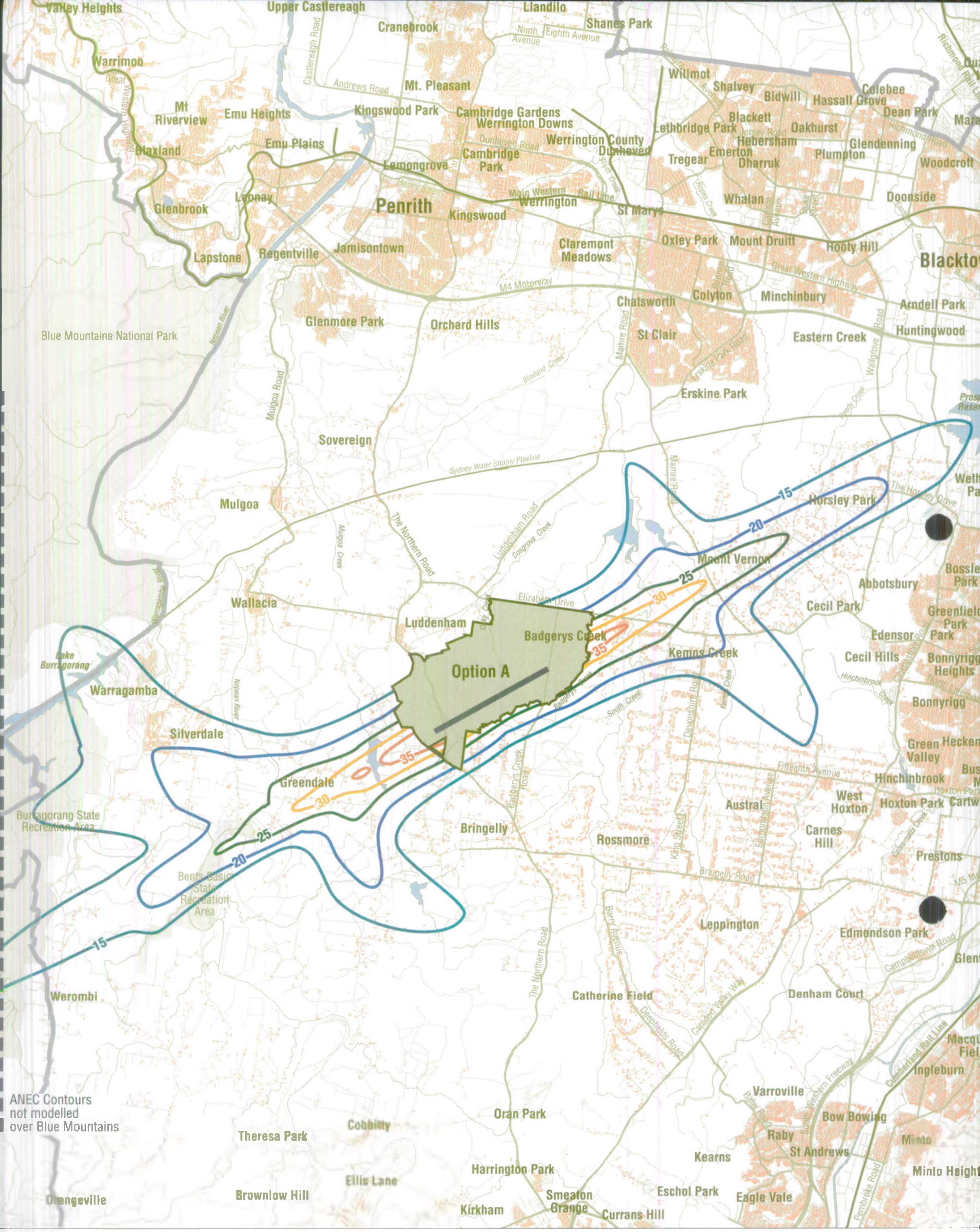
These figures show maximum values of ANEC for all modes of airport operation, as in Figures 12.19 to 12.24 of the Draft EIS. That is, they represent the outer extent of the contour under any of the three airport operation scenarios described in the Draft EIS.

8.6.6 Daily and Seasonal Variation

Noise level contours have been calculated for a 'worst day'. These have been calculated in terms of N70, the number of events per 24-hours exceeding 70 dBA, but in this case this represents the greatest number of events which are predicted to exceed 70 dBA on any one day. Variation between days would be due largely to meteorological conditions. The actual number of aircraft movements at the airport is not expected to vary greatly from day to day, and the size of specific peaks in volume, such as on Christmas Eve or Good Friday, has not been estimated. These calculations are for the Second Sydney Airport operating at 30 million passengers per year.

For locations affected mainly by operations on the parallel runways, it is assumed that these may continue in either a northerly or southerly direction for an entire 24-hour period. This would not be an uncommon occurrence, from the available meteorological data it could occur on between approximately 20 percent and 50 percent of all days, depending on the airport option and operating scenario.

For locations affected by cross wind runway operations, the position is more difficult. *Airport Operation 3* assumes that up to seven percent of all operations may occur on



15 ANEC
20 ANEC
25 ANEC
30 ANEC
35 ANEC
Indicates density of dwellings in 1996
Extent of dwelling data

TN MN N

0Km 5Km

Figure 8.21

Modelled Maximum ANEC Contours for All Assessed Air Traffic Forecasts and Airport Operations for Option A (up to 15 Million Passengers Per Year)

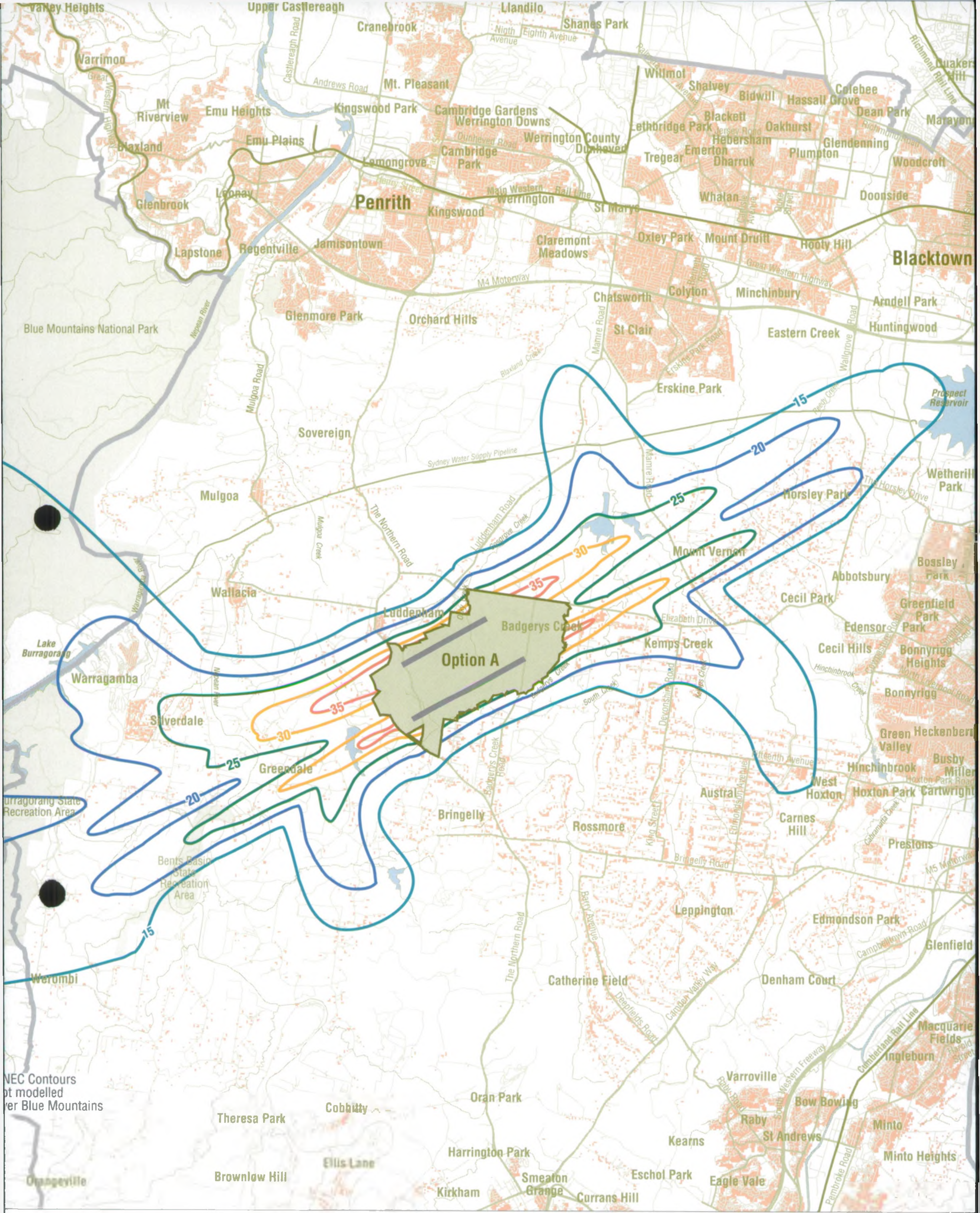
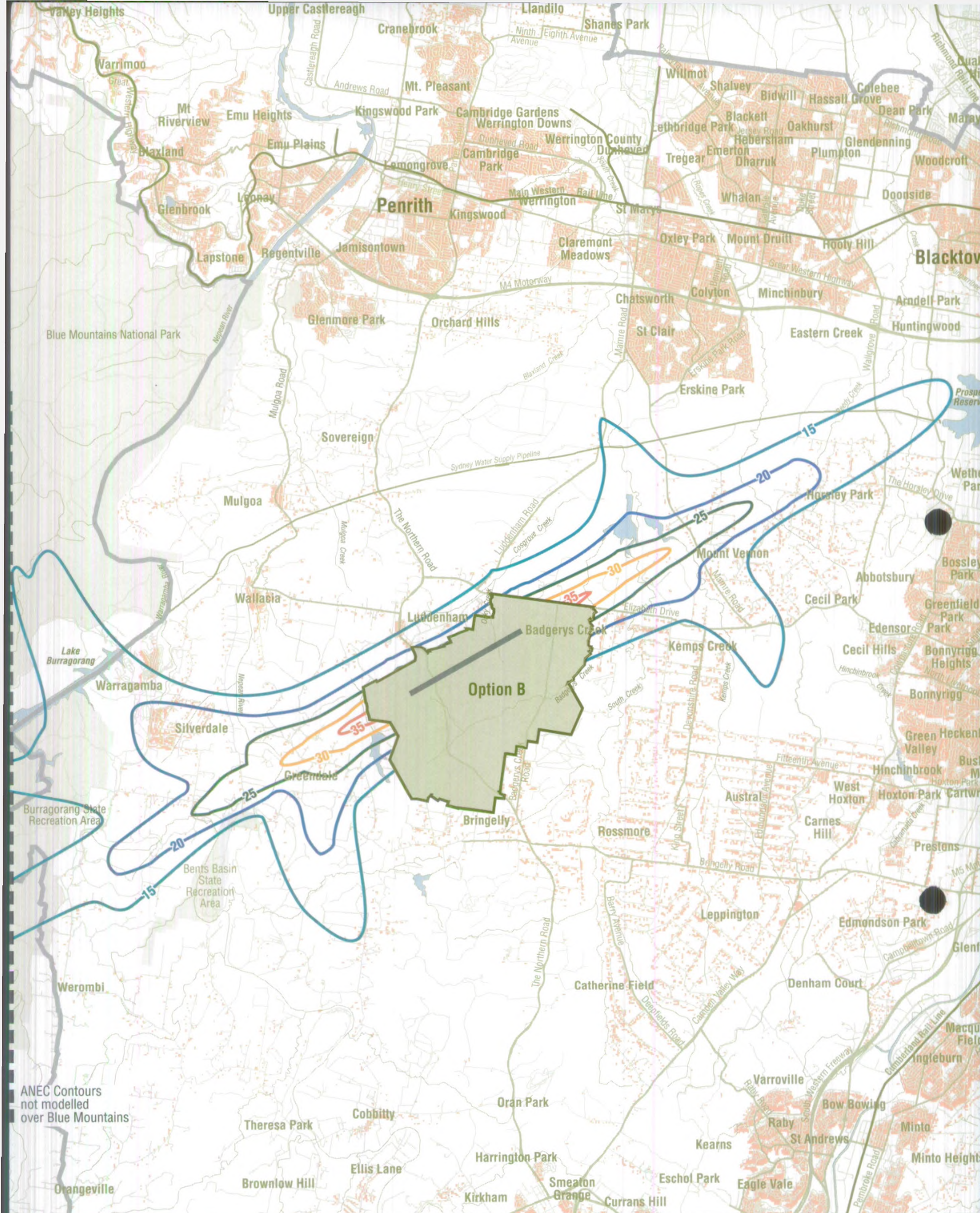


Figure 8.22

Modelled Maximum ANEC Contours for All Assessed Air Traffic Forecasts and Airport Operations for Option A (30 Million Passengers Per Year)



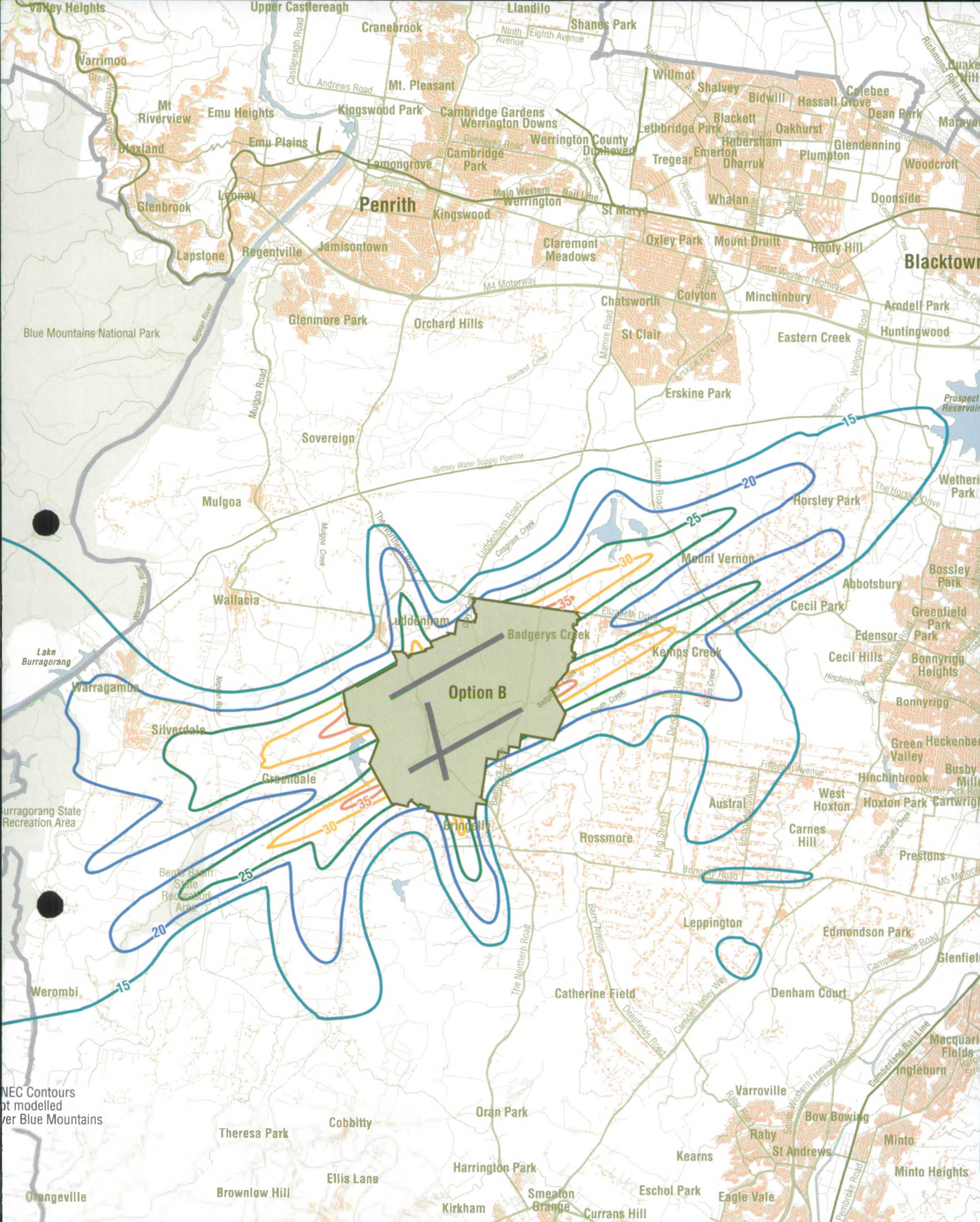
15 ANEC
20 ANEC
25 ANEC
30 ANEC
35 ANEC
Indicates density of dwellings in 1996
Extent of dwelling data

TN MN N

0Km 5Km

Figure 8.23

Modelled Maximum ANEC Contours for All Assessed Air Traffic Forecasts and Airport Operations for Option B (up to 15 Million Passengers Per Year)



15 ANEC
20 ANEC
25 ANEC
30 ANEC
35 ANEC
Indicates density of dwellings in 1996
Extent of dwelling data

Figure 8.24

Modelled Maximum ANEC Contours for All Assessed Air Traffic Forecasts and Airport Operations for Option B (30 Million Passengers Per Year)

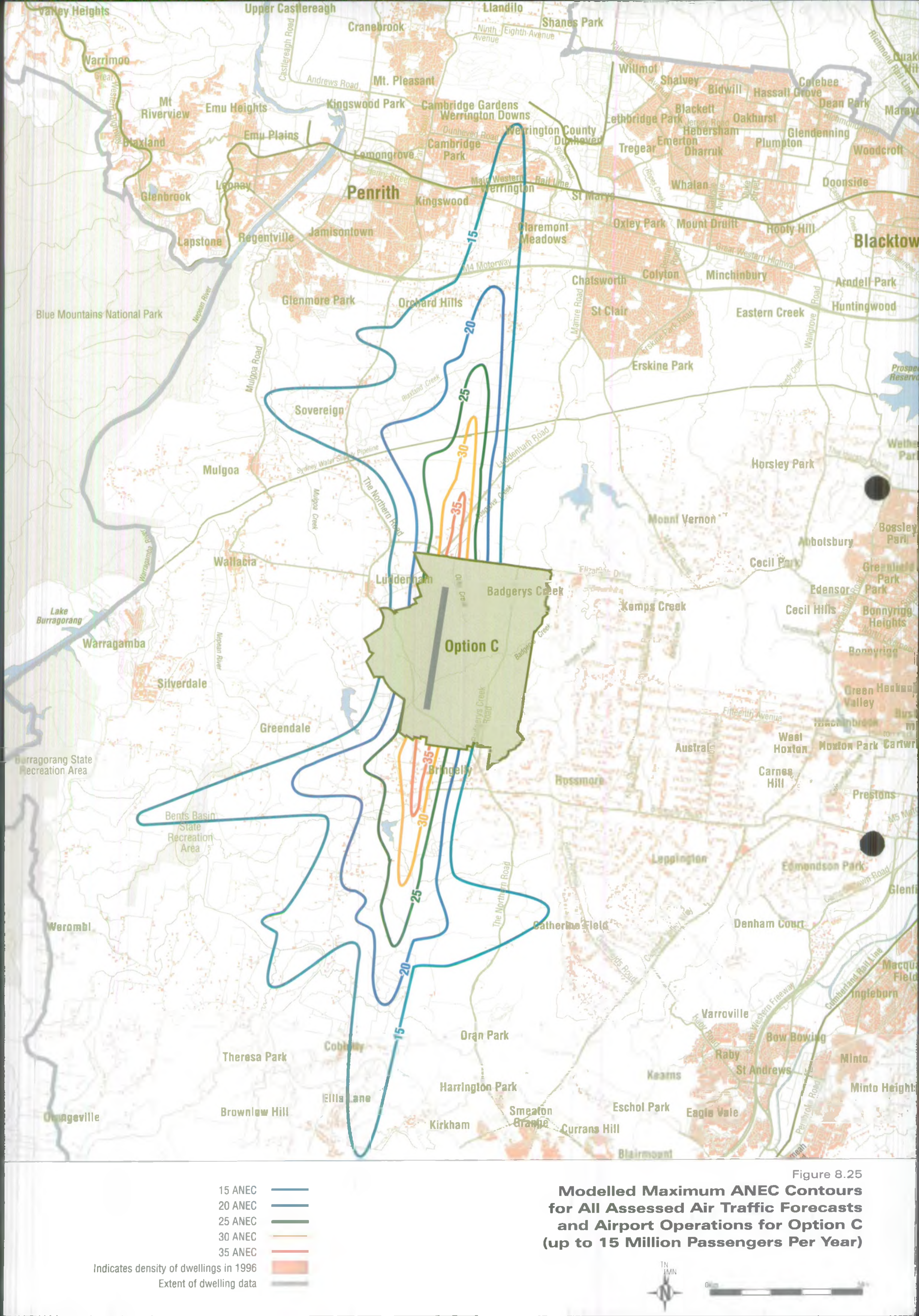
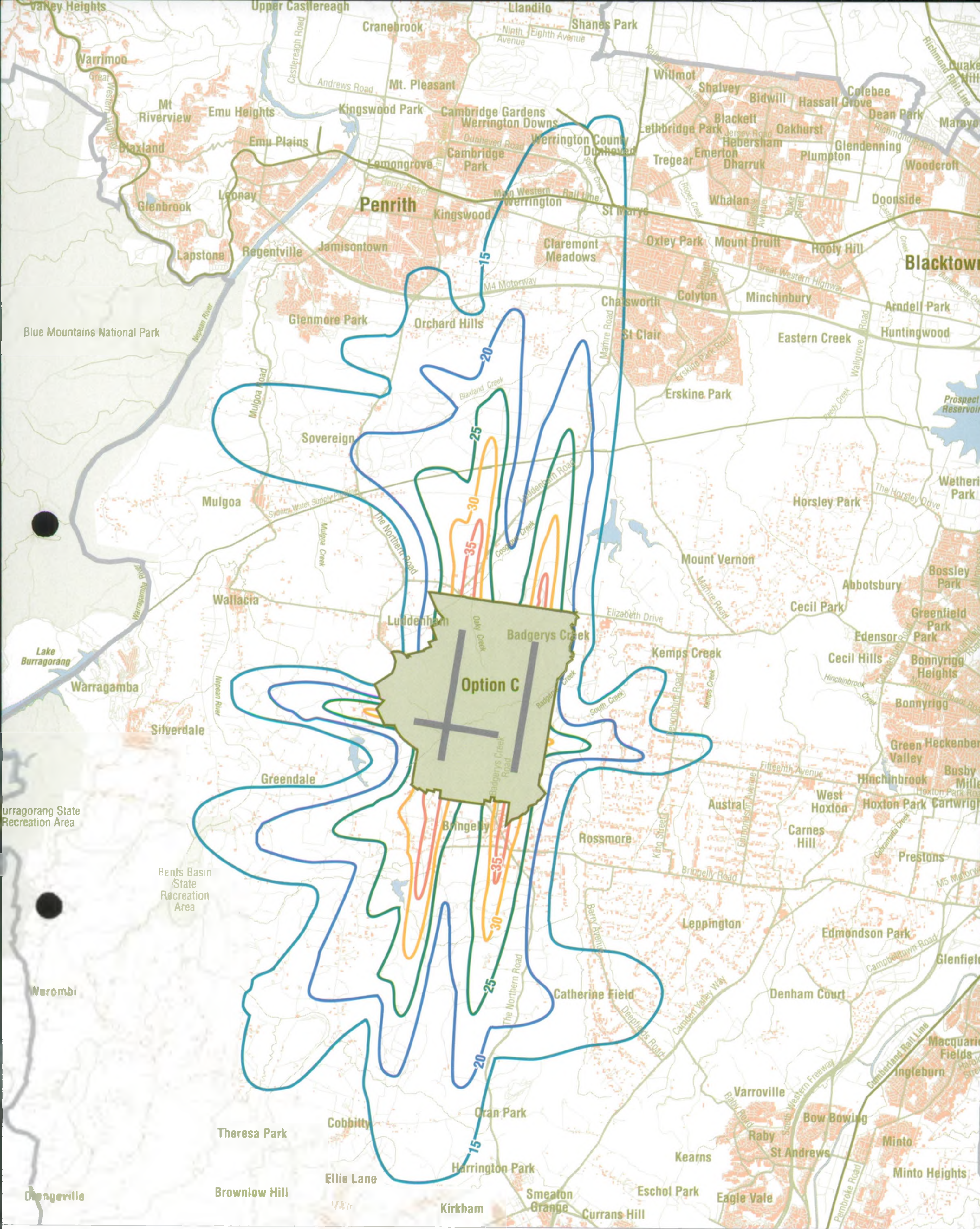


Figure 8.25

Modelled Maximum ANEC Contours for All Assessed Air Traffic Forecasts and Airport Operations for Option C (up to 15 Million Passengers Per Year)



15 ANEC
20 ANEC
25 ANEC
30 ANEC
35 ANEC
Indicates density of dwellings in 1996
Extent of dwelling data

Figure 8.26
Modelled Maximum ANEC Contours for All Assessed Air Traffic Forecasts and Airport Operations for Option C (30 Million Passengers Per Year)

the cross wind runway. However, in that mode these operations would be deliberately planned, and would probably occur at regular times during the day. Hence, under this mode the 'worst day' use of this runway would be the same as the average usage, unless use of the cross runway was forced by meteorological conditions.

For Option B, in two years of available meteorological data there was not one hourly interval when wind conditions would have required all aircraft to use the cross wind runway. For Option C, the cross wind runway would have been required on four days in that period, three days for periods of two hours, and one for six hours. In this situation, it was determined that 'worst day' operation for locations affected by cross wind runway operations could be estimated as five hours' usage of that runway during any day. These were assumed to be the busiest five hours of the day, and based on hourly usage patterns at Sydney Airport this would constitute approximately 46 percent of total aircraft movements during that day.

To form final contours for 'worst day' usage, six operating modes were considered:

- all operations to the north;
- all operations to the south;
- 46 percent of operations in one direction of the cross wind runway, the remainder either all to the north or all to the south; and
- 46 percent of operations in the other direction of the cross wind runway, the remainder either all to the north or all to the south.

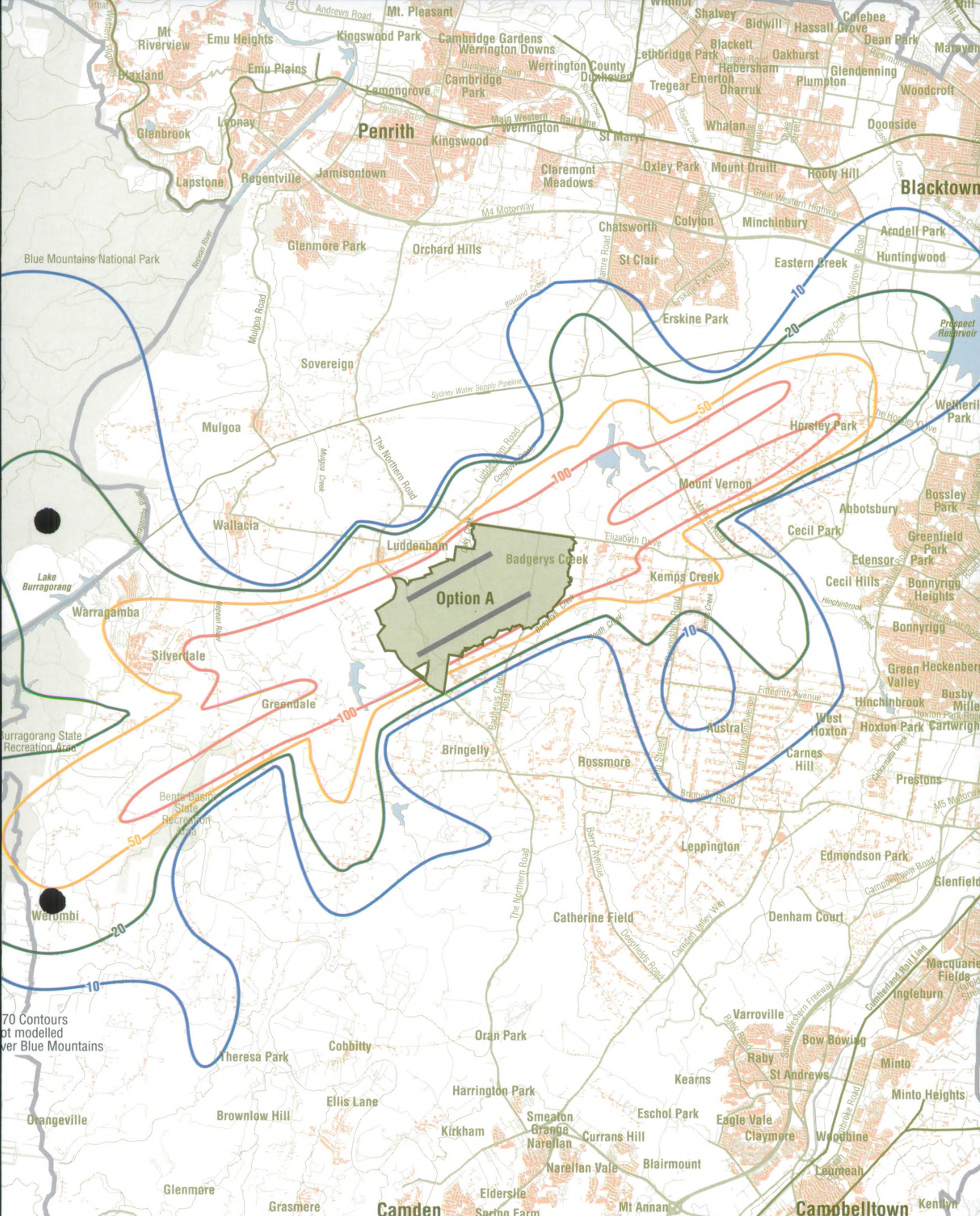
The highest exposure in any of these modes was taken as the 'worst day' exposure. (Of course, for Option A, only the first two modes are relevant, since there is no cross wind runway). Contours of equal 'worst day' exposure, in terms of the number of events exceeding 70 dBA, for each of the airport options are shown in *Figures 8.27 to 8.29*.

These contours, while presenting a realistic 'worst day' noise exposure as requested in many submissions, must be interpreted with considerable care. As noted above, in areas affected by noise from the parallel runways, these 'worst day' values could occur on up to 50 percent of all days. On the other hand, for areas affected by cross wind runway operation, the 'worst day' noise exposure could be expected to occur on possibly one day in two years, or less.

Many submissions also requested presentation of the likely seasonal variation in noise exposure. The available meteorological data were analysed to give the average predicted runway usage by season. Usage patterns in spring and autumn were found to be intermediate between those for summer and winter, and hence only summer and winter patterns are presented. *Figures 8.30 to 8.35* show average number of noise events exceeding 70 dBA during the summer and winter periods, for all airport options and operational modes.

For airport Options A and B, there is a clear seasonal trend, with operations in a south-westerly direction being more prevalent in winter. This leads to higher exposure in areas under departure tracks to the south, and under arrival tracks from the north. The converse is true in summer.

For airport Option C, there is very little seasonal variation, with average exposure during summer and winter being very similar (and similar to the overall yearly exposure presented in the Draft EIS).



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA during worst case 24-hour operation — 10 — 20

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA during worst case 24-hour operation — 20 — 50

Extent of dwelling data

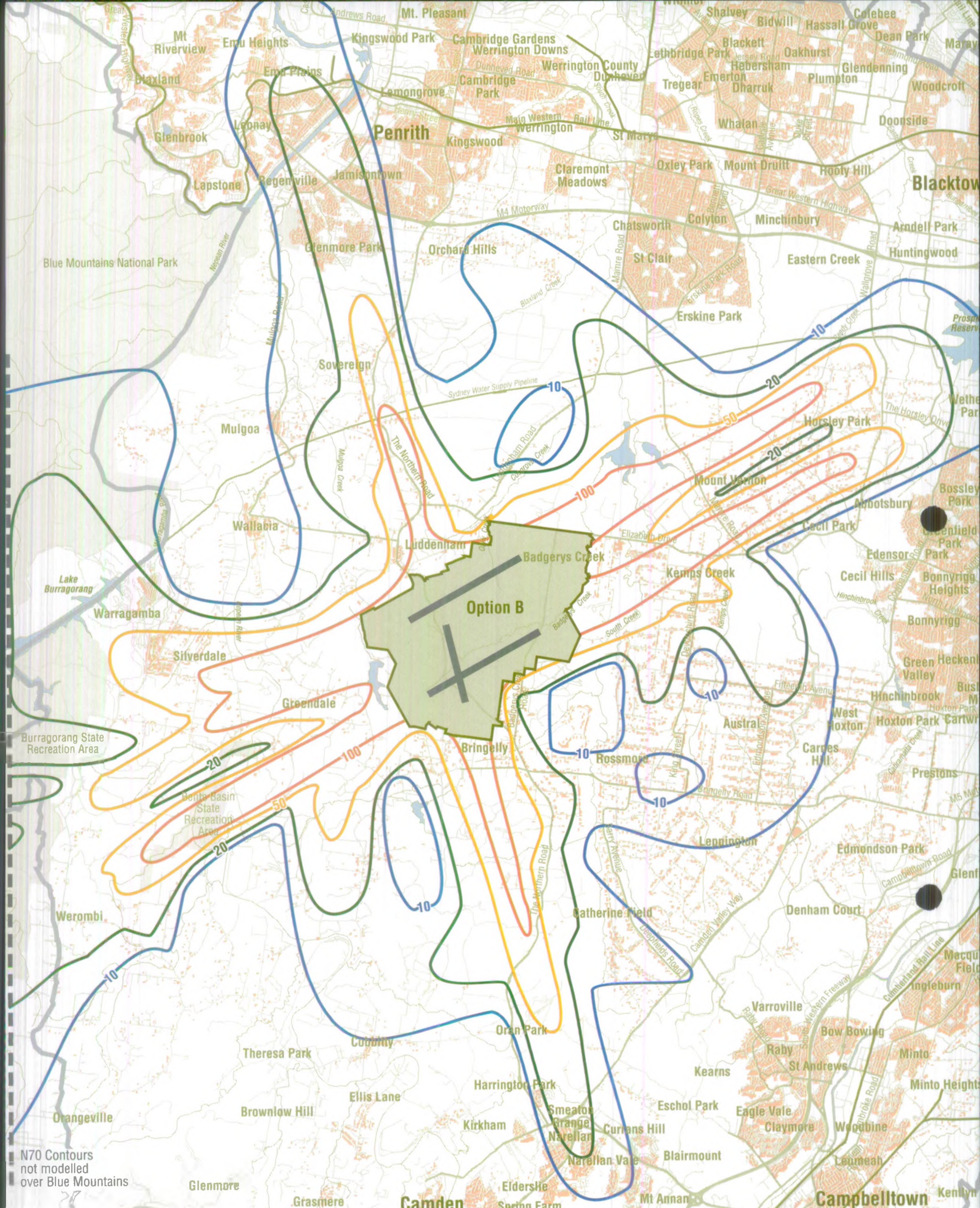
Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70 dBA during worst case 24-hour operation — 50 — 100

Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA during worst case 24-hour operation — 100

Indicates density of dwellings in 1996

Figure 8.27

N70 dBA Contours for Options A (30 Million Passengers Per Year) - Worst Case 24-Hour Operation



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA during worst case 24-hour operation —10— —20—

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA during worst case 24-hour operation —20— —50—

Extent of dwelling data

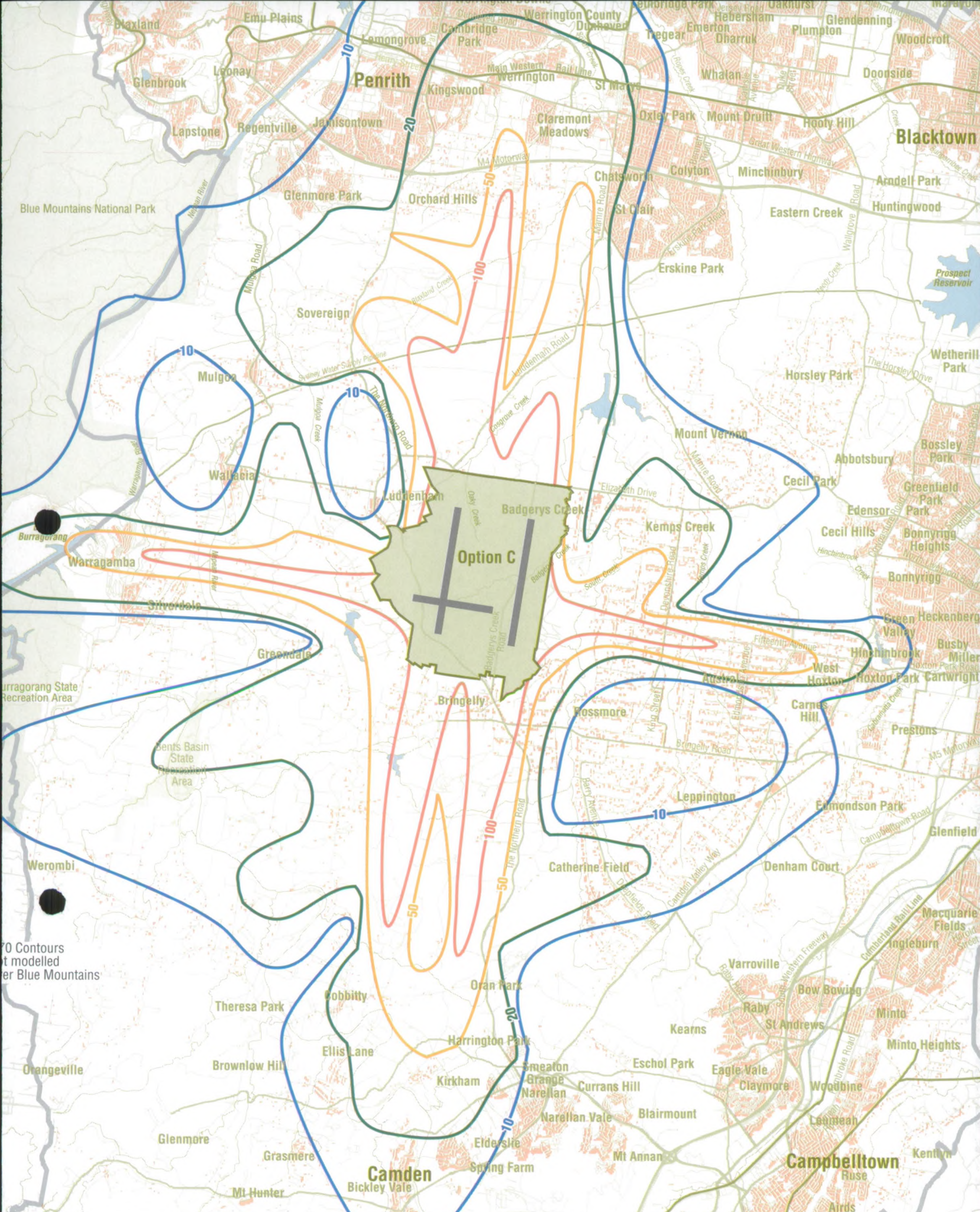
Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70 dBA during worst case 24-hour operation —50— —100—

Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA during worst case 24-hour operation —100—

Indicates density of dwellings in 1996

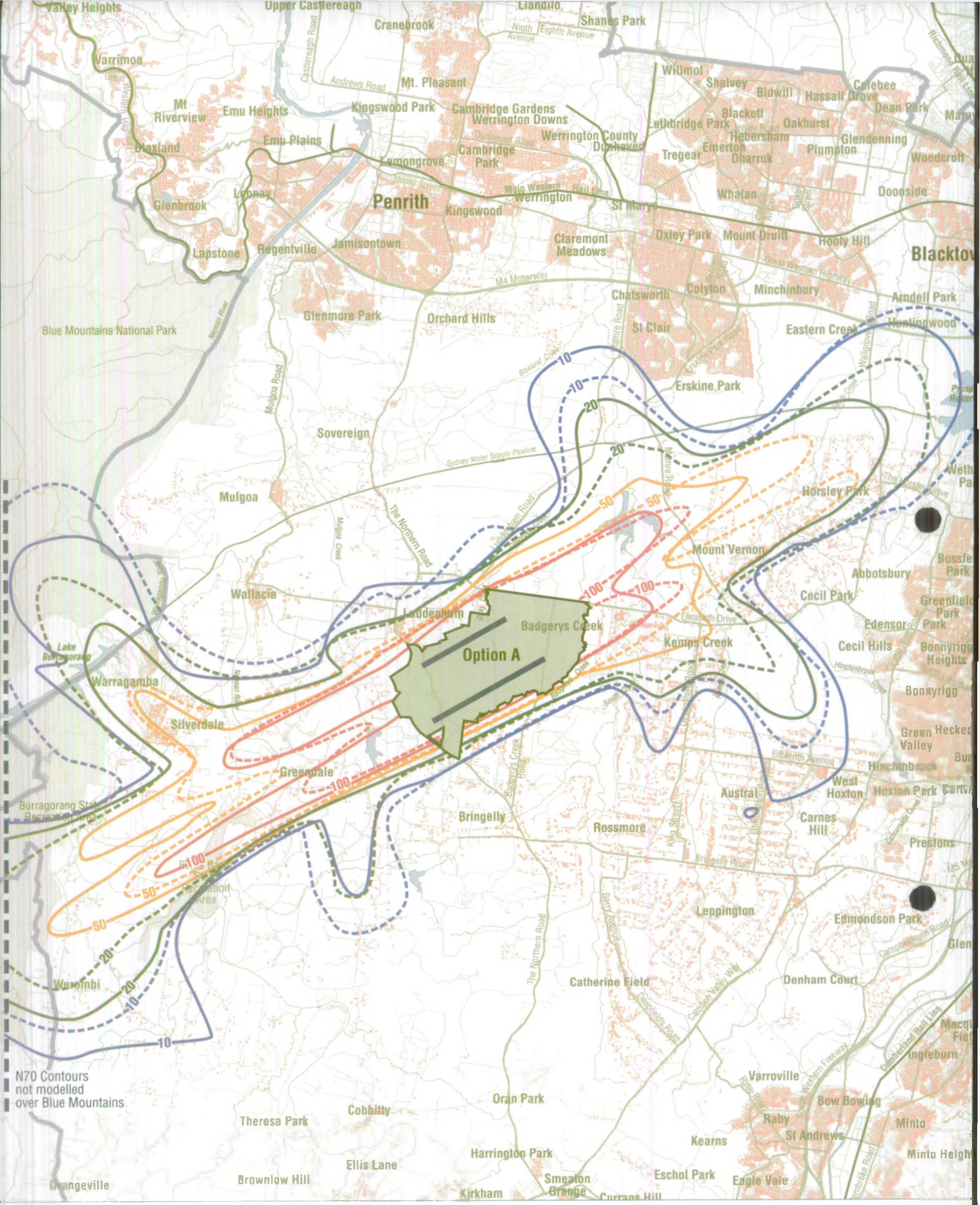
Figure 8.28

N70 dBA Contours for Options B (30 Million Passengers Per Year) - Worst Case 24-Hour Operation



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA during worst case 24-hour operation	—10— —20—	Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 7 0dBA during worst case 24-hour operation	—50— —100—
Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA during worst case 24-hour operation	—20— —50—	Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA during worst case 24-hour operation	—100—
Extent of dwelling data		Indicates density of dwellings in 1996	

Figure 8.29
N70 dBA Contours for Option C (30 Million Passengers Per Year) - Worst Case 24-Hour Operation



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA during worst case 24-hour operation —10— —20—

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA during worst case 24-hour operation —20— —50—

Summer —10—

Extent of dwelling data

Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 7 OdBA during worst case 24-hour operation —50— —100—

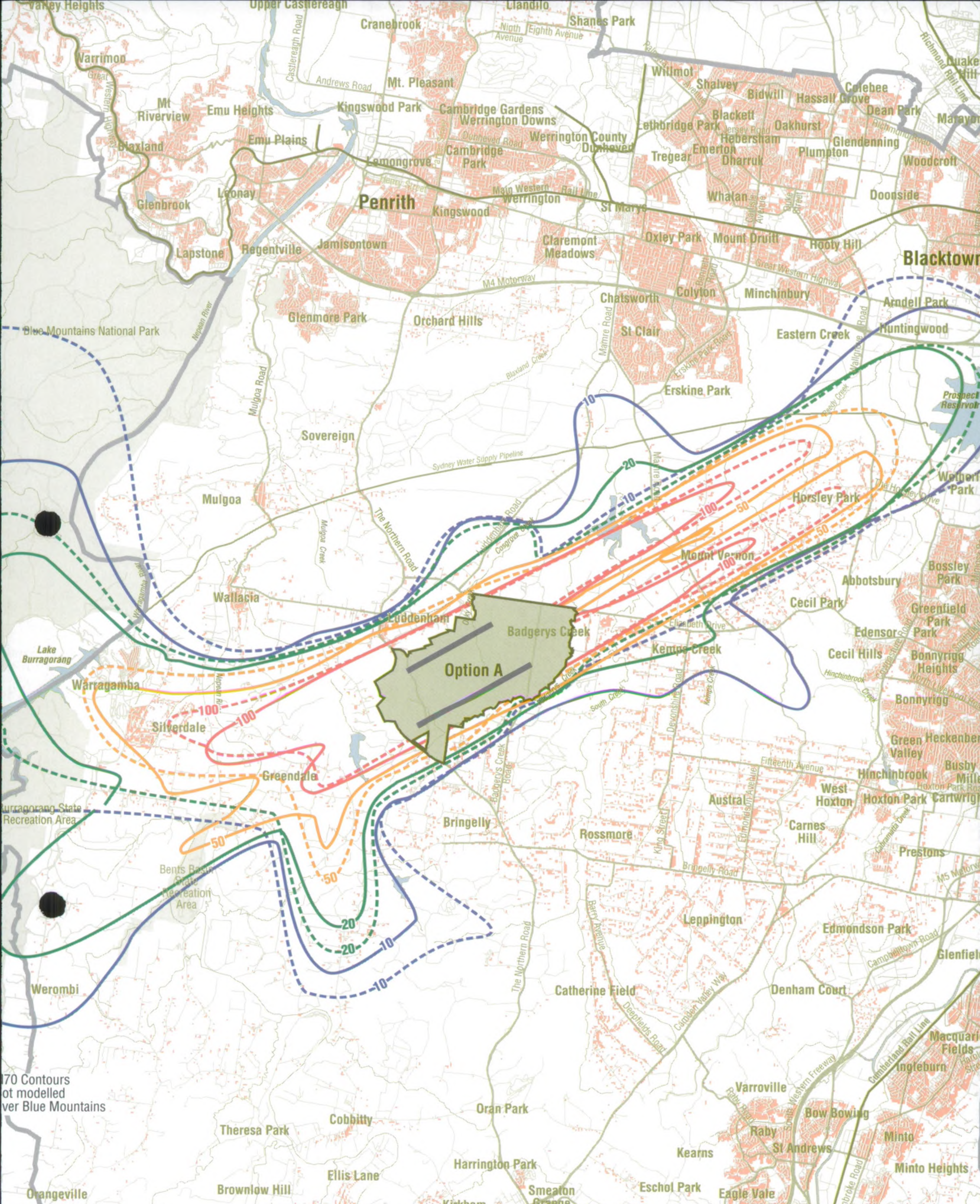
Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA during worst case 24-hour operation —100—

Winter - -10- -

Indicates density of dwellings in 1996

Figure 8.30

N70 dBA Contours for Option A - Summer and Winter (Airport Operation 1, 30 Million Passengers Per Year)



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA during worst case 24-hour operation —10— —20—

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA during worst case 24-hour operation —20— —50—

Summer —10—

Extent of dwelling data

Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 7 0dBA during worst case 24-hour operation —50— —100—

Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA during worst case 24-hour operation —100—

Winter - -10- -

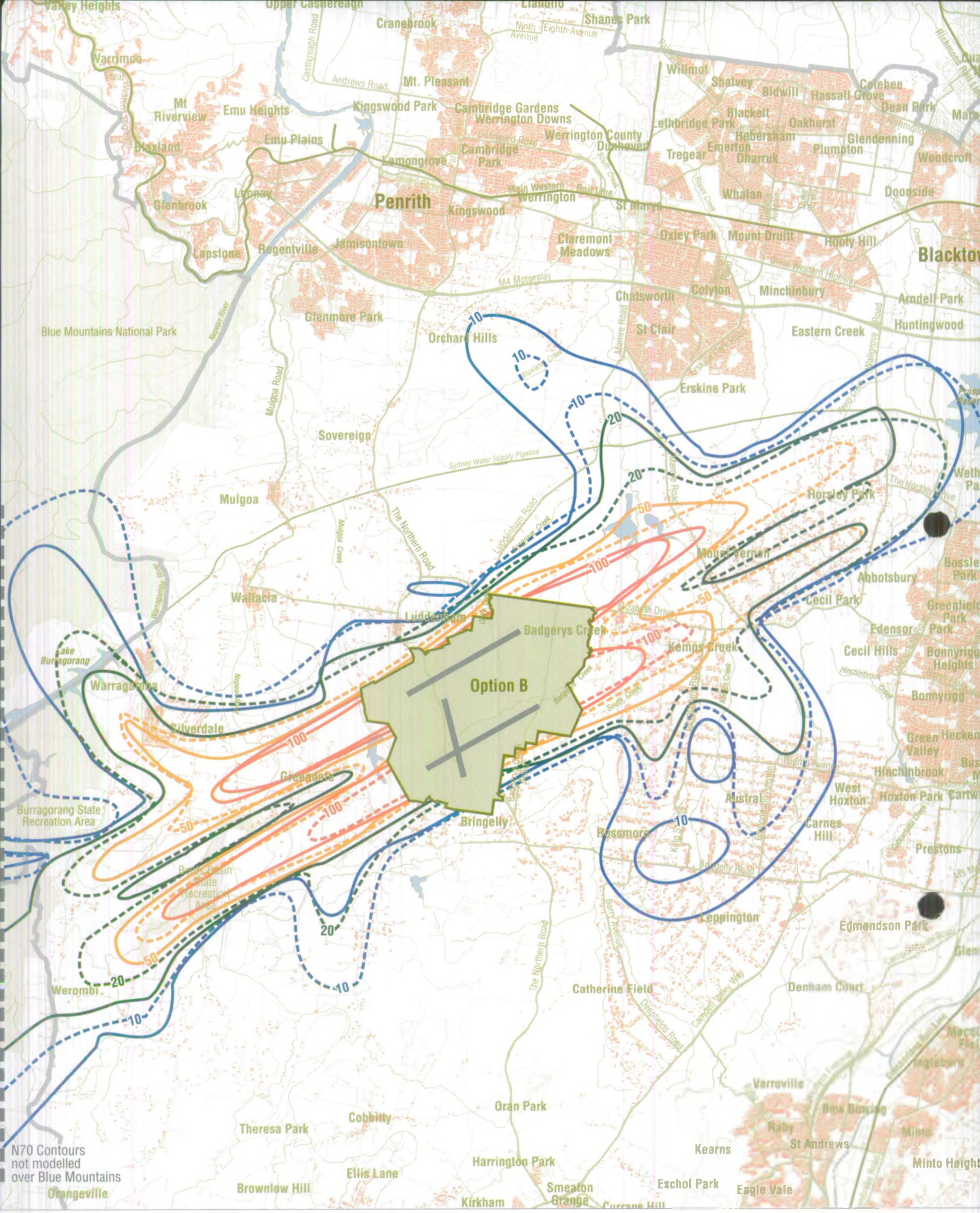
Indicates density of dwellings in 1996

Figure 8.31

N70 dBA Contours for Option A - Summer and Winter (Airport Operation 2, 30 Million Passengers Per Year)

TN MN N

0Km 5Km



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA during worst case 24-hour operation —10— —20—

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA during worst case 24-hour operation —20— —50—

Summer —10—

Extent of dwelling data

Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 7 0dBA during worst case 24-hour operation —50— —100—

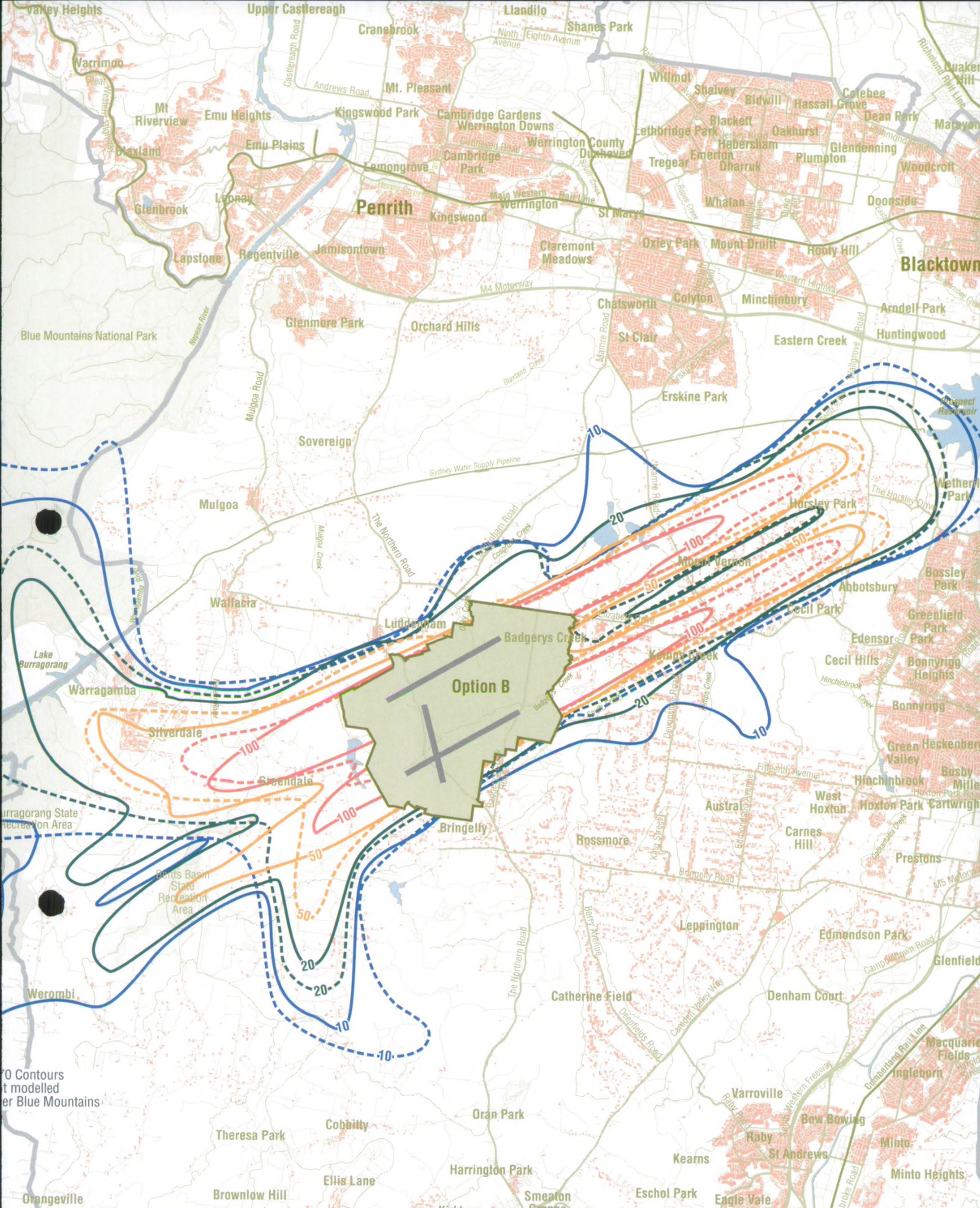
Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA during worst case 24-hour operation —100—

Winter - -10- -

Indicates density of dwellings in 1996

Figure 8.32

N70 dBA Contours for Option B - Summer and Winter (Airport Operation 1, 30 Million Passengers Per Year)



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA during worst case 24-hour operation —10— —20—

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA during worst case 24-hour operation —20— —50—

Summer —10—

Extent of dwelling data

Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 7 0dBA during worst case 24-hour operation —50— —100—

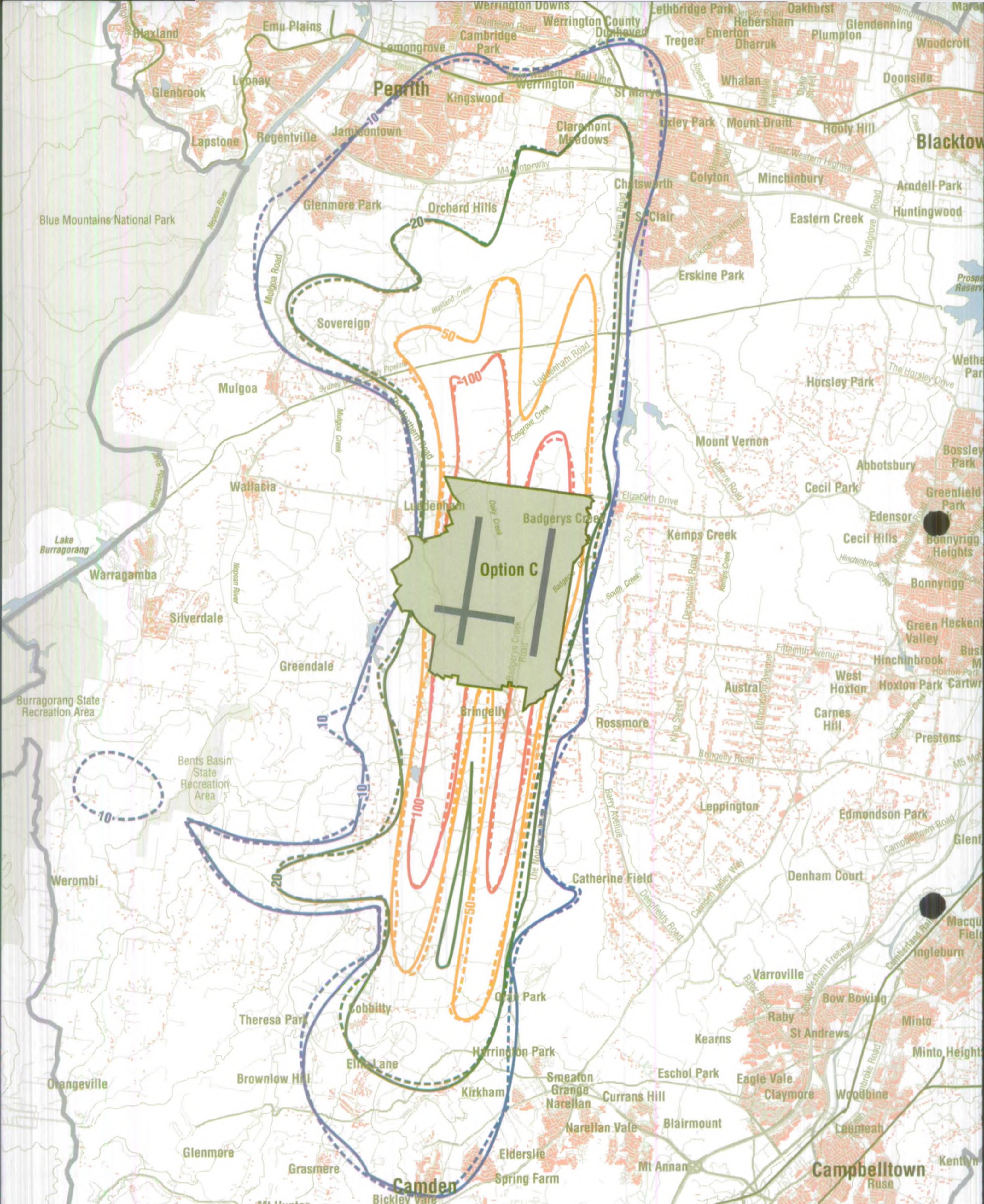
Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA during worst case 24-hour operation —100—

Winter - -10- -

Indicates density of dwellings in 1996

Figure 8.33

N70 dBA Contours for Option B - Summer and Winter (Airport Operation 2, 30 Million Passengers Per Year)



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA during worst case 24-hour operation —10— —20—

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA during worst case 24-hour operation —20— —50—

Summer —10—

Extent of dwelling data

Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 7 0dBA during worst case 24-hour operation —50— —100—

Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA during worst case 24-hour operation —100—

Winter - -10- -

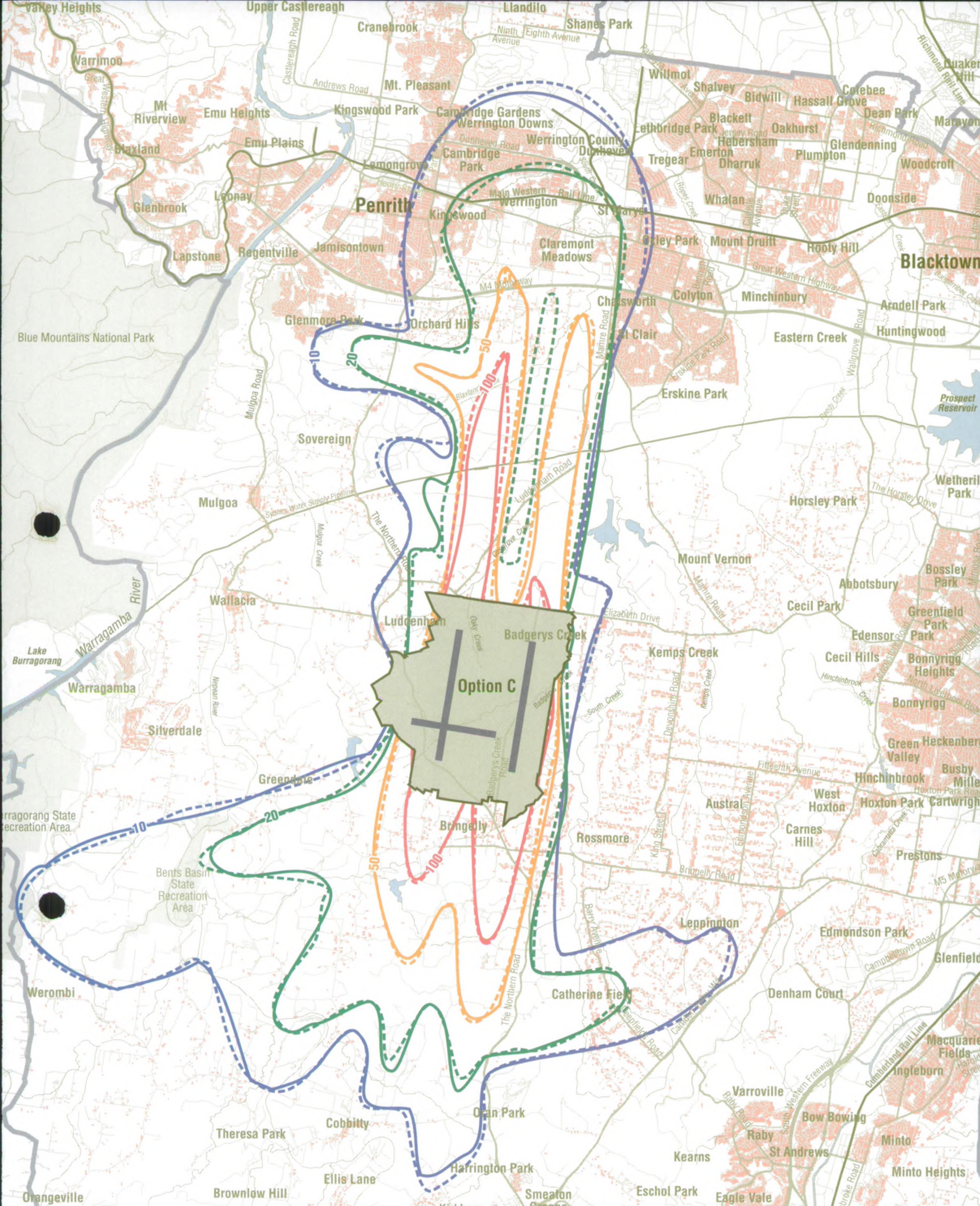
Indicates density of dwellings in 1996

Figure 8.34

N70 dBA Contours for Option C - Summer and Winter (Airport Operation 1, 30 Million Passengers Per Year)

TN MN N

0Km 5Km



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA during worst case 24-hour operation — 10 — 20 —

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA during worst case 24-hour operation — 20 — 50 —

Summer — 10 —

Extent of dwelling data

Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 7 0dBA during worst case 24-hour operation — 50 — 100 —

Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA during worst case 24-hour operation — 100 —

Winter - 10 -

Indicates density of dwellings in 1996

Figure 8.35

N70 dBA Contours for Option C - Summer and Winter (Airport Operation 2, 30 Million Passengers Per Year)

8.6.7 Comparison With Existing Noise Levels

The Auditor has requested a comparison between existing noise levels and new levels including aircraft overflights. In general, such a comparison is considered misleading, as there is a tendency to believe that if a new noise is below the level of the existing noise (under some descriptor) then it should not cause annoyance, or other impacts. In fact, because aircraft noise occurs in discrete events, it can be definitely audible, and cause impacts, even though other noise may at times be as loud. A number of studies indicate that aircraft noise causes a greater level of reaction than either road traffic or railway noise at the same LAeq noise level, even under steady-state exposure conditions (see, for example, Hall et al, 1981). If the aircraft noise is a newly-introduced source, the difference would be much larger.

Because of the different time histories of aircraft and ambient noise, the only noise index which can be used to directly compare the two is the LAeq level, a measure of the total noise energy received during a defined period, which in this case is taken to be one 24-hour period. Despite the above caveats, a comparison is presented in *Table 8.10* between the predicted total LAeq noise level (including both predicted aircraft noise and the existing ambient noise) and the LAeq level due to the ambient noise alone, as requested by the Auditor.

Table 8.10 Comparison Between Predicted Total LAeq Noise Levels and Existing Ambient Levels

$L_{Aeq,\ 24\text{-hour}}$ Including Predicted Aircraft Noise Minus Ambient $L_{Aeq,\ 24\text{-hour}}$, dBA	Estimated Population[1] Experiencing Stated Difference Between (Aircraft Noise Plus Ambient) and Ambient Leq Level[2]		
	Option A	Option B	Option C
Greater than 15	1,500	1,500	400
Greater than 10	6,000	4,000	1,000
Greater than 5	9,000	11,000	10,000
Greater than 3	28,000	15,000	63,000

Notes:
1. *Based on population projections for 2016*
2. *There are limitations on the accuracy of predicting future populations and predicting future aircraft noise levels. Estimates of population greater than 10,000 have been rounded to the nearest 1,000, estimates of population between 1,000 and 10,000 have been rounded to the nearest 500; and estimates of populations less than 1,000 have been rounded to the nearest 100. Estimates of populations less than 100 are expressed as less than 100.*

Table 8.10 shows that large numbers of people are expected to experience total LAeq noise levels which are at least three dB higher than the existing ambient levels. In comparing airport options, the following familiar pattern is found:

- at high noise exposure, fewer people are impacted under Option C; and
- at lower levels (in this case when predicted total noise levels are up to five dB above ambient LAeq levels) many more people are affected under Option C;

The difference between aircraft noise levels and ambient levels as quoted in *Table 8.10* should not be confused with the traditional 'background +5 dB' noise assessment criterion for general noise sources. That criterion is based on comparison between the LA90 level of the ambient noise and the LA10 level of the noise source, whereas *Table 8.10* is based on the LAeq level of both types of noise. The 'background +5 dB' criterion cannot be directly applied in this case, because the LA10 level of aircraft noise is not definable, in many of the areas studied aircraft noise would not be present for ten percent of the time.

8.7 Management of Aircraft Overflight Noise

8.7.1 Investigation of Possible Noise Management Measures

Several submissions requested that noise impacts be calculated under airport operating conditions which incorporate realistic noise abatement procedures. The impacts presented in the Draft EIS, and in the analysis above, are based on flight paths and operating procedures which were determined largely on operational grounds, with little consideration for noise abatement. This was considered to provide a realistic 'worst-case' noise assessment. Given that operational and noise abatement procedures for a Second Sydney Airport have not been established, any determination of likely procedures would be premature.

Nevertheless, it was pointed out in submissions that some noise abatement procedures would almost certainly be used at this airport, and speculate that with such procedures, the relativity between Options A, B and C may be altered. In particular, it is suggested that noise abatement would be more difficult for Option C, so that with the inclusion of noise abatement procedures this option may have a greater noise impact, in comparative terms, than would appear from the Draft EIS.

In response to this, potential noise abatement procedures which could reasonably be expected to be implemented for each airport option have been identified and resultant noise impacts analysed. It must be emphasised, however, that while Airservices Australia have confirmed that all procedures described below would be feasible in operational terms, many would involve additional costs, particularly in terms of fuel usage. These procedures are examined for illustrative purposes only and do not alter the description of the proposal provided in Part C of the Draft EIS and clarified in *Chapter* 6 of this Supplement.

It should also be noted that in reducing noise impacts, only impacts in populated areas have been considered. The result is that in some cases, impacts over non-populated areas, particularly the Blue Mountains National Park, would increase under these scenarios. In addition, most management procedures involve 'trading' higher noise exposure for a small number of people against lower exposure for a much larger number. Determination of final noise abatement procedures would need to consider these issues as well as the concepts of noise sharing, respite and other related strategies. These matters are highlighted in *Appendix* M.

8.7.2 Methodology for Noise Management Design

Alterations to the previously assumed airport operation scenarios are based on possible changes to flight paths and runway usage. They do not include changes to the predicted volume or mix of aircraft operations, or their distribution by sector of origin/destination or time of day. The alterations considered also do not include changes to the runway layout or other physical airport infrastructure.

The measures considered apply to the Second Sydney Airport operating at 30 million passengers per year. The selection of noise mitigation measures to be considered was based on consideration of the N70 noise exposure metric, although very similar results would be obtained using other metrics.

This investigation did not seek to provide the absolute minimum achievable noise impact under any specific impact descriptor, but rather to illustrate the level of noise impact reduction which could feasibly be achieved, compared with the options presented in the Draft EIS. Minimisation of noise impact is considered in terms of minimising the number of residents affected by specific noise levels. An alternative approach would be to minimise the exposure of the worst affected residents, by 'noise sharing'. This would correspond to *Airport Operation 3*, as presented in the Draft EIS, and the impacts as described there would generally apply.

Possible noise mitigation measures are presented separately for Options A and B, and Option C. Given the anticipated limited use of the cross runway within Option B, it was considered that there was no need to distinguish between its assessment and that of Option A.

8.7.3 Noise Management Measures for Options A and B

Impacts Described in the Draft EIS

Of the two airport operating scenarios considered for Options A and B, it is *Airport Operation 1* which affords the greater opportunity to minimise the overall noise impact. This is despite that in this mode of operation as described in the Draft EIS for Option A, approximately 25,000 residents would be exposed to 10 or more noise events per 24-hours greater than 70 dBA, compared with 14,000 residents for Airport Operation 2.

N70 noise contours for Option A operating at 30 million passengers per year - *Airport Operation 1* are presented in Figure 12.8 of the Draft EIS, and contours for Option B in Figure 12.10. Detailed analysis of the areas affected identifies the Cecil Hills urban release area and Silverdale/Warragamba as the most populous regions having N70 greater than 10 events. In excess of 18,000 of the 25,000 affected residents are located within these regions alone.

Noise to Cecil Hills under *Airport Operation 1* arises from departures from the northern end of the southern runway (runway 05R) turning west, and to a lesser extent those turning south. Noise from arrivals generally does not affect this area.

Noise to Silverdale under this mode arises predominantly from arrivals on the northern runway (runway 05L) from the north and north-west, and less significantly, departures on runway 23R to the east, north and west.

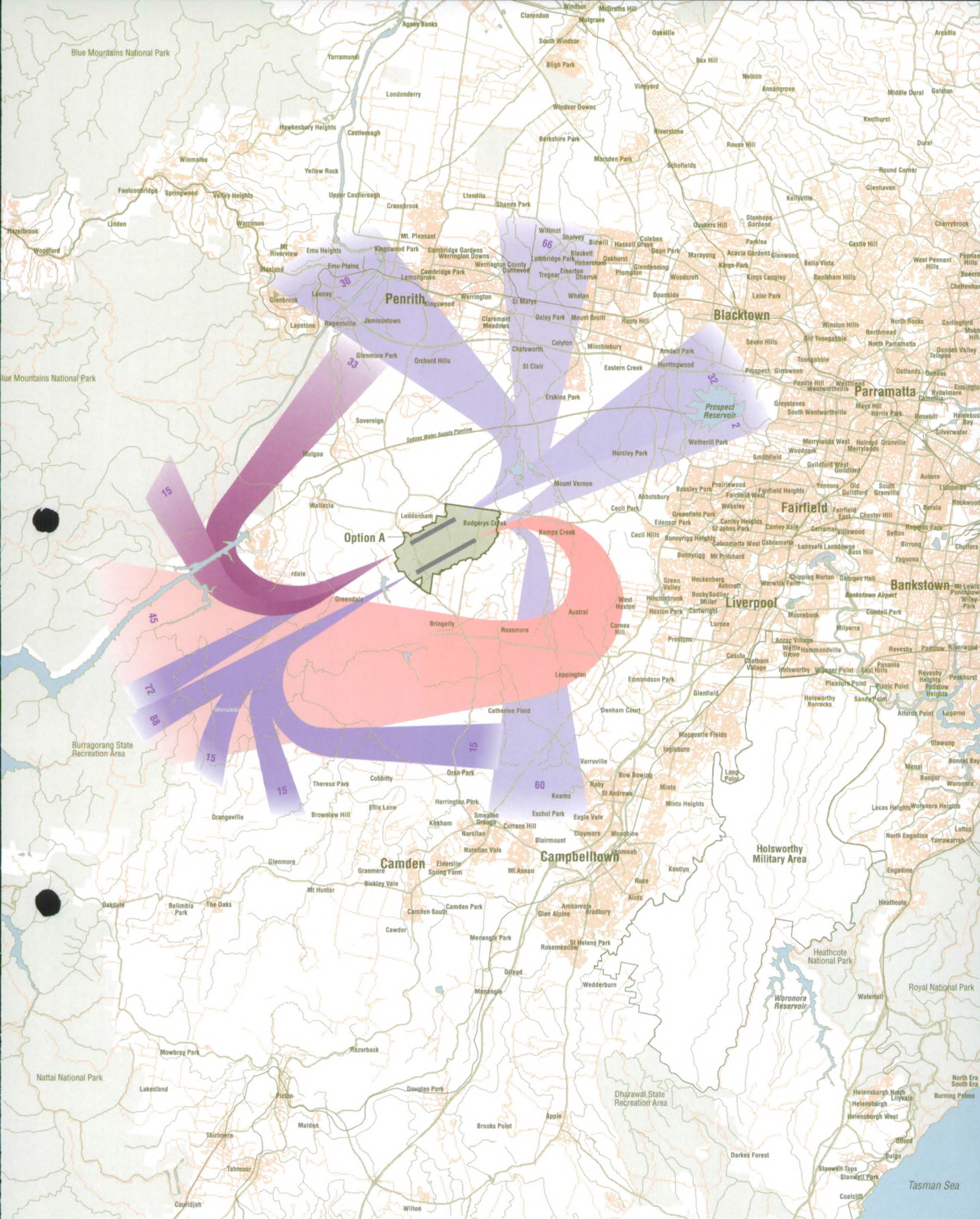
A potential urban village identified in the Draft EIS as a possible urban growth area adjacent to a rail link to the airport would also be impacted by departures from the southern runway (runway 23L) turning south. Although the level of impact is generally less than 10 events per 24-hours greater than 70 dBA, relocation of these flight paths would result in some reduction in the total noise impact.

Possible Noise Management Procedures for Airport Options A and B

Operation During Daytime Hours

The noise management scenario adopted for Options A and B is based on *Airport Operation 1*, with the following amendments to flight paths as shown in *Figure 8.36 to 8.39*:

- departures from the northern end of the southern runway (runway 05R), heading south, would all turn south as quickly as allowed by aircraft operational parameters. The assumed turn location is similar to that for the tightest turn modelled for these movements in the Draft EIS;



Preliminary landing flight paths

Preliminary take off flight paths

Modified preliminary landing flight paths

Modified preliminary take off flight paths

Assumed number of aircraft movements per day with airport operating at 30 million passengers per year — 45

Urban areas (indicated by local roads)

Figure 8.36

Modified Flight Paths Used to Assess Noise Management Potential of Option A: Landings from the South-West and Take Offs to the North-East

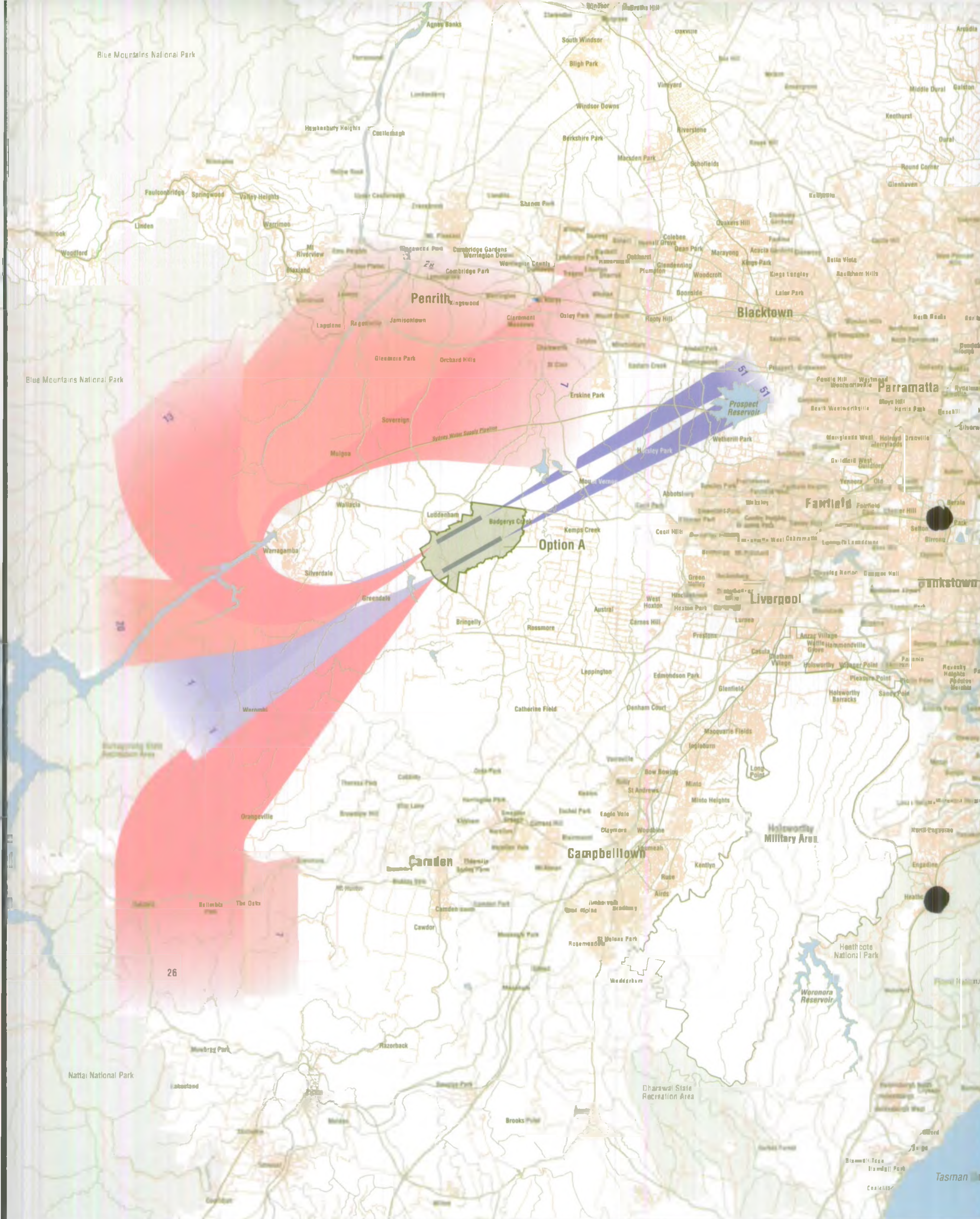
Source: Second Sydney Airport Planners, 1997a

Notes: 1. Flight Paths provided to a distance of about 19 kilometres. Aircraft would be seen and heard beyond that distance.

2. Flight paths which have been deleted are not shown as the aircraft movements previously assigned to these flight paths have been reassigned to existing or modified flight paths.

TN MN

0Km 10Km



Preliminary landing flight paths

Preliminary take off flight paths

Modified preliminary landing flight paths

Modified preliminary take off flight paths

Assumed number of aircraft movements per day with airport operating at 30 million passengers per year — 45

Urban areas (indicated by local roads)

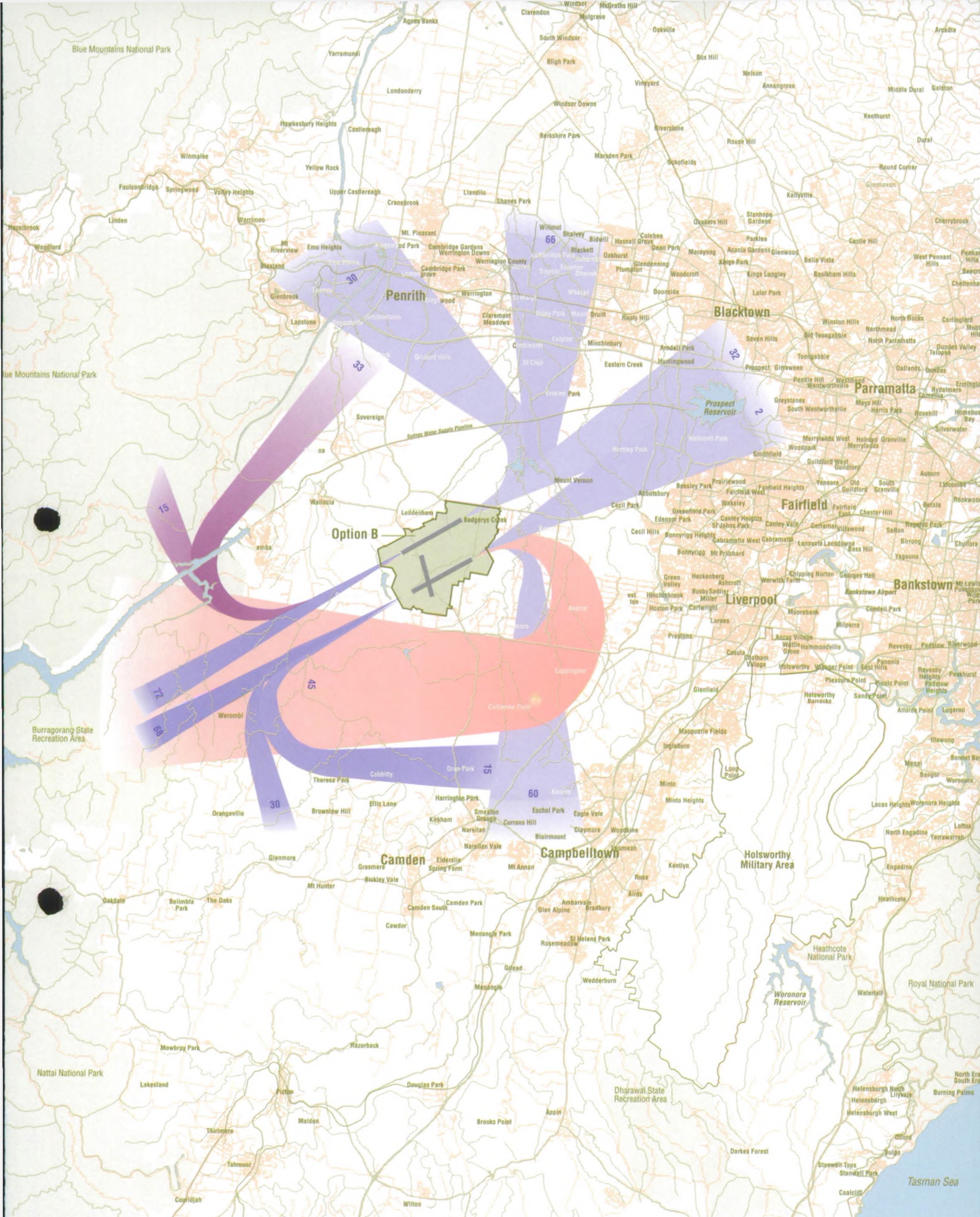
Figure 8.37

Modified Flight Paths Used to Assess Noise Management Potential of Option A: Landings from the North-East and Take Offs to the South-West

Source: Second Sydney Airport Planners, 1997a

Notes:
1. Flight Paths provided to a distance of about 19 kilometres. Aircraft would be seen and heard beyond that distance
2. Flight paths which have been deleted are not shown as the aircraft movements previously assigned to these flight paths have been reassigned to existing or modified flight paths

TN
MN
N
0Km



Preliminary landing flight paths

Preliminary take off flight paths

Modified preliminary landing flight paths

Modified preliminary take off flight paths

Assumed number of aircraft movements per day with airport operating at 30 million passengers per year — 45

Urban areas (indicated by local roads)

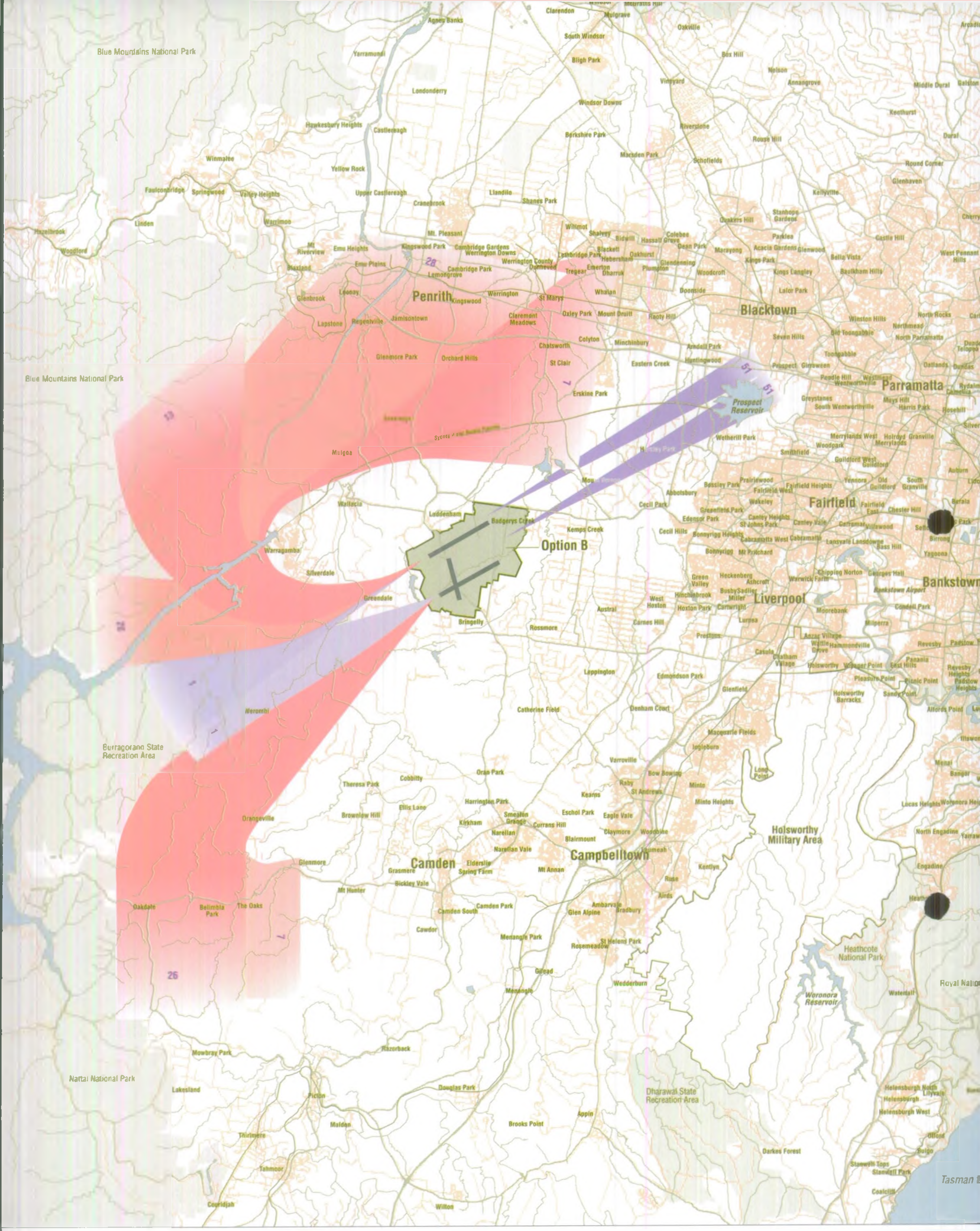
Figure 8.38

Modified Flight Paths Used to Assess Noise Management Potential of Option B: Landings From the South-West and Take Offs to the North-East

Source: Second Sydney Airport Planners, 1997a

Notes: 1. Flight Paths provided to a distance of about 19 kilometres. Aircraft would be seen and heard beyond that distance.

2. Flight paths which have been deleted are not shown as the aircraft movements previously assigned to these flight paths have been reassigned to existing or modified flight paths.



Preliminary landing flight paths
Preliminary take off flight paths
Modified preliminary landing flight paths
Modified preliminary take off flight paths
Assumed number of aircraft movements per day with airport operating at 30 million passengers per year
Urban areas (indicated by local roads)

Figure 8.39

Modified Flight Paths Used to Assess Noise Management Potential of Option B: Landings from the North-East and Take Offs to the South-West

Source: Second Sydney Airport Planners, 1997a

Notes: 1. Flight Paths provided to a distance of about 19 kilometres. Aircraft would be seen and heard beyond that distance.
2. Flight paths which have been deleted are not shown as the aircraft movements previously assigned to these flight paths have been reassigned to existing or modified flight paths.

- departures from the northern end of the southern runway (runway 05R), heading west, would turn as quickly as possible to a westerly heading. The assumed turn location is similar to that for south-going departures;
- arrivals from the north and east to the southern end of the northern runway (runway 05L) would be required to join the final approach path further west than was previously modelled. Rather than over Silverdale, arrivals on these tracks would join final approach at a point nominally above the boundary of the Burragorang State Recreation Area;
- similarly, departures from this runway end (runway 23R) heading east, north or north-west would hold their departure heading until a point nominally above the boundary of the Burragorang State Recreation Area; and
- departures from the southern end of the southern runway (runway 23L), heading south, would initially turn 15 degrees left, and then hold this heading until a point nominally above the boundary of the Burragorang State Recreation Area.

Operation During Night-Time Hours

Given the reduced traffic volumes expected at night-time, noise mitigation would best be achieved by a segregated runway operation. The proposed operating scenario would incorporate a preferred operational mode in which all departures operate to the north from the northern runway (runway 05L), and all arrivals operate from the south on the southern runway (runway 05R). Flight paths would be as described above for day time operation, but where necessary, translated to an alternative runway.

Where this mode is unavailable due to weather, all departures would operate to the south from the southern runway (runway 23L) and all arrivals from the north on the northern runway (runway 23R). Once again, flight tracks would be as described above, where necessary translated to the alternative runway.

Where use of the cross wind runway is required (for Option B), tracks would be as modelled for the Draft EIS.

Alternative arrangements may also be possible, for example, arrivals from the south on the southern runway, the use of runway 05R for arrivals and departures to the south on the southern runway (runway 23L), 23L for departures in a 'head-to-head' configuration. However, preliminary analysis suggests that the proposed scenario would result in lower overall noise impacts.

8.7.4 Noise Management Measures for Option C

Impacts Described in the Draft EIS

Of the three airport operating scenarios considered for Option C, it is *Airport Operation 1* which would cause the lowest noise impact, and also offers the greatest potential for noise impact reduction. With operations as described in the Draft EIS, there would be approximately 46,000 residents exposed to 10 or more noise events per 24-hours greater than 70 dBA under *Airport Operation 1*, compared with 49,000 residents under Airport Operation 2.

N70 noise contours for Option C operating at 30 million passengers per year, prefer north are presented in Figure 12.13 of the Draft EIS. Detailed analysis of the areas affected identifies Camden to the south, and Penrith/Glenmore Park and Claremont

Meadows to the north, as the most populous regions having N70 greater than 10. In excess of 40,000 of the 46,000 affected residents are located within these areas.

Under *Airport Operation 1*, noise to Camden results almost exclusively from arrivals on the eastern runway (runway 36R).

Noise to Penrith and Glenmore Park under this mode arises predominantly from departures on the western runway (runway 36L), particularly those heading north-west, and arrivals from the north-west. Claremont Meadows is most affected by noise from departures on the eastern runway (runway 36R), all of which follow a straight track, and from arrivals on both parallel runways.

Possible Noise Management Procedures for Airport Option C

Operation During Daytime Hours

Potential noise management measures for Option C are based on *Airport Operation 1*, with the following amendments to flight paths as shown in *Figures 8.40 and 8.41*:

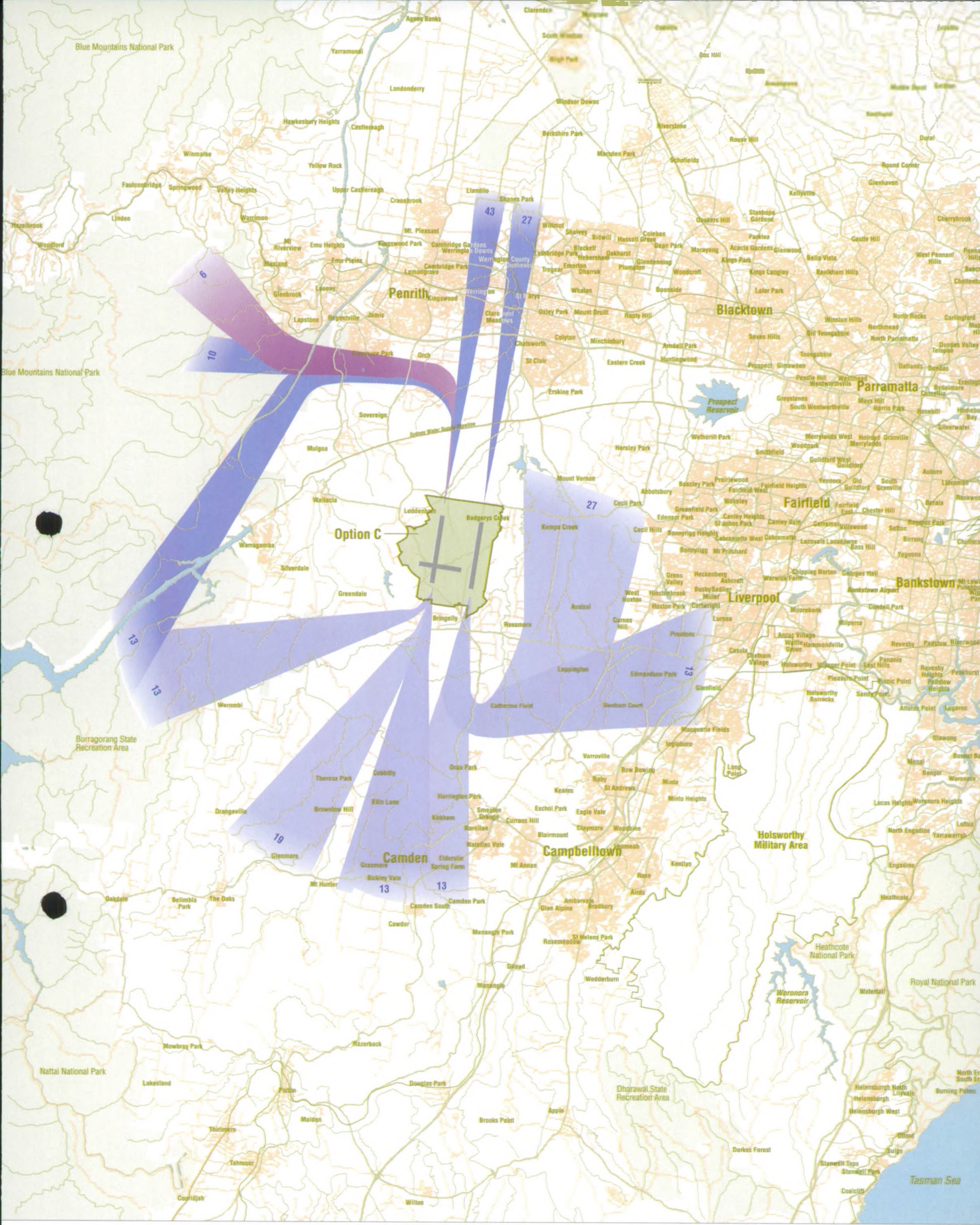
- an estimated 70 percent of arrivals to the southern end of the eastern runway (runway 36R) could join the final approach further north, nominally above Catherine Field. This measure effectively 'trades off' higher exposure for residents in Catherine Field, Leppington and similar areas against lower exposure for a larger number of residents near Camden. The issues of equity which would be involved here are more significant than for other measures considered, since a larger number of residents would be negatively affected than for the other measures. As described above, the noise management measures considered do not represent a commitment to any airport operating policy, but rather an attempt to indicate the potential for reductions in noise impacts, in terms of the number of people affected;
- departures from the northern end of the western runway (runway 36L), heading north-west, would initially follow a westerly flight path, turning north over the Blue Mountains National Park; and
- arrivals on the western runway (runway 18R) from the north-west would join a westerly arrival flight path at a point above the Blue Mountains National Park, and continue the approach on that path.

Significant noise reduction measures for the residents of Claremont Meadows/St Clair are not considered practical given their siting with respect to the airport, and the limited opportunities to re-configure flight tracks to the north-west of the airport due to the airspace requirements of Sydney Airport.

Operation During Night-Time Hours

Given the reduced traffic volumes expected at night, noise mitigation would best be achieved by the use of a single runway (the western runway) for all operations. The proposed operating scenario would incorporate a preferred operational mode in which all departures operate to the north from this runway, and all arrivals operate from the south. Flight paths would be as described above for day time operation, but where necessary, translated to the alternative runway. It is probable that during the night period, a higher percentage of arrivals from the north and east could join the final southern approach above Catherine Field. However, for modelling, the estimated 70 percent figure was also used for night-time operations.

Where the above operating scenario is unavailable due to weather, all departures would operate to the south from the western runway, and all arrivals from the north.



Preliminary landing flight paths
Preliminary take off flight paths
Modified preliminary landing flight paths
Modified preliminary take off flight paths
Assumed number of aircraft movements per day with airport operating at 30 million passengers per year 45
Urban areas (indicated by local roads)

Figure 8.40
Modified Flight Paths Used to Assess Noise Management Potential of Option C: Landings from the North and Take Offs to the South

Source: Second Sydney Airport Planners, 1997a

Notes: 1. Flight Paths provided to a distance of about 19 kilometres. Aircraft would be seen and heard beyond that distance.
2. Flight paths which have been deleted are not shown as the aircraft movements previously assigned to these flight paths have been reassigned to existing or modified flight paths.

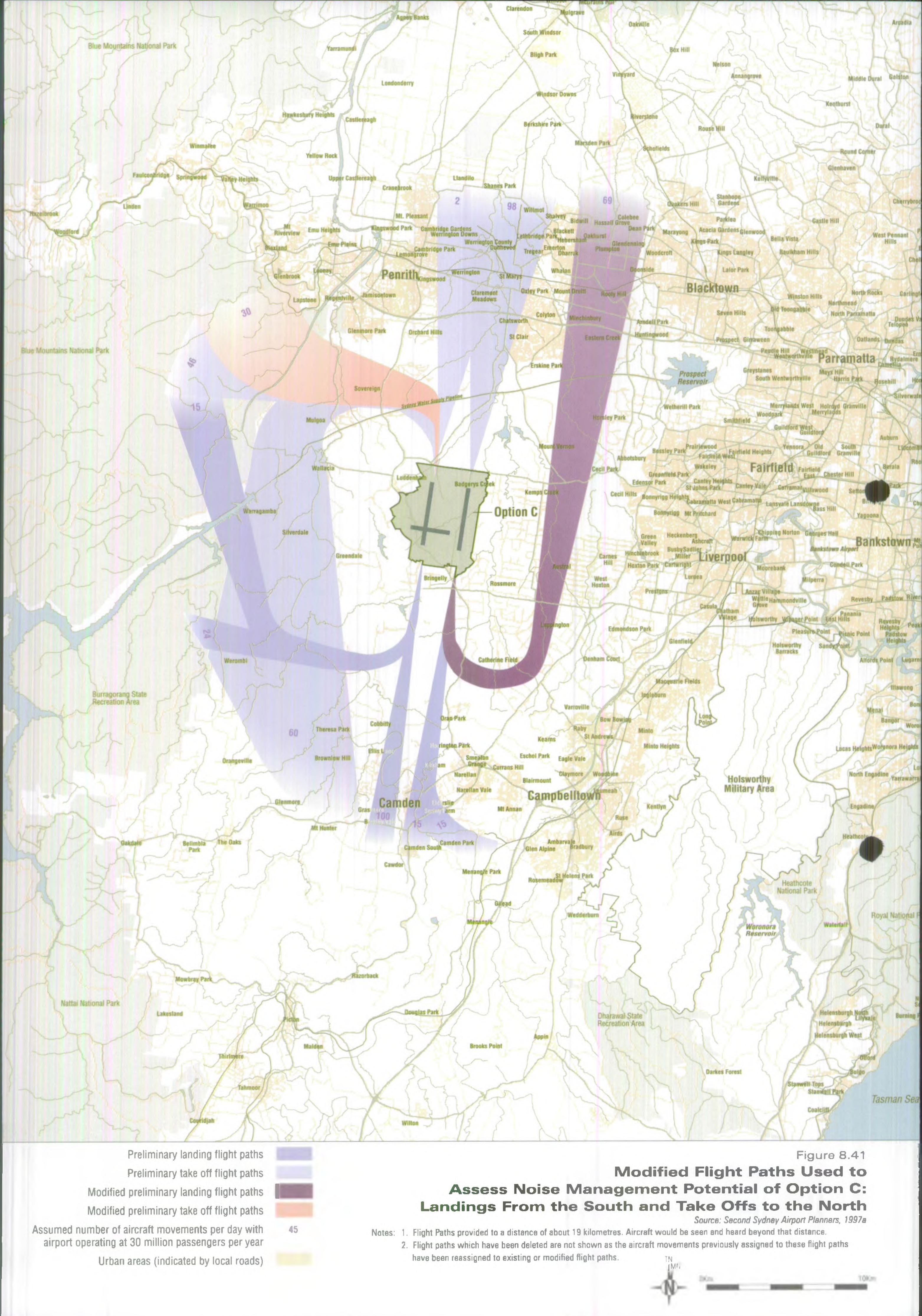


Figure 8.41

Modified Flight Paths Used to Assess Noise Management Potential of Option C: Landings From the South and Take Offs to the North

Source: Second Sydney Airport Planners, 1997a

Notes: 1. Flight Paths provided to a distance of about 19 kilometres. Aircraft would be seen and heard beyond that distance.
2. Flight paths which have been deleted are not shown as the aircraft movements previously assigned to these flight paths have been reassigned to existing or modified flight paths.

Once again, flight paths would be as described above, where necessary translated to the alternative runway.

Where use of the cross wind runway is required, flight paths would be as modelled for the Draft EIS.

Once again, the use of 'head-to-head' operations on a single runway was considered, but appears to offer no advantage in terms of overall noise impact.

8.7.5 Modifications to Urban Land Use Assumptions

Chapter 7 of this Supplement responds to submissions raising issues regarding the future urban land use scenarios adopted in the Draft EIS. Development of these future land use scenarios was based on the assumption that planning for urban development would continue in accordance with the NSW Government's current planning strategies and some modifications would be required based on potential impacts of aircraft overflight noise. It was also identified that there would be potential to create urban villages adjacent to any proposed rail link to the airport. Depending on the route for the rail link it was assumed that by 2016 up to 12,000 residents could be located in new urban villages in either the Bringelly area for an airport rail link to Options A or B or the Rossmore area for an airport rail link to Option C.

Following consideration of comments in submissions, two further future urban land use scenarios were developed. The first refined the location of the urban villages to reduce the potential extent of noise impacts on these future residents and the second was based on the assumption that the urban villages would not be developed either because further residential development of the South Creek Valley was deemed to be inappropriate by the NSW Government or an alternative route for the airport rail link was adopted, perhaps through the Liverpool Urban Release Areas.

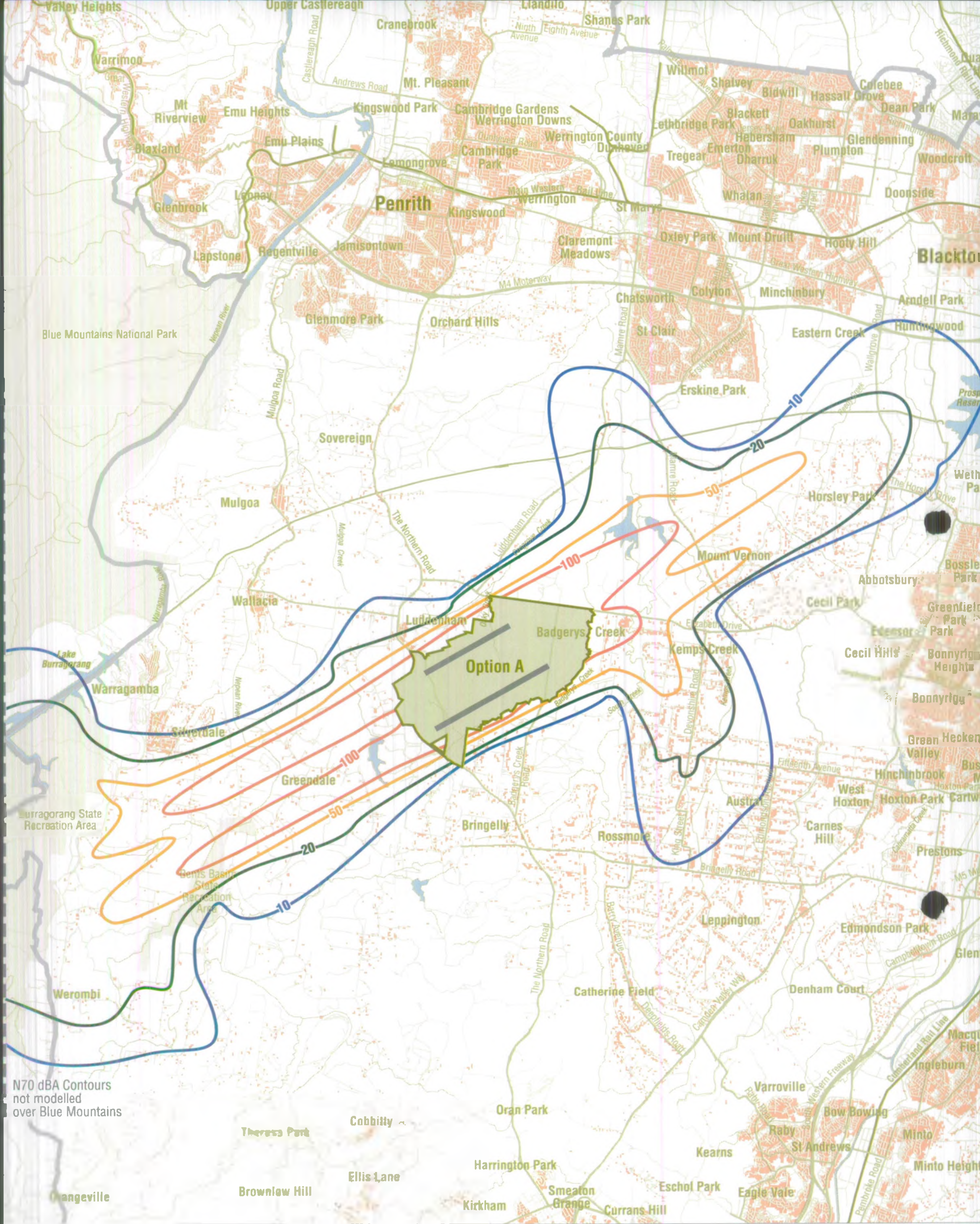
Therefore, the assessment of potential noise impacts based on the noise management measures discussed above considers impacts of potential populations that might exist in 2016 under future urban land use scenarios, namely:

- the Draft EIS Land Use Scenario which adopts a population of 12,000 people by 2016 in an urban village either located at Bringelly (for Options A and B) or Rossmore (for Option C);
- the Refined South Creek Valley Urban Village Scenario which adopts a similar population of 12,000 people but more precisely defines the location of these future residents within the land use model in order to minimise noise impacts; and
- the Exclusion of Future Residential Development from South Creek Valley Scenario which generally adopts current urban development program planning for western Sydney.

8.7.6 Noise Impacts with Assumed Noise Management Measures

24-Hour Impacts

Figures 8.42 to 8.44 show 24-hour N70 contours for all three airport options, assuming the implementation of the above noise management measures. As in all assessments above, *Air Traffic Forecast 3* is assumed. *Figures 8.45 to 8.47* show the equivalent ANEC contours.



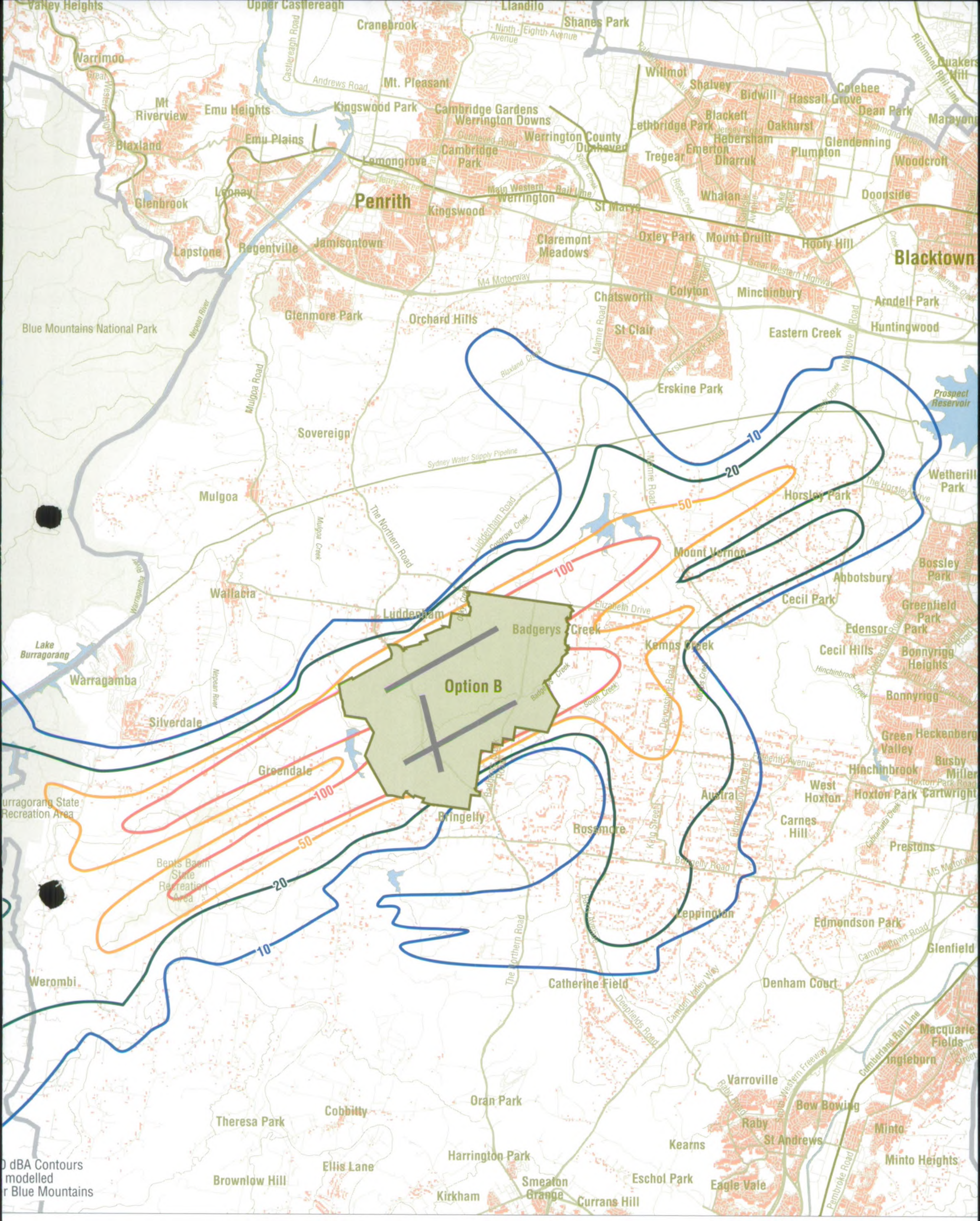
Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA on an average day	—10— / —20—	Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70 dBA on an average day	—50— / —100—
Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA on an average day	—20— / —50—	Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA on an average day	—100—
Extent of dwelling data		Indicates density of dwellings in 1996	

Figure 8.42

N70 Contours for Option A with Noise Management (30 Million Passengers Per Year)

TN MN N

0Km 5Km



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA on an average day —10— —20—

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA on an average day —20— —50—

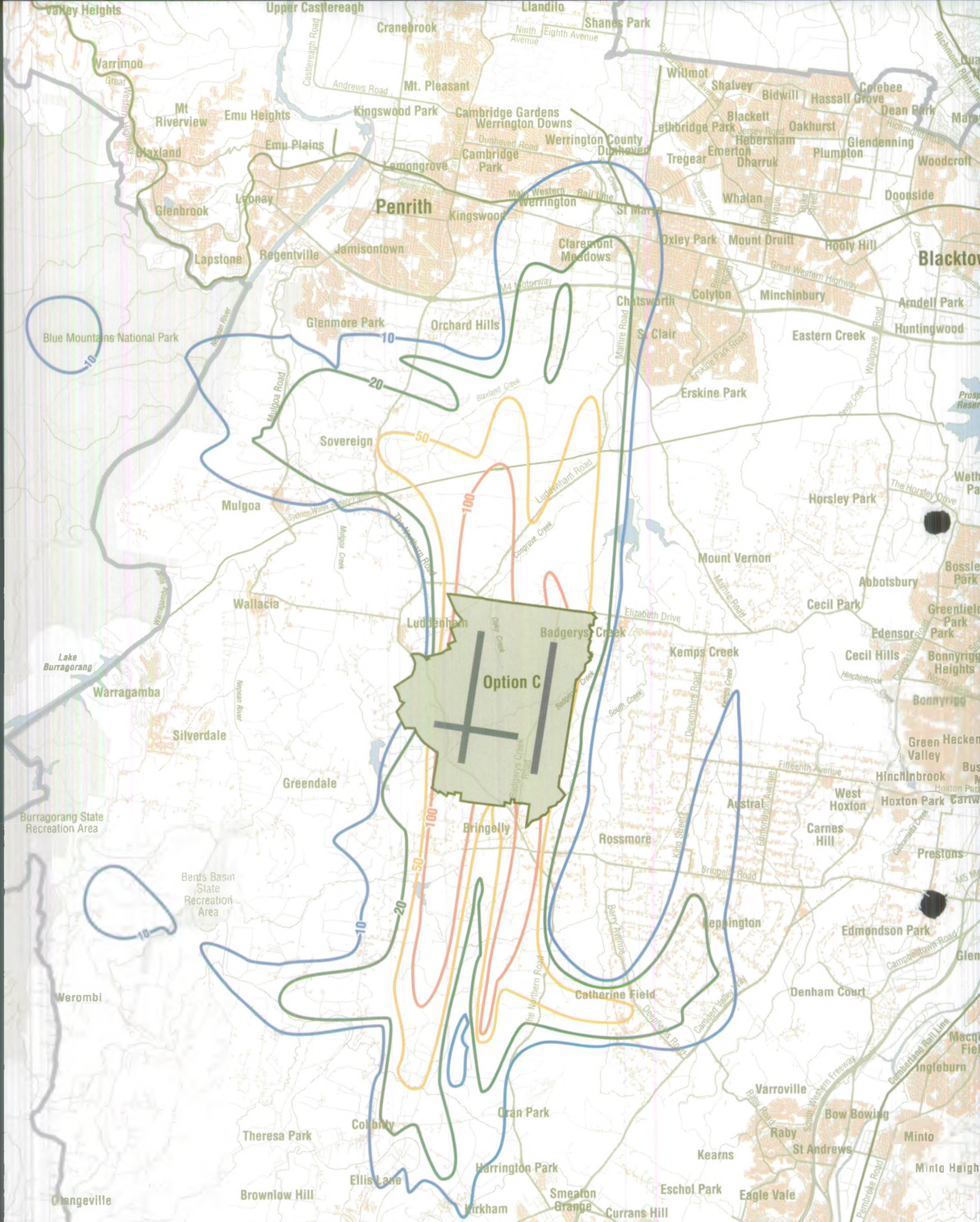
Extent of dwelling data

Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70 dBA on an average day —50— —100—

Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA on an average day —100—

Indicates density of dwellings in 1996

Figure 8.43
N70 Contours for Option B with Noise Management (30 Million Passengers Per Year)



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70 dBA on an average day — 10 — 20

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70 dBA on an average day — 20 — 50

Extent of dwelling data

Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70 dBA on an average day — 50 — 100

Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70 dBA on an average day — 100

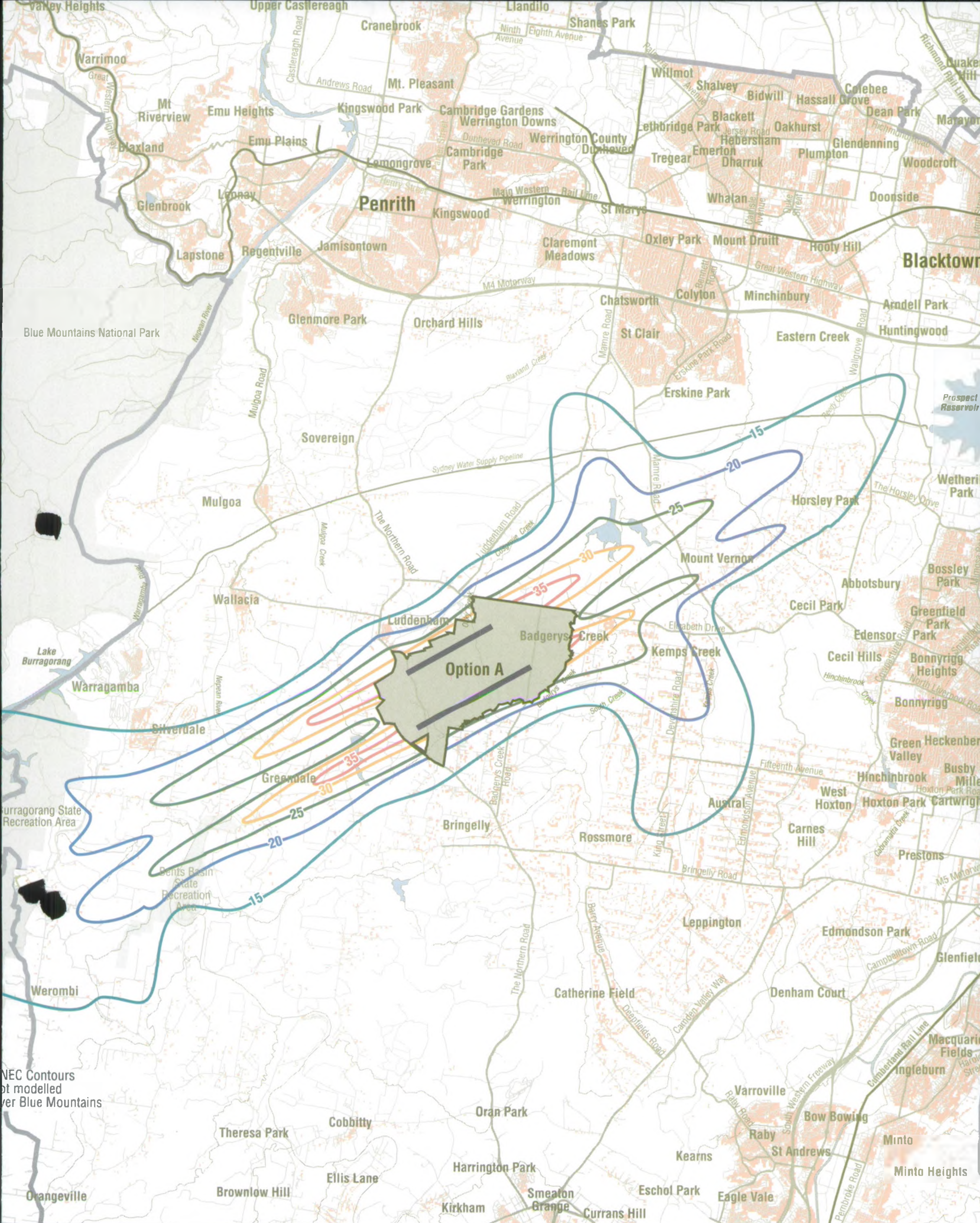
Indicates density of dwellings in 1996

TN MN N

0Km 5Km

Figure 8.44

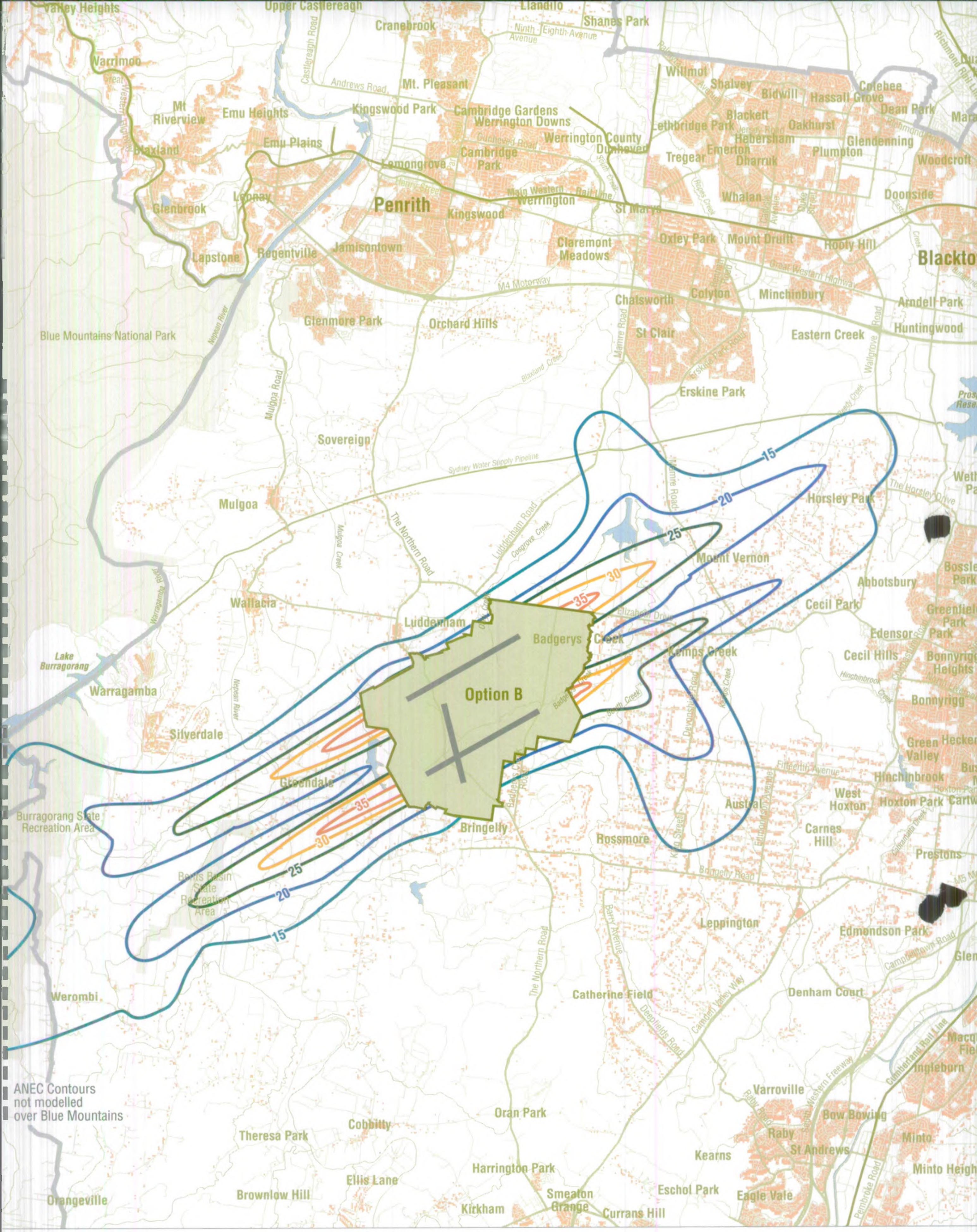
N70 Contours for Option C with Noise Management (30 Million Passengers Per Year)



15 ANEC
20 ANEC
25 ANEC
30 ANEC
35 ANEC
Indicates density of dwellings in 1996
Extent of dwelling data

Figure 8.45
ANEC Contours for Option A with Noise Management (30 Million Passengers Per Year)

TN MN
0Km 5Km



15 ANEC
20 ANEC
25 ANEC
30 ANEC
35 ANEC
Indicates density of dwellings in 1996
Extent of dwelling data

Figure 8.46
ANEC Contours for Option B with Noise Management (30 Million Passengers Per Year)

TN MN N

0Km 5Km

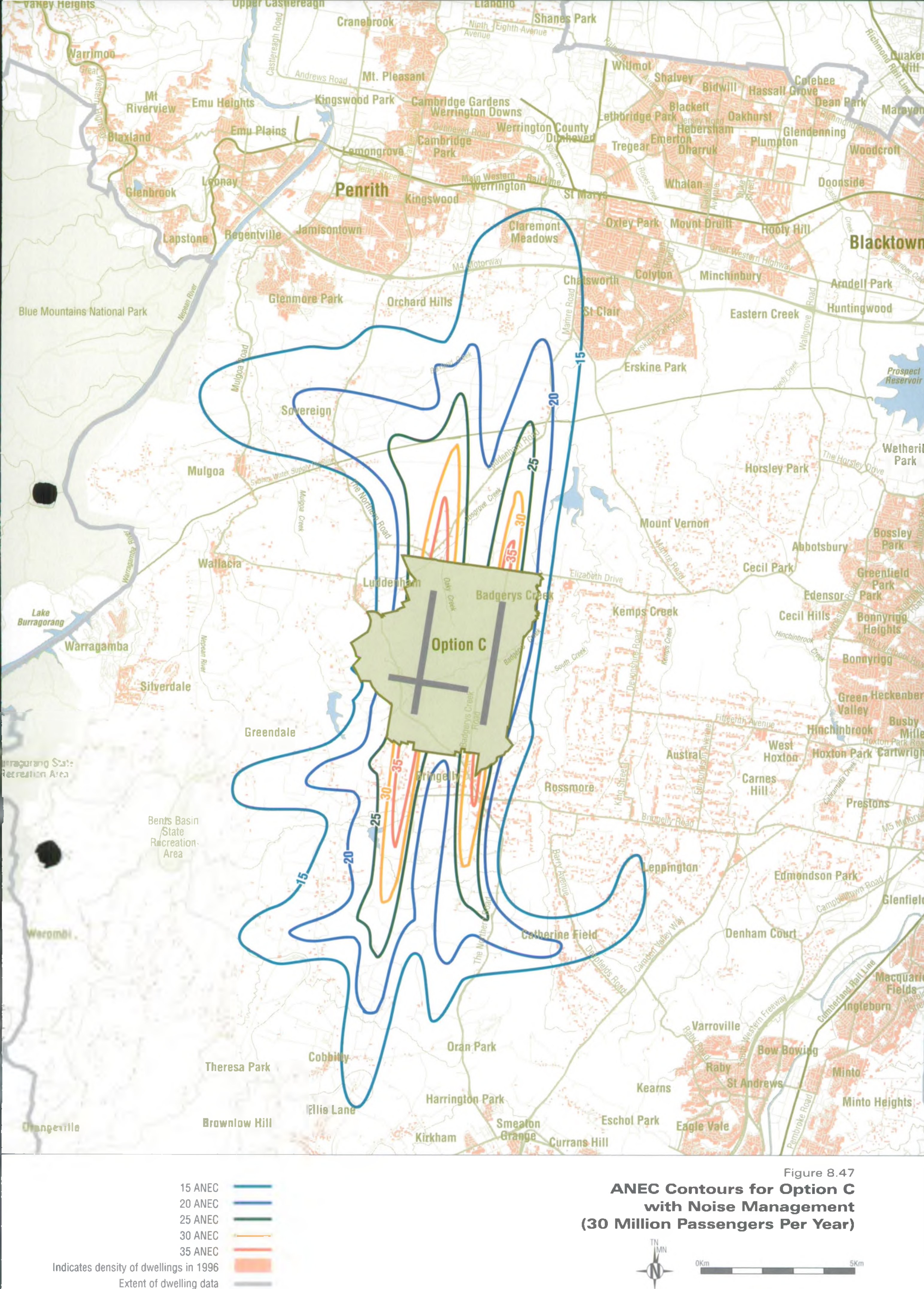


Figure 8.47

ANEC Contours for Option C with Noise Management (30 Million Passengers Per Year)

Tables 8.11 to 8.13 summarise the number of people who would experience various levels of noise impact when the airport is operating at 30 million passengers per year, with the adoption of the noise management measures.

Table 8.11 **Aircraft Overflight Noise Impacts of Option A Operating at 30 Million Passengers Per Year with Noise Management Measures**

Noise Indicator	Population Affected[1,2]		
	Draft EIS Land Use	Refined South Creek Land Use	No South Creek Urban Land Use
People that may experience, on average, the following ANEC levels[3]:			
Greater than 30			
flight paths/operations in Draft EIS[4]	200	200	200
with noise management measures	200	200	200
Greater than 25			
flight paths/operations in Draft EIS[4]	700	700	700
with noise management measures	700	700	700
Greater than 20			
flight paths/operations in Draft EIS[4]	4,500	4,500	4,500
with noise management measures	2,500	2,500	2,500
Greater than 15			
flight paths/operations in Draft EIS[4]	14,000	14,000	14,000
with noise management measures	8,000	8,000	8,000
People that may experience, on average, the following number of noise events over 70 dBA a day:			
Greater than 100 events			
flight paths/operations in Draft EIS[4]	300	400	400
with noise management measures	500	500	500
Greater than 50 events			
flight paths/operations in Draft EIS[4]	2,500	3,000	3,000
with noise management measures	1,500	1,500	1,500
Greater than 20 events			
flight paths/operations in Draft EIS[4]	8,500	9,000	9,000
with noise management measures	5,000	5,000	5,000
Greater than 10 events			
flight paths/operations in Draft EIS[4]	15,000	15,000	15,000
with noise management measures	10,000	10,000	10,000

Notes:
1. *Based on population projections for 2016.*
2. *There are limitations on the accuracy of predicting future populations and predicting future aircraft noise levels. Estimates of population greater than 10,000 have been rounded to the nearest 1,000, estimates of population between 1,000 and 10,000 have been rounded to the nearest 500; and estimates of populations less than 1,000 have been rounded to the nearest 100. Estimates of populations less than 100 are expressed as less than 100.*
3. *Impacts of levels of ANEC assume all residential properties within the 35 ANEC contour would be acquired.*
4. *Impacts arising from Airport Operation 1.*

Tables 8.11 to 8.13 indicate that at some levels of noise exposure, a greater number of people may be affected under the noise management measures than under the measures adopted in the Draft EIS. This is a result of the fact that in some cases the measures described result in higher exposure for a relatively small number of people, while providing lower exposure for a larger number.

Table 8.12 Aircraft Overflight Noise Impacts of Option B Operating at 30 Million Passengers Per Year with Noise Management Measures

Noise Indicator	Population Affected[1,2]		
	Draft EIS Land Use	Refined South Creek Land Use	No South Creek Urban Land Use
People that may experience, on average, the following ANEC levels[3] in 2016:			
Greater than 30			
flight paths/operations in Draft EIS[4]	less than 100	less than 100	less than 100
with noise management measures	less than 100	less than 100	less than 100
Greater than 25			
flight paths/operations in Draft EIS[4]	500	500	500
with noise management measures	400	400	400
Greater than 20			
flight paths/operations in Draft EIS[4]	3,500	3,500	3,500
with noise management measures	2,000	2,000	2,000
Greater than 15			
flight paths/operations in Draft EIS[4]	11,000	11,000	11,000
with noise management measures	7,500	8,000	8,000
People that may experience, on average, the following number of noise events over 70 dBA a day in 2016:			
Greater than 100 events			
flight paths/operations in Draft EIS[4]	300	300	300
with noise management measures	300	300	300
Greater than 50 events			
flight paths/operations in Draft EIS[4]	2,000	2,000	2,000
with noise management measures	2,000	2,000	2,000
Greater than 20 events			
flight paths/operations in Draft EIS[4]	7,000	7,000	7,000
with noise management measures	8,000	8,000	8,000
Greater than 10 events			
flight paths/operations in Draft EIS[4]	17,000	17,000	17,000
with noise management measures	16,000	17,000	14,000

Notes:
1. *Based on population projections for 2016.*
2. *There are limitations on the accuracy of predicting future populations and predicting future aircraft noise levels. Estimates of population greater than 10,000 have been rounded to the nearest 1,000; estimates of population between 1,000 and 10,000 have been rounded to the nearest 500; and estimates of populations less than 1,000 have been rounded to the nearest 100. Estimates of populations less than 100 are expressed as less than 100.*
3. *Impacts of levels of ANEC assume all residential properties within the 35 ANEC contour would be acquired.*
4. *Impacts arising from Airport Operation 1.*

Table 8.13 Aircraft Overflight Noise Impacts of Option C Operating at 30 Million Passengers Per Year with Noise Management Measures

Noise Indicator	Population Affected[1,2]		
	Draft EIS Land Use	Refined South Creek Land Use	No South Creek Urban Land Use
People that may experience, on average, the following ANEC levels[3] in 2016:			
Greater than 30			
flight paths/operations in Draft EIS[4]	less than 100	less than 100	less than 100
with noise management measures	100	100	100
Greater than 25			
flight paths/operations in Draft EIS[4]	300	300	300
with noise management measures	400	400	400
Greater than 20			
flight paths/operations in Draft EIS[4]	900	900	900
with noise management measures	1,000	1,000	1,000
Greater than 15			
flight paths/operations in Draft EIS[4]	15,000	15,000	15,000
with noise management measures	10,000	10,000	10,000
People that may experience, on average, the following number of noise events over 70 dBA a day in 2016:			
Greater than 100 events			
flight paths/operations in Draft EIS[4]	200	200	200
with noise management measures	200	200	200
Greater than 50 events			
flight paths/operations in Draft EIS[4]	500	500	500
with noise management measures	700	700	700
Greater than 20 events			
flight paths/operations in Draft EIS[4]	6,000	6,000	6,000
with noise management measures	7,500	6,500	6,500
Greater than 10 events			
flight paths/operations in Draft EIS[4]	72,000	72,000	72,000
with noise management measures	32,000	28,000	29,000

Notes:
1. *Based on population projections for 2016.*
2. *There are limitations on the accuracy of predicting future populations and predicting future aircraft noise levels. Estimates of population greater than 10,000 have been rounded to the nearest 1,000; estimates of population between 1,000 and 10,000 have been rounded to the nearest 500; and estimates of populations less than 1,000 have been rounded to the nearest 100. Estimates of populations less than 100 are expressed as less than 100.*
3. *Impacts of levels of ANEC assume all residential properties within the 35 ANEC contour would be acquired.*
4. *Impacts arising from Airport Operation 1.*

Options A and B demonstrate a similar capacity for noise impact reduction should a noise management strategy similar to the one suggested in this Supplement be adopted. At the higher levels of potential impacts (ANEC greater than 25 and more than 100 events over 70 dBA a day) there would be either no change, a minor increase or a minor reduction in the number of people affected. Greater reductions would occur at lower levels of exposure where up to approximately 30 percent reduction in the numbers of people affected may be achieved.

The noise management strategy considered in this Supplement would also result in minor reductions and some minor increases in the populations affected by Option C at the higher levels of overflight noise considered. Substantial reductions in impacts would, however, occur at the lower levels of noise considered, that is within the 15 ANEC contour or areas that may experience approximately 10 events a day over 70 dBA. A reduction in the numbers of people affected by up to 60 percent could be achieved.

The analysis of the three potential future land uses scenarios indicates that a controlled form of urban development within South Creek Valley could occur without substantially increasing the noise impacts of the Second Sydney Airport on future residential populations. The planning and environmental issues that would arise if such development were contemplated are discussed in *Chapter 7* of this supplement.

Notwithstanding the different potential for the aircraft overflight noise impacts to be reduced for each airport option, it is considered that the general conclusions of the Draft EIS in comparing the relative impacts of the options remain valid. For many of the noise indicators that have been considered there would be only small differences between the potential impacts of the options. For example, the impacts would be similar for the higher and mid range noise levels modelled. It is therefore difficult to rank the airport options in terms of the impacts of the higher and mid range noise levels (say above 15 ANEC or more than 50 noise events per day greater than 70 dBA) on the community as a whole. This is because methods to quantify the degree of noise impact for each option are not accurate enough to provide a definitive ranking.

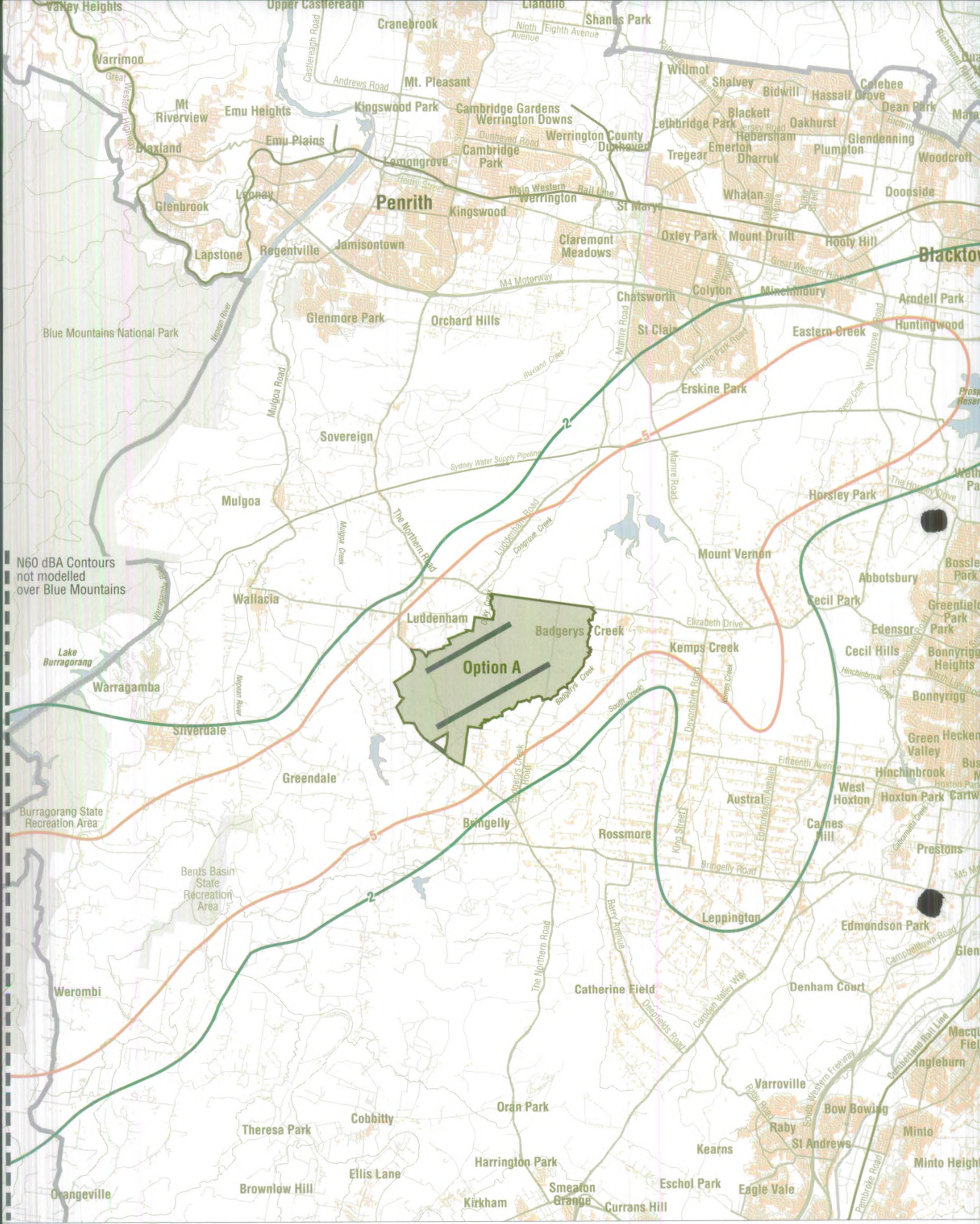
At the lower noise levels modelled (10 noise events a day greater than 70 dBA) it can still be concluded that Option C is likely to impact more people than Options A and B. This would still be the case notwithstanding the potential for significant reductions in the number of people affected by these lower noise levels that would be generated by Option C.

Night-Time Impacts

Figures 8.48 to *8.50* show night-time N60 contours for all three airport options, assuming the implementation of the above mitigation measures. As in all assessments above, *Air Traffic Forecast 3* is assumed.

Table 8.14 summarises the number of people who would experience various levels of noise during the night when the airport is operating at 30 million passengers per year with the adoption of the noise management measures.

Table 8.14 shows that a substantial reduction in night-time noise impacts could be achieved with the adoption of an appropriate noise management strategy. The level of this reduction is greater than for 24-hour operations, particularly for Option C, as in this case it would be possible to use only the western runway and direct all north-going departures over the Blue Mountains National Park. Therefore, direct overflights over most large population centres could be substantially avoided at night.



Area within these two contours is estimated to receive between two and five aircraft overflights louder than 60 dBA on the worst case night

Area within this contour is estimated to receive more than five aircraft overflights louder than 60 dBA on a worst case night

Indicates density of dwellings in 1996

Extent of dwelling data

Figure 8.48

N60 Night-Time Contours for Option A with Noise Management (30 Million Passengers Per Year)

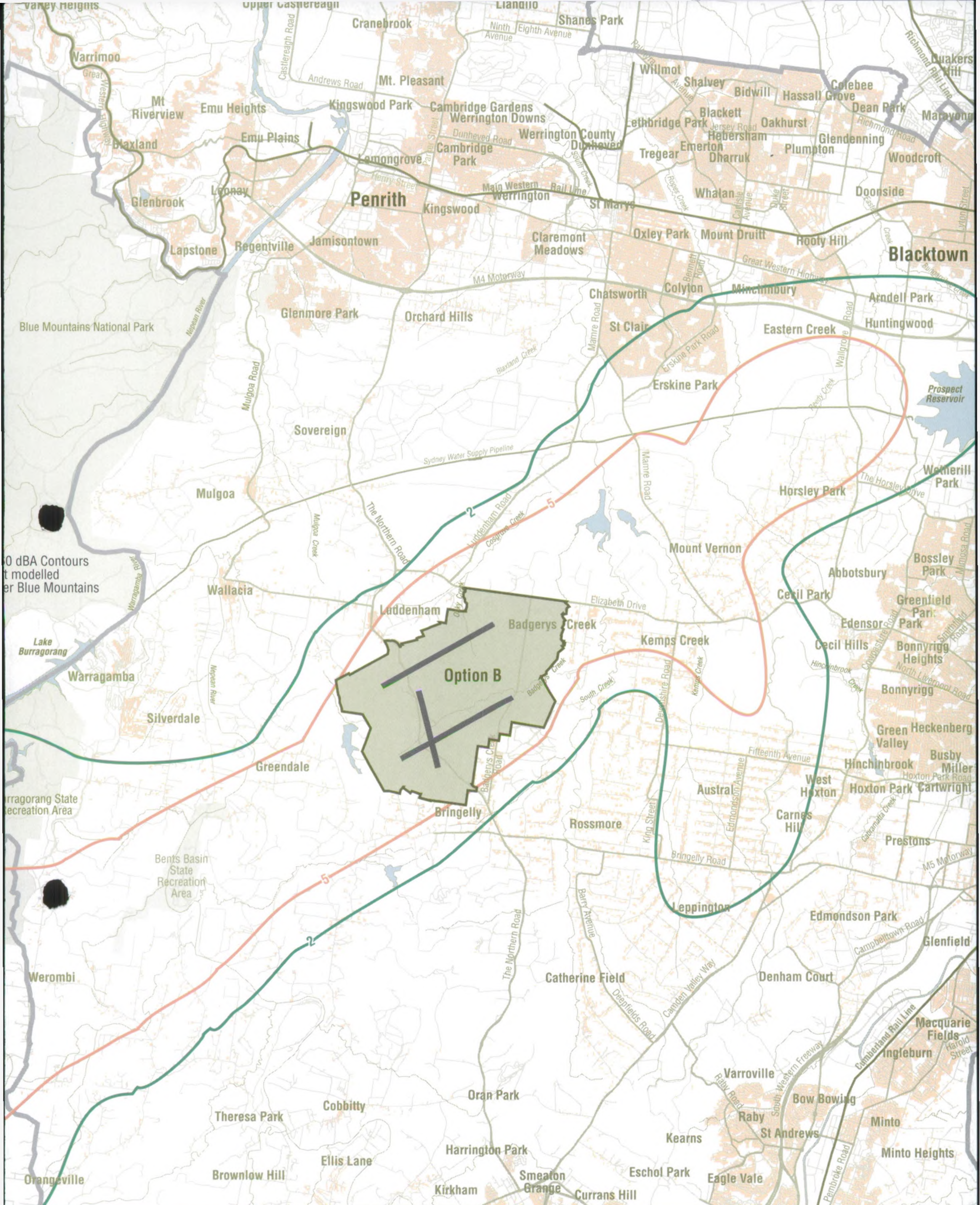


Figure 8.49

N60 Night-Time Contours for Option B with Noise Management (30 Million Passengers Per Year)

Area within these two contours is estimated to receive between two and five aircraft overflights louder than 60 dBA on the worst case night —2— —5—

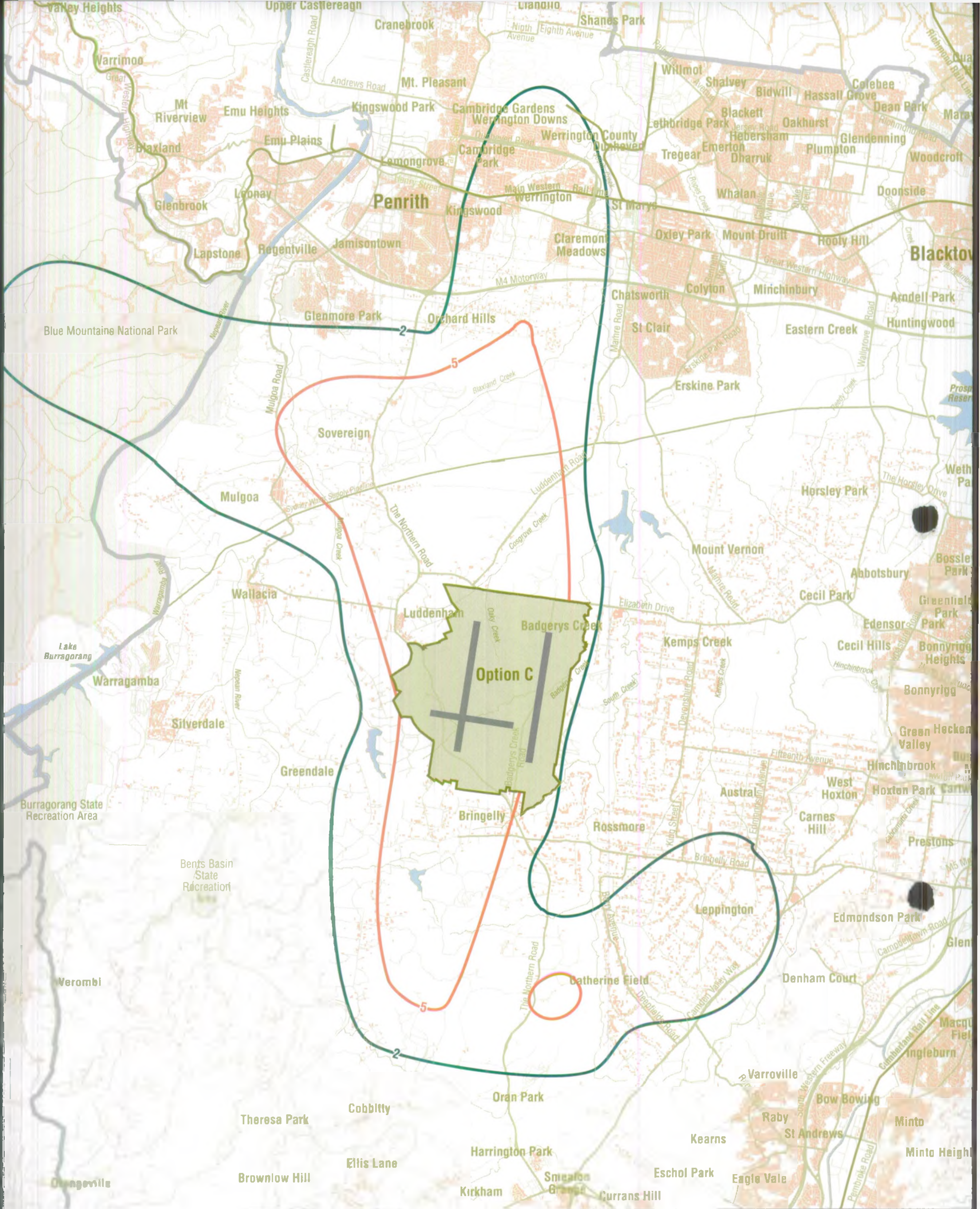
Area within this contour is estimated to receive more than five aircraft overflights louder than 60 dBA on a worst case night —5—

Indicates density of dwellings in 1996

Extent of dwelling data

TN MN N

0Km 5Km



Area within these two contours is estimated to receive between two and five aircraft overflights louder than 60 dBA on the worst case night —2— —5—

Area within this contour is estimated to receive more than five aircraft overflights louder than 60 dBA on a worst case night —5—

Indicates density of dwellings in 1996

Extent of dwelling data

Figure 8.50

N60 Night-Time Contours for Option C with Noise Management (30 Million Passengers Per Year)

Table 8.14 **Aircraft Overflight Noise Impacts During Night-Time for Airport Operating at 30 Million Passengers Per Year with Noise Management Measures (Draft EIS Land Use Scenarios)**

Noise Indicator	Population Affected[1,2]		
	Option A	Option B	Option C
People that may experience the following number of noise events over 60 dBA during the night (worst case scenario):			
Greater than 5 events			
flight paths/operations in Draft EIS	18,000	19,000	47,000
with noise management measures	4,500	4,500	2,000
Greater than 2 events			
flight paths/operations in Draft EIS	124,000	108,000	178,000
with noise management measures	60,000	39,000	48,000

Notes:
1. *Based on population projections for 2016.*
2. *There are limitations on the accuracy of predicting future populations and predicting future aircraft noise levels. Estimates of population greater than 10,000 have been rounded to the nearest 1,000, estimates of population between 1,000 and 10,000 have been rounded to the nearest 500; and estimates of populations less than 1,000 have been rounded to the nearest 100. Estimates of populations less than 100 are expressed as less than 100.*

Impacts on Schools

Table 8.15 summarises the number of educational facilities, including childcare centres, which would experience greater than 10 events per school day exceeding 65 dBA, with the adoption of the noise management measures.

Table 8.15 shows that a substantial reduction in the number of educational facilities that may experience noise events greater than 65 dBA could be achieved with the adoption of an appropriate noise management strategy.

Table 8.15 **Aircraft Overflight Noise Impacts on Existing Educational Facilities for the Airport Operating at 30 Million Passengers Per Year with Noise Management Measures[1,2]**

Noise Indicator	Educational Facilities		
	Option A	Option B	Option C
Educational facilities that may experience, on average, the following number of noise events over 65 dBA[2] between 9.00 am and 3.00 pm:			
Greater than 20 events			
flight paths/operations in Draft EIS	15	13	25
with noise management measures	5	2	3
Greater than 10 events			
flight paths/operations in Draft EIS	20	20	75
with noise management measures	14	11	26

Notes:
1. *Definition of educational facilities has been expanded to include childcare centres.*
2. *65 dBA is level at which communication within educational buildings would be disturbed.*

8.7.7 Conclusions of Further Analysis of Impacts of Aircraft Overflight Noise

Conclusions from the expanded assessment of aircraft overflight noise impacts described above do not differ qualitatively from those in the Draft EIS. They are summarised as follows:

- for many of the noise indicators examined, there would be only small differences between the potential noise impacts of the airport options. For example, the impacts would be similar for the higher and mid range noise levels modelled. At the lower noise levels modelled (10 noise events a day greater than 70 dBA), it is possible to conclude that Option C is likely to impact more people than Options A and B;
- for areas affected largely by operations on the main parallel runways, 'worst day' noise impacts would not vary greatly from 'average day' impacts. In these areas, 'worst day' impacts could occur on between 20 and 50 percent of all days. For areas affected largely by cross wind runway operations, 'worst day' impacts would be very much higher than 'average day' impacts. However, in these areas, 'worst day' impacts could occur as infrequently as one day in two years;
- seasonal variation in noise impacts would be most pronounced for Options A and B. For these options, operations in a south-westerly direction would be more prevalent in winter. This leads to higher exposure in areas under departure flight paths to the south, and under arrival flight paths from the north. The converse is true in summer. For Option C, there is very little predicted seasonal variation in noise exposure; and
- it would be possible to reduce noise impacts by modifying both flight paths and operations of the airport through the development of a noise management strategy. An example of some measures that could be used in the development of such a strategy have been analysed. The analysis shows that reductions in the numbers of people affected by aircraft overflight noise could be achieved for all airport options. For operations over 24-hours, the most substantial reductions in noise impacts would be achieved at the lower noise levels examined, especially for Option C. For night-time operations, more substantial reductions in noise impacts would be possible for all airport options.

8.8 Comparison of Noise Impacts at Sydney Airport and the Second Sydney Airport

There has been considerable public discussion about the overall noise impacts of the Second Sydney Airport and the level of assistance it would provide in managing the impact of aircraft noise from Sydney Airport. This section addresses the issue of whether there would be a net reduction in noise exposure for Sydney residents if a second airport was developed. The analysis was therefore based on a comparison between the exposure of Sydney residents to increasing noise at Sydney Airport, and noise from a new airport at Badgerys Creek.

8.8.1 Urban Land Use Patterns

Existing and future urban land use patterns of Sydney have been discussed in detail in the Draft EIS and this Supplement. The different characteristics of urban development surrounding Sydney Airport and the sites of the options for the Second Sydney Airport would result in significantly different noise impacts from each airport.

The populations living near Sydney Airport and Badgerys Creek are plotted as a function of distance from the airport sites in *Figure 8.51*.

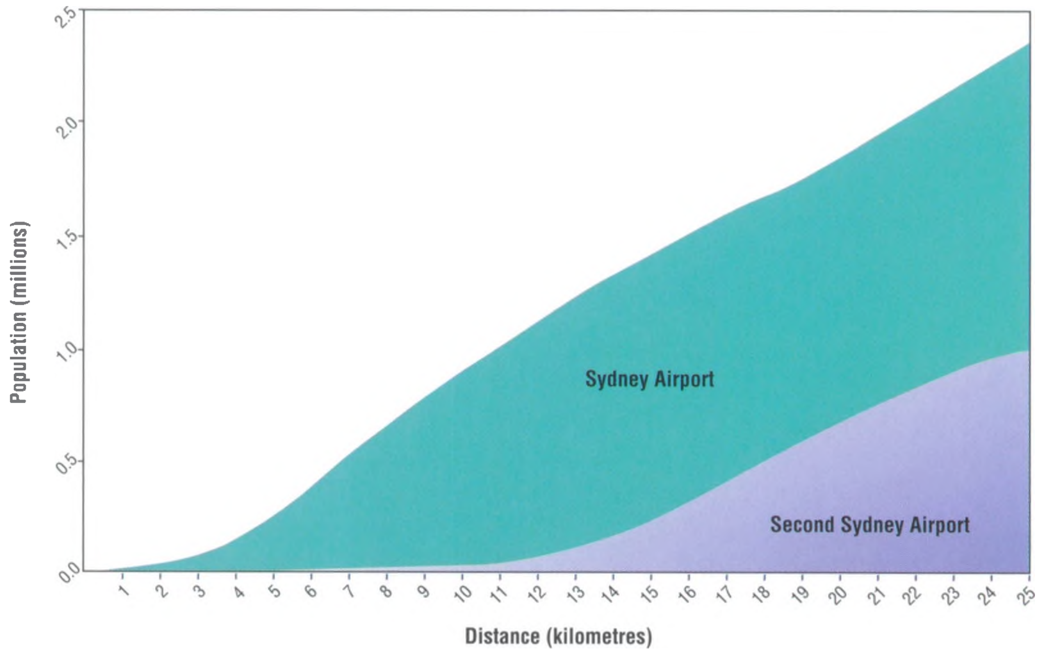


Figure 8.51
Populations Living Near Sydney Airport and the Second Sydney Airport Sites

It can be seen from this figure that the population differences are large, particularly close to the sites. For example, about 840,000 people live within 10 kilometres of

Sydney Airport and about 18,000 people live within 10 kilometres of the sites of the proposed Second Sydney Airport options.

8.8.2 Noise Exposure From Traffic Growth In The Sydney Basin

It was planned initially to calculate new noise exposure data for Sydney Airport and the proposed Second Sydney Airport so that a strict 'like for like' comparison could be made. It became clear, however, that valid qualitative conclusions could be drawn from existing data, despite the fact that the data for Sydney Airport and the proposed Second Sydney Airport were not based on identical assumptions.

The analysis was based on comparing the noise exposure from expanding Sydney Airport from 303,000 to 353,000 aircraft movements per annum with the noise exposure from Badgerys Creek operating at 130,000 aircraft movements.

There is no unique way of describing aircraft noise exposure and for this reason a range of measures was used in the analysis. In addition to the N70 and ANEC measures used elsewhere in this Chapter, the Person-Events Index was developed.

Person-Events Index

The Person-Events Index has been developed by the Department of Transport and Regional Services as a simple way of comparing the noise loads generated by different airports or by different airport operating configurations.

The Person-Events Index is calculated by adding up, for each aircraft movement in an average day, the number of people exposed to noise above a specified limit (usually 70 dBA). The Person-Events Index therefore represents a measure of the 'noise load' experienced by the community as a whole.

For example, at Sydney Airport when a B747-200 (the loudest aircraft type to commonly use the Airport) takes off to the south from the main north-south runway about 4,000 persons are exposed to a noise event louder than 70 dBA. By way of contrast, when one of these aircraft takes off to the north from the same runway and travels toward the north-west more than 250,000 persons are exposed to a noise event louder than 70 dBA. This type of information can be computed for all flight paths and all aircraft types using an airport, and the total number of 'noise events' (where a noise event is an individual being exposed to a noise louder than 70 dBA) is calculated to give the Person-Events Index.

Using the Person-Events Index, a Concentration Factor can be calculated which is the average number of noise events per day to which individuals would be exposed. The Concentration Factor is an estimate of the extent to which the aircraft noise is concentrated or spread. The Concentration Factor is calculated by dividing the Person-Events Index by the population in the areas affected.

It can be seen from *Table 8.16* that the Person-Events Index for Sydney Airport at 303,000 movements per year is approximately 11 million. This means that, on an average day, there would be 11 million individual instances of exposure to a noise event louder than 70 dBA (based on counting persons who are exposed to 10 or more events per day). The Person-Events Index has a cut-off of 10 events per day to be consistent with the other N70 information in the Draft EIS which is based on outer N70 contour of 10 events per day.

Table 8.16 Comparison of the Noise Exposure for Sydney Airport and the Proposed Second Sydney Airport Using the Person Events Index

Airport	Movements/ Year	Person Events Index (millions)	Concentration Factor
Sydney Airport	303,000	11.1	38
	353,000	13.3	43
Second Sydney Airport			
Option A	130,000	.27	45
Option B	130,000	.18	34
Option C	130,000	.35	17

Source: Department of Transport and Regional Services.

Notes: 1. The Person Events Index was calculated by summing, for each aircraft movement in an average day, the number of people exposed to noise above 70 dBA. All individuals exposed to more than ten events per day were included.

2. The Concentration Factor is the average number of noise events per day greater than 70 dBA to which individuals would be exposed. Locations which would experience less than ten noise events per day were not included in the calculations.

Table 8.16 shows that, if the traffic at Sydney Airport grew from 303,000 to 353,000 movements per year, the increase in the total noise load (a Person-Events Index increase of approximately two million) would be between approximately six to 11 times the total noise load for proposed Second Sydney Airport operating at 130,000 movements per year.

Table 8.16 also shows that the total noise load (Person-Events Index) generated by Sydney Airport at 353,000 movements per year would be between approximately 40 and 60 times that generated by the proposed Second Sydney Airport operating at 130,000 movements per year. The Person-Events Index value for all the Badgerys Creek airport options is very significantly less than that for Sydney Airport. Therefore, while there is a big relative difference between the Person-Events Index for Option B and that for Option C, the absolute difference between the two when compared to Sydney Airport is negligible.

The differences between the two airports is not as clear cut when viewed using the Concentration Factor. For most of the scenarios at both Sydney Airport and the proposed Second Sydney Airport, the average level of exposure (Concentration Factor) is between 34 and 45 noise events per day. The exception is Option C for the second airport, for which the average exposure would be about 17 events per day and hence the average number of events louder than 70 dBA experienced by individuals (receiving more than 10 events per day) under Option C would be approximately half that of Sydney Airport and the other two Badgerys Creek options. This difference reflects the land use patterns around the proposed Second Sydney Airport and the fact that, compared with Options A and B, Option C would expose fewer people to very frequent noise events but more to less frequent events.

Number of Events Above 70 dBA

Table 8.17 shows the populations that would be exposed to a different number of noise events per day louder than 70 dBA. It can be seen that in all the exposure zones the number of people exposed to events louder than 70 dBA would be significantly larger at Sydney Airport than at the proposed Second Sydney Airport.

Table 8.17 **Comparison of the Noise Exposure for Sydney Airport and the Proposed Second Sydney Airport Using Estimates of the Population Within N70 Contours[1]**

Airport	Movements / Year	Population within N70						
		10-20	20-50	50-100	100-150	150-200	>200	Total
Sydney Airport	303,000	99,000	126,400	57,800	5700	700	100	289,700
	353,000	101,500	124,700	70,800	13,000	2,300	200	312,500
Second Sydney Airport								
Option A	130,000	2,750	1,750	800	700	0	0	6,000
Option B	130,000	2,000	2,650	450	150	0	0	5,250
Option C	130,000	19,300	920	150	100	0	0	20,470

Source: Department of Transport and Regional Services.
Note: 1. A N70 contour shows the locations where the population would be exposed to N events on an average day where the noise level exceeded 70 dBA.

Table 8.17 also shows that at Sydney Airport an increase in annual movements from 303,000 to 353,000 would lead to an extra 22,000 persons being exposed to more than 50 noise events per day. This is significantly greater than the total number of persons in this noise zone at all the Second Sydney Airport options. However, there would be only small changes in the number of persons receiving between 10 and 50 events per day if the traffic growth took place at Sydney Airport.While it is only a very crude indicator of total noise load, *Table 8.17* indicates that there are very significantly larger numbers of people within the N70 contour (greater than 10 events per day) at Sydney Airport than at the proposed Second Sydney Airport – ranging from 15 times for Option C to 60 times for Option B.

Australian Noise Exposure Forecasts

Table 8.18 shows the populations within the ANEF zones for Sydney Airport and the proposed Second Sydney Airport.

Table 8.18 Comparison of the Noise Exposure for Sydney Airport and the Proposed Second Sydney Airport Using ANEF Contour

Airport	Movements / Year	Population within ANEF					
		15-20	20-25	25-30	30-35	>35	Total for >20 ANEF
Sydney Airport	303,000	N/a	62,100	20,400	3,400	100	86,000
	353,000	N/a	66,600	21,000	3,600	100	91,300
Second Sydney Airport							
Option A	130,000	2,750	1,250	350	150	0	1,750
Option B	130,000	2,200	1,650	50	100	0	1,800
Option C	130,000	12,300	250	100	100	0	450

Source: Department of Transport and Regional Services

If Sydney Airport traffic increased from 303,000 to 353,000 movements per year, then an additional 5,000 people would live within the 20 ANEF contour. This figure can be compared with a total population of between about 450 and 1,750 in the 20 ANEF contour for the proposed Second Sydney Airport operating at 130,000 movements per year. Compared with the Person-Events Index and N70 results, this is a relatively small difference between the airports and is due to the fact that there are relatively small changes in ANEF contours when traffic is increased from a large base. Nevertheless, the ANEF results show that the noise exposure at Sydney Airport would exceed the exposure at the proposed Second Sydney Airport.

8.9 Overview of Aircraft Overflight Noise

8.9.1 Methods used to Assess Aircraft Overflight Noise Impacts

The methods used to assess the noise impacts of each airport option allows the options to be compared as well as permitting the impacts on specific areas to be identified. The assessment process was complex due to uncertainty as to how the airport may develop and operate.

To ensure that the likely range of possible impacts was identified, a number of assumptions were tested in the noise assessment. These assumptions related to air traffic forecasts, the staging of the development of the airport and the way the airport would operate. In addition, the noise assessment looked at two stages of development and operation of the airport. The first year was 2006, which is assumed to reflect the early stages of operation, and a master plan stage when about 30 million passengers would be using the airport each year.

Because of the number of assumptions adopted, many of the results of the noise assessment show a range of noise impacts for individual communities, from relatively low to relatively high noise impacts. The actual noise impacts would likely be somewhere between these two levels.

8.9.2 Measurement of Aircraft Overflight Noise

The loudness of noise is usually measured in decibels (dB). Because the ear responds to different types of noise in different ways, the A-weighted decibel (dBA) has been developed. The dBA measure most closely represents the way noise is heard by the human ear. Because of the way the dBA scale is calculated, a 10 dBA increase in noise is generally equivalent to doubling the loudness of the noise.

A useful way of describing aircraft noise is to use the maximum noise level of the particular aircraft. This is the highest level that occurs as the aircraft flies overhead, and is commonly measured in dBA.

In Australia, the most common measure of overall aircraft noise exposure is the Australian Noise Exposure Forecast system. This system takes into account the noise level of each aircraft passing overhead, the number of movements and the time of day or night. The system was originally designed for planning the use of land near airports, and is less than ideal for explaining potential noise impacts on residents in areas surrounding airports. The information it provides is commonly displayed in the form of contours on a map.

The Australian Noise Exposure Forecast system yields a number of measures which are used for different purposes. In particular, the Australian Noise Exposure Concept (ANEC) is based on indicative data on aircraft types, airport operations and flight zones, and is the form of Australian Noise Exposure Forecast presented in the EIS.

Other more recently-developed, and less well-known, measures of noise exposure have been designed to indicate the extent of particular forms of impact. In particular, the Sleep Disturbance Index depends on the number and noise level of night-time noise events, and provides one indication of the severity of potential impacts on sleep.

8.9.3 Effects of Aircraft Overflight Noise

A literature search was carried out for the Draft EIS and supplemented by further analysis for this Supplement into the effects of noise from overflying aircraft. There are a number of potential impacts on people, property values and wildlife, but the research to date does not provide sufficient information to accurately quantify many of the potential impacts on particular sensitive groups.

It does, however, show that there are some more general impacts which can be reasonably predicted. These are sleep disturbance, disturbance to voice communication, community annoyance when disturbed by aircraft noise and devaluation of housing values.

Disturbance to Sleep

Intermittent environmental noise such as aircraft noise, at sufficiently high levels, is known to result in various forms of sleep disturbance, including awakenings, changes to a lighter stage of sleep, additional time to get to sleep, tiredness the following morning, and increased use of sedatives and other medications. However, the relationship between these effects and physical aspects of the noise exposure is much less certain than for disturbance to communication. Only in the case of awakenings and, with less certainty, changes to a lighter stage of sleep, does sufficient data exist to provide a reasonably precise prediction of the level of impact. However, these two reactions can generally be taken as indicative of the extent of sleep disturbance overall.

It is usually agreed that significant sleep disturbance is unlikely for noise events with an internal noise level of below approximately 50 dBA. This corresponds to an external level of approximately 60 dBA if bedroom windows are open to a typical extent. Hence, the number of night-time events with levels exceeding 60 dBA provides one measure of the potential extent of sleep disturbance.

Although no authority in Australia sets out standards for assessment of 'acceptable' levels of sleep disturbance due to noise, a number of guidelines have been prepared by environmental bodies and by individual researchers throughout the world. These can all be expressed approximately in terms of values of the Sleep Disturbance Index – an index which represents the predicted number of awakenings due to the noise per night, but which can also be related to numbers of changes to a lighter stage of sleep. The guidelines vary widely in their severity, from a Sleep Disturbance Index value of approximately 0.04 (one awakening each 25 nights) to greater than 0.2 (one awakening each five nights). This reflects a diversity of views as to what represents an appropriate criterion for protection against significant sleep disturbance.

Disturbance to Communication

Impacts on communication are relatively straight-forward, in that noise from aircraft may drown out the sound of conversation, television, radio, or other forms of communication. For normal domestic conversation indoors, if the external windows of a room are open to a typical extent, an external noise level of approximately 70 dBA is sufficient to disrupt communication. Hence, the number of aircraft noise events per 24-hours which have maximum levels greater than 70 dBA provides an indication of the severity of this type of impact.

Within a school classroom, an external noise level of 65 dBA is sufficient to disrupt communication with a class, and hence for communication within schools the number of events between 9 am and 3 pm which exceed 65 dBA provides a better indication of the severity of impacts on communication within schools. Results from two studies indicate that for approximately 10 events per school day greater than 65 dBA, disruption to classroom communication is likely to be minimal, but at higher exposure the impact becomes significant.

The above discussion relates to a typical resident or school classroom. For specific susceptible groups, notably the hearing impaired, the elderly, young children, and people for whom English is not their first language, interference to communication may occur at lower noise levels.

Noise Reaction (Annoyance)

Reaction to noise is a very commonly studied form of noise impact, and is related to people's overall feelings of annoyance, dissatisfaction, or similar feelings toward the noise environment. It is related both to the maximum loudness of the noise during an overflight, and the number of times per day when the noise is heard. The ANEC unit provides a measure of the number of people 'seriously affected' and 'moderately affected' by aircraft noise, in a 'steady-state' situation – that is, where noise exposure in an area has not changed significantly.

Where a source has been newly introduced into an area, higher levels of reaction can be expected. The exact size of the additional reaction which can be expected is not clear from available research, but there is some indication that it may be equivalent to a difference of about 8 ANEF points in noise exposure. That is, reaction to a newly-introduced source at, say, 20 ANEC would be equivalent to reaction to a 'steady-state' source at 28 ANEC.

Effects on Property Values

Research has shown that noise from overflying aircraft can reduce residential property values in areas affected by high levels of aircraft overflight noise. Analysis of previous research and additional surveys carried out allow forecasts to be made of potential changes in property values that might result from the operation of the proposed Second Sydney Airport. These are shown in *Table 8.19*.

Table 8.19 Housing Price Devaluation Factors

ANEC Band[1]	Devaluation Range	Assumed Devaluation[2]
Under 15	Nil	Nil
15-20	0 to -6%	-3%
20-25	-5.9% to -13.6%	-8%
25-30	-8.6% to 19.6%	-15%
30-35	-10.9% to -24.3%	-20%

Notes:
1. *No devaluation estimates for ANEC greater than 35 because dwellings located in this noise level are assumed to be acquired.*
2. *Compared to under 15 ANEC.*

Other Effects of Aircraft Overflight Noise

Studies on the reaction of people visiting natural areas to aircraft noise have been reviewed. The most meaningful information indicates that people in these areas are approximately 10 dB more sensitive to aircraft noise than those in residential areas.

There is no clear relationship between the behaviour of wildlife and aircraft noise levels. This is because of the diverse reaction that could occur across the different species and the different noise levels and character of noise that might be experienced. The review of studies of this type of impact indicates that it is not possible to quantify the overall impact of aircraft overflight noise from the Second Sydney Airport on fauna in natural areas in the region surrounding the sites of the Second Sydney Airport options.

The effects of aircraft noise on agricultural livestock has not been extensively researched in Australia, with most studies relating to the effects on sheep and cattle. There have, however, been several important studies conducted overseas, which include the effects of noise on poultry. This matter is discussed further in *Chapter 15* of this Supplement.

Under *Australian Standard 2021*, and directions released by the NSW Department of Urban Affairs and Planning, land use around airports in NSW is controlled according to the ANEC level. Areas with ANEC greater than 25 are considered 'unacceptable' for new residential or other noise-sensitive development, areas with ANEC less than 20 are considered 'acceptable', and areas with ANEC between 20 and 25 are considered 'conditionally acceptable', which means that new developments are acceptable provided that appropriate noise controls are incorporated into the design of the structure.

8.9.4 Calculation of Aircraft Overflight Noise

Consistent with the recommendations of the 1995 Senate Select Committee on Aircraft Noise in Sydney, a range of indicators has been used to describe the potential impacts of aircraft overflight noise. These impacts are described in detail in the Draft EIS and this Supplement, including noise level predictions for each Community Assessment Area.

The number and noise level of aircraft overflights was calculated for each of the three airport options, three aircraft movement forecasts and two or three airport operations. This gives a range of possible noise impacts at any point, for any of the airport options. The Draft EIS calculated values for two years, 2006 and 2016. The Draft EIS assumed that the forecast of 30 million passengers per year would be reached in 2016. As described in *Chapter 4* of this Supplement this volume of passenger movements would not be likely to be reached until much later. Accordingly, because the populations affected by overflight noise are based on projections to 2016 the noise impacts described in this Supplement are considered to be conservative worst case impacts. Calculations used the standard INM aircraft noise prediction model, and were based on aircraft movement forecasts derived for the Draft EIS.

In general, noise exposure is presented based on the average number of aircraft movements per day. However, to indicate the likely extent of daily and seasonal fluctuations about this average, contours of N70 (the number of movements per day exceeding 70 dBA) are also presented for a 'worst day', and for the summer and winter periods.

Three basic tools are used to present the results of the assessment. They are:

- noise contours display the areas within which certain noise levels are exceeded. This technique is used to show values of N70 (the number of events per 24-hours exceeding 70 dBA – related to communication disturbance); N60 (night-time) (related to potential sleep disturbance); and ANEC, as well as several other descriptors;
- detailed descriptions of noise exposure are provided for each of 85 Community Assessment Areas around the airport site. In some cases these areas are further sub-divided to provide more accurate definition of the noise climate within each area; and
- summary tables list the population exposed to various noise levels, based on estimated population in the relevant future year.

8.9.5 Aircraft Overflight Noise Impacts

The Draft EIS and this Supplement contain both quantitative predictions and qualitative discussions of the potential impacts of aircraft overflight noise. These include:

- sleep disturbance;
- disturbance to voice communication either in a residential situation or within educational facilities;
- property devaluation;
- impacts on health;

- impacts on natural areas and wildlife; and
- impacts on land use planning.

The impact assessment is based on a range of possible air traffic movement forecasts and airport operation scenarios. These have been developed with no explicit consideration of reducing impacts on environmental grounds. Consequently, the impact assessment generally presents a likely worst case situation.

The Supplement provides an analysis of a potential noise management strategy which adopts a set of airport operations and flight paths which may reduce the level of impact. This analysis was carried out to assess the potential reduction in impacts that may result from the future implementation of a noise management strategy for each airport option.

Disturbance to Sleep

Table 8.20 summarises the potential for each airport option to disturb sleep with the airport operating at 30 million passengers per year. The table provides an estimate of the frequency of awakenings that may impact on people due to average operations of the airport options. Also provided is the 'worst case' prediction of the number of people affected by noise events exceeding 60 dBA during the night (10.00 pm to 6.00 am). An external noise level of 60 dBA approximates an internal level of 50 dBA with windows open, which is within the range generally accepted as the point at which sleep disturbance impacts may arise.

Table 8.20 Summary of Predicted Disturbance to Sleep for the Airport Operating at 30 Million Passengers Per Year

Noise Indicator	Population Affected[1 2]		
	Option A	Option B	Option C
People who may, on average, be awoken the following times:			
once a night	less than 100	less than 100	less than 100 to 100
once every 2 nights	500 to 1,000	300 to 800	400 to 600
once every 5 nights	6,000 to 8,000	3,500 to 6,000	1,500 to 17,000
People who may experience the following number of noise events greater than 60 dBA on a worst case night:			
greater than 5 events	18,000 (4,500)[3]	19,000 (4,500)[3]	47,000 (2,000)[3]
greater than 2 events	124,000 (60,000)[3]	108,000 (39,000)[3]	178,000 (48,000)[3]

Notes:
1. Based on population projections for 2016.
2. There are limitations on the accuracy of predicting future populations and predicting future aircraft noise levels. Estimates of population greater than 10,000 have been rounded to the nearest 1,000; estimates of population between 1,000 and 10,000 have been rounded to the nearest 500; and estimates of populations less than 1,000 have been rounded to the nearest 100. Estimates of populations less than 100 are expressed as less than 100.
3. Figures in brackets represent impacts with the adoption of potential noise management measures. NR means no reduction in impact.
4. Impacts of levels of ANEC assume all residential properties within the 35 ANEC contour would be acquired.

While Option C has the potential to create the greatest disturbance to sleep, it also would have the greatest potential for a reduction in impacts with the implementation of noise management measures.

Disturbance to Communication

Table 8.21 summarises the impacts of aircraft overflight noise from all airport options on communications within residential situations when the airport is operating at 30 million passengers per year. *Table 8.22* summarises the potential impacts on existing educational facilities for each airport option. *Appendix* C2 provides a list of schools that would be impacted by the higher levels of noise.

Table 8.21 Summary of Predicted Disturbance to Communication for the Airport Operating at 30 Million Passengers Per Year

Noise Indicator	Population Affected[1,2]		
	Option A	Option B	Option C
People that may experience, on average, the following number of noise events over 70 dBA a day:			
greater than 100 events	400 to 900 (NR)[3]	300 to 700 (NR)[3]	300 to 500 (NR)[3]
greater than 50 events	2,500 to 5,000 (1,500)[3]	2,000 to 4,000 (NR)[3]	700 to 1,000 (NR)[3]
greater than 20 events	8,500 to 9,500 (5,000)[3]	7,000 to 9,500 (NR)[3]	6,000 to 17,000 (NR)[3]
greater than 10 events	15,000 (10,000)[3]	16,000 to 17,000 (NR)[3]	60,000 to 72,000 (32,000)[3]

Notes:
1. *Based on population projections for 2016*
2. *There are limitations on the accuracy of predicting future populations and predicting future aircraft noise levels. Estimates of population greater than 10,000 have been rounded to the nearest 1,000; estimates of population between 1,000 and 10,000 have been rounded to the nearest 500; and estimates of populations less than 1,000 have been rounded to the nearest 100. Estimates of populations less than 100 are expressed as less than 100.*
3. *Figures in brackets represent impacts with the adoption of potential noise management measures. NR means no reduction in impact.*
4. *Impacts of levels of ANEC assume all residential properties within the 35 ANEC contour would be acquired.*

Table 8.22 Aircraft Overflight Noise Impacts on Existing Educational Facilities for the Airport Operating at 30 Million Passengers Per Year[1,2]

Noise Indicator	Educational Facilities		
	Option A	Option B	Option C
Educational facilities that may experience, on average, the following number of noise events over 65 dBA[2] between 9.00 am and 3.00 pm:			
greater than 20 events	15 (5)[3]	13 (2)[3]	25 (3)[3]
greater than 10 events	20 (14)[3]	20 (11)[3]	75 (26)[3]

Notes:
1. *Definition of educational facilities has been expanded to include childcare centres.*
2. *65 dBA is level at which communication within educational buildings would be disturbed.*
3. *Figures in brackets represent impacts with the adoption of potential noise management measures. NR means no reduction in impact.*

Figures 8.27 to 8.35 show N70 contours for a 'worst day' for each airport option and N70 contours for summer and winter variations. The worst day contours should be interpreted with caution, because the number of days on which 'worst day' noise impacts would be experienced would vary greatly at different locations within the contours. In areas affected by noise from the parallel runways, impacts could occur on up to 50 percent of all days. For areas affected by cross-wind runway operations, 'worst day' noise exposure could be expected to occur on as little as one day in two years, or less.

Noise Reaction (Annoyance) and Land Use Planning

Table 8.23 provides a summary of predicted populations impacted by ANEC levels when the airport is operating at 30 million passengers per year. It also shows the populations that may be affected if noise management measurements are adopted. In estimating likely levels of noise reaction from these values, allowance must be made for the additional reaction to the introduction of a new noise source.

Table 8.23 Population Impacted by ANEC Levels for the Airport Operating at 30 Million Passengers Per Year

Noise Indicator	Population Affected[1,2]		
	Option A	Option B	Option C
People that may experience the following ANEC Levels:			
greater than 30	200 (NR)[3]	less than 100 to 200 (NR)[3]	less than 100 to 300 (NR)[3]
greater than 25	700 to 1,000 (NR)[3]	500 to 800 (400)[3]	300 to 700 (NR)[3]
greater than 20	4,500 to 6,000 (2,500)[3]	3,500 to 5,000 (2,000)[3]	900 to 1,500 (NR)[3]
greater than 15	11,000 to 14,000 (8,000)[3]	11,000 to 14,000 (7,500)[3]	15,000 to 19,000 (10,000)[3]

Notes:
1. *Based on population projections for 2016*
2. *There are limitations on the accuracy of predicting future populations and predicting future aircraft noise levels. Estimates of population greater than 10,000 have been rounded to the nearest 1,000; estimates of population between 1,000 and 10,000 have been rounded to the nearest 500; and estimates of populations less than 1,000 have been rounded to the nearest 100. Estimates of populations less than 100 are expressed as less than 100.*
3. *Figures in brackets represent impacts with the adoption of potential noise management measures. NR means no reduction in impact.*
4. *Impacts of levels of ANEC assume all residential properties within the 35 ANEC contour would be acquired.*

Impacts on Property Values

The effect of aircraft noise on residential property values provides a basis for comparing the airport options. It does not provide a precise measure of possible devaluation for individual properties. The analysis addresses only the direct impacts on dwellings in areas potentially affected by noise levels of greater than 15 ANEC. There is also likely to be more indirect impacts on property values such as changes to the future development potential of land in the region surrounding the airport.

The estimated net direct residential property devaluation for each airport option is shown in *Table 8.24*.

Table 8.24 Estimated Net Direct Residential Property Devaluation[1]

Airport Option	2016 Net Devaluation[2]
Option A	$49m to $67m
Option B	$52m to $60m
Option C	$25m to $31m

Notes:
1. *All results are expressed in real 1996 dollars.*
2. *Figures rounded to nearest $ million.*

Impacts on Wildlife and Natural Areas

Only an limited amount is known about the effects of noise on wildlife. This is because of the diverse reaction that could occur across different species, and the different levels and character of noise that might be experienced. It is therefore not possible to quantify the relationship between the levels of aircraft overflight noise and impacts on wildlife.

Noise associated with the airport options has the potential to affect wildlife in the Blue Mountains National Park and the natural areas south of Lake Burragorang. However, in these areas the noise levels would generally be relatively low, and overflights would be infrequent.

Options A and B may generate up to 25 aircraft overflights a day exceeding 70 dBA, and up to five exceeding 80 dBA in some areas of the Blue Mountains National Park. South of Lake Burragorang, fewer overflights would occur, with about 15 exceeding 70 dBA and one or two exceeding 80 dBA. At these levels, it is unlikely that there would be significant effects on wildlife in these areas.

Option C would have a lower effect than the first two options. Within the two natural areas it is expected that no overflights would exceed 80 dBA, while up to seven or eight overflights daily would exceed 70 dBA. This level of noise is unlikely to have an adverse effect on wildlife.

Although the likely effect of aircraft noise on domestic animals and birds is not clearly understood, there is some evidence that some animals located under flight paths, such as horses and chickens, might be affected. This is particularly so in areas close to the airport boundaries.

It is reasonable to assume, and some studies have suggested, that people visiting natural areas are likely to have a greater reaction to aircraft noise than people in normal everyday environments. Depending on the airport option, up to 25 flights a day over the Blue Mountains could exceed 70 dBA, with up to five of these flights potentially exceeding 80 dBA. The Bents Basin State Recreation Area located to the south-west of the airport site could experience up to 130 overflights with noise levels greater than 70 dBA per 24-hours with the airport operating at 30 million passengers per year.

8.9.6 Conclusions

The impacts of aircraft overflight noise are presented through the use of contours, information on potential impacts for individual communities (Appendix D of the Draft EIS) and data contained in summary tables.

The impacts of the three airport options vary depending on which noise indicator is examined. For many of the indicators only small differences between the potential impacts of the options would exist. For example, the impacts would be similar for the higher and mid-range noise levels modelled (say above 15 ANEC or more than 20 noise events a day greater than 70 dBA). At the lower noise levels (10 noise events a day greater than 70 dBA), however, it can be concluded that Option C is likely to impact more people than Options A and B. The potential implementation of noise management measures could significantly reduce the level of impact for the lower noise levels modelled, particularly for Option C. When all levels of noise impacts and the potential for a reduction in impacts through the implementation of noise management measures are taken into consideration, it is not possible to provide a definitive ranking between airport options.

It is also the case that methods available to quantify the degree of noise impact for each option are not precise enough to provide a definitive ranking. For example, the actual airport operations have yet to be precisely defined and the knowledge of the relationship between the noise indicators and the response of effected communities is relatively limited.

The three airport options would result in different noise levels from aircraft overflights to individual communities. The relative impacts of these differences would depend on individual reactions. Information is contained in Appendix D of the Draft EIS to provide an indication of potential impacts such as disturbance to communication and sleep on residents living in particular communities.

Recent studies suggest a quantifiable relationship between health impacts and relatively high levels of noise. Analysis of these impacts suggest that noise management measures, at a minimum, should be considered for several schools located immediately surrounding the airport sites and residents located within areas most severely affected by aircraft overflight noise.

Other impacts of aircraft overflight noise identified in the Draft EIS and Supplement include impacts on property values, wildlife and agricultural production.

The impacts of aircraft overflight noise from each airport option could be reduced by the adoption of noise management measures. The most effective measures would be the adoption of procedures such as refining flight paths and restricting some types and times of runway and flight path use to minimise overflying of residential areas, particularly at night.

Chapter 9

Other Noise Impacts

Chapter 9
Other Noise Impacts

9.1 Summary of the Draft Environmental Impact Statement

9.1.1 Ground Operation Noise

The greatest impact from noise generated within the airport is expected to be that from ground running of large aircraft. The impact of this noise was reported in the Draft EIS in the form of noise contours for a Boeing 747 aircraft running up under high power conditions. Although a directional noise pattern is expected around such an aircraft, the orientation of the aircraft during run up would vary as a result of a number of environmental conditions. Accordingly, the noise contours were based on maximum noise levels in all directions.

Noise contours were provided for two meteorological conditions: neutral conditions and temperature inversion conditions. The temperature inversion conditions are considered appropriate for night-time ground running, which is expected to cause the greatest noise impact. Based on Environment Protection Authority guidelines, the level of intermittency of the noise and the background noise levels measured in the surrounding area, a noise criterion of 50 dBA was set for night-time.

The area identified as potentially affected by ground running noise at night includes the rural and rural residential areas surrounding the sites of the airport options, in addition to the villages of Luddenham to the north-west, Badgerys Creek and Rossmore to the east, Bringelly to the south and Greendale, Silverdale and Warragamba to the west.

The potential methods for mitigating ground running noise identified in the Draft EIS included a limitation on night-time ground running and the provision of noise shielding by building location or by special construction.

9.1.2 Construction Noise

Construction of the airport is likely to generate substantial noise. Large earth moving equipment during the earth works stage, such as scrapers and trucks, produce high noise levels which can propagate to the surrounding area.

The Draft EIS reported the impact of the earthworks associated with construction of the first parallel runway during day time. Noise calculations were carried out for both neutral and temperature inversion conditions and the noise contours for neutral conditions were included in the Draft EIS as applying to day time.

A noise criterion of 45 dBA was set for assessment of construction noise, based on Environment Protection Authority guidelines. Noise levels above 45 dBA were shown to be contained almost totally within the airport boundary.

9.1.3 Road Traffic and Rail Noise

Road access to the Second Sydney Airport would mostly be along existing roads. Many of these roads would need to be upgraded to accommodate the additional road traffic. The impact of airport traffic on these roads was assessed in general terms in

Chapter 13 of the Draft EIS. An increase in road traffic noise level of two dBA was adopted as the criterion for noise assessment. This would be appropriate for the upgrading of new roads, as such an increase in traffic noise levels would generally not be noticeable.

The increase in noise expected on most roads affected by airport traffic was predicted to be less than the two dBA criterion. However, at some locations along Bringelly Road, Camden Valley Way, Denham Court Road, Devonshire Road, Elizabeth Drive, Fifteenth Avenue, Luddenham Road, Mamre Road and the Northern Road noise increases are expected to be greater than two dBA.

Where required to meet the two dBA increase, a quiet road surface or roadside noise barriers could be used for noise amelioration.

As a result of a new rail link most likely to be constructed to a Second Sydney Airport, increased train movements would be expected on a number of existing lines.

Noise levels on most existing rail lines affected by the airport would be expected to increase less than the two dBA criterion adopted in the Draft EIS. The only exception is the East Hills rail line where greater increases would be expected.

The impact of noise associated with a newly constructed rail link would depend on the alignment of the link. Noise levels could be controlled to comply with Environment Protection Authority guidelines by careful alignment during the design stage and the use of noise barriers.

9.2 Summary of Issues Related to Other Noise Impacts

9.2.1 Issues Raised in Submissions

Concerns raised in submissions regarding ground operation noise related to the adopted methodology, the identification of noise impacts and the management of those impacts. For instance, it was suggested that aircraft are normally run-up at high power prior to taking-off resulting in a continuous noise which is not intermittent. Accordingly, the assessment methodology used for this type of noise should not have allowed for an intermittency.

Management of Ground Operation Noise

Concern was also expressed in submissions that inadequate consideration had been given to the high frequency of the occurrence of temperature inversions in the prediction and assessment of ground running noise. The Draft EIS was also considered to have inadequately addressed the control and management of ground running noise.

Construction Noise

Communities Against an Airport in Western Sydney, the Western Sydney Alliance and others who made submissions on the Draft EIS considered that the assessment of construction noise was cursory and insufficient detail had been provided. In addition to general concerns expressed in submissions regarding the impacts of construction noise, it was stated that noise monitoring was required.

Noise from Road and Rail Traffic

Both the NRMA and NSW State Government expressed concern in their submissions that noise mitigation measures relating to road and rail access to the Second Sydney Airport had not been specified in the Draft EIS. Further, concern was expressed by the NRMA, and in other submissions, that the impact of noise from road and rail access to the airport had not been adequately considered and more detail was required regarding the impact of rail noise.

9.2.2 Issues Raised by the Auditor

No specific issues were raised by the Auditor in respect to the impacts of ground operation noise, construction noise or noise from road and rail traffic. The Auditor's report indicated that noise and vibration impacts should be assessed in accordance with the Environment Protection Authority's guidelines.

9.3 Response to Other Noise Impact Issues

9.3.1 Further Analysis of Ground Operation Noise

Frequency of Ground Operations

During major engine maintenance, it is normal procedure to remove the jet engine from the aircraft and to carry out tests on the completion of maintenance in a purpose built facility. However, when minor maintenance is required, it is mandatory on completion to test the engine when it is mounted on the aircraft.

The running of engines while they are fitted to the aircraft not associated with the actual departure or arrival of an aircraft at an airport is called engine ground running. Ground running is carried out as part of the mandatory maintenance of aircraft engines to ensure their safe operation. There are certain maintenance activities, associated with the setting up and trouble shooting of aircraft engines, which can only be carried out with the engine fitted on a wing. In many cases, the running of engines is mandatory for compliance with regulatory requirements to clear the engines for flight and, to facilitate this testing, an engine run-up bay is normally used. This normally occurs prior to the next scheduled flight of the aircraft.

Historical information from Sydney Airport (Mitchell McCotter and Associates, 1994a) has been used to make an estimate of the number of ground running operations that would occur at the Second Sydney Airport. Sydney Airport records for 1992 show that 36 high power ground running operations occurred at night-time during the year, with an average duration on high power of one minute. Since there is forecast to be more aircraft movements at the Second Sydney Airport when it is handling 30 million passengers per year the number of night-time operations was firstly estimated by scaling the Sydney Airport number up in proportion to the total number of movements. This gave an estimate of 48 night-time operations on high power per year. It would be expected that the average duration of one minute on high power would be maintained.

However, an aircraft operational curfew applies at Sydney Airport and it may be the case that no curfew would apply at the Second Sydney Airport. Accordingly, it is possible that more than 48 high power operations would occur per year at the Second Sydney Airport, but the average duration of each high power operation would be maintained at one minute. This represents approximately one high power operation per week and, therefore, it is unlikely that more than one of these operations would occur during any one night.

This analysis confirms the assumptions in the Draft EIS that the noise criterion could be based on an estimated one minute (at the most) per night of ground running on high power. Such operation is intermittent, rather than continuous, and the noise criterion has been confirmed at 50 dBA.

It is anticipated that the ground activity at the airport would, from time to time, generate a relatively continuous noise. This noise might be generated by such things as aircraft taxiing around the airport. However, this type of continuous noise would be at a substantially lower level than that level generated by ground running for maintenance purposes.

Frequency of Temperature Inversions

Chapter 14 of the Draft EIS indicated that temperature inversions would most likely occur at Badgerys Creek on 60 to 75 percent of nights in summer and 60 to 95 percent of nights in winter. During both summer and winter, these frequencies represent a significant percentage of time during the night and the occurrence of a temperature inversion is an appropriate assumption for the assessment of noise from night-time ground running. The Draft EIS correctly assumes the presence of a temperature inversion for the calculation of night-time ground operation noise.

The calculations reported in the Draft EIS for day time ground running were based on neutral conditions (isothermal conditions where temperature is constant with height). This is consistent with the *Draft Policy for Stationary Noise Sources* recently published by the Environment Protection Authority (1998d). This assumption for day time is also considered to be a valid assumption given the direction provided by the Environment Protection Authority.

The effect of a temperature inversion is to focus a sound propagation down to the ground, thereby increasing noise levels at distances from the noise source. The increase depends mostly on the degree of temperature inversion (temperature gradient) and the topography and shielding obstacles between the noise source and the receiver. In the case of ground running at the sites of the airport options, an increase of approximately 10 dBA would result from a temperature inversion (compared with neutral conditions) in all directions around the airport. This effect is demonstrated in Figures 13.1 and 13.2 of the Draft EIS.

Ground Operation Noise Management

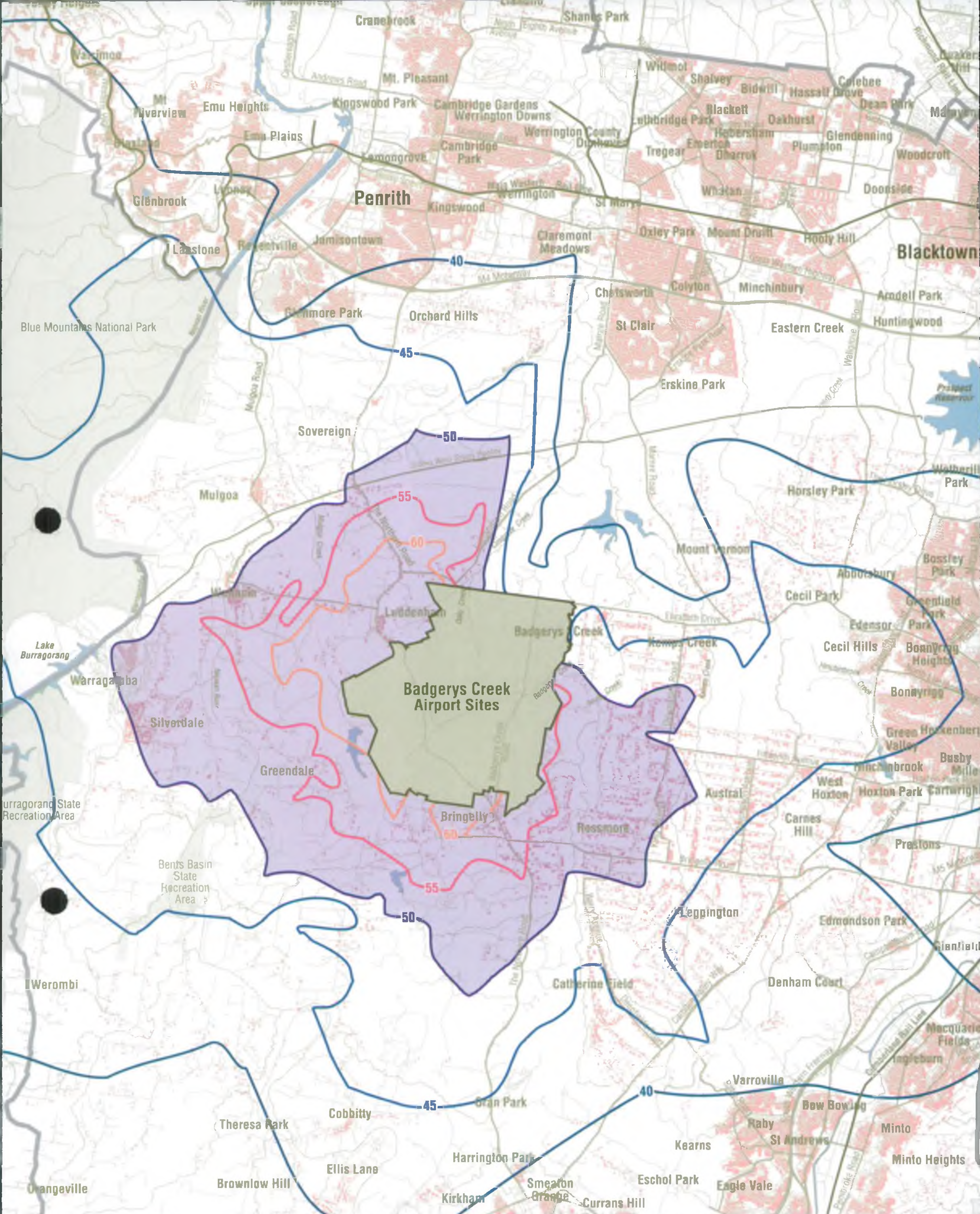
The Draft EIS discussed three methods of managing ground operation noise to reduce the overall impact.

The noise contours for ground operation noise, as shown in Figures 13.1 and 13.2 of the Draft EIS, are based on assuming the noise level emanating from the aircraft in the direction of maximum noise applies all around the aircraft. This approach was taken so that the noise contours derived indicated the greatest noise impact which could occur at any time since the orientation of the aircraft is unknown at this stage and is likely to change from day to day.

However, the noise pattern around an aircraft engine during high power ground running is directional with more noise emanating towards the back than towards the side and front of the engine. Orientation of the aircraft can therefore be used as a method of noise control in some directions when flexibility in orientation exists. When there is a wind blowing, it is common practice to point the aircraft into the wind, but under still conditions any orientation would be suitable.

To indicate the extent of noise reduction that can be achieved in some directions, noise contours have been prepared for a Boeing 747 aircraft oriented with its nose to the south-west. This orientation was chosen since it involves the aircraft pointing into the night-time air drainage from the south-west.

The resultant noise contours for night-time, based on temperature inversion conditions, are shown in *Figure 9.1*. It can be seen that the noise impact in a single



Noise contour measured in dBA —55—

Area predicted to exceed night-time noise criterion of 50 dBA

Indicates density of dwellings in 1996

Extent of dwelling data

Figure 9.1

Ground Operation Noise Contours Assuming Adoption of Management Measures (Night-time - Temperature Inversion Conditions)

direction would be less than that indicated in the equivalent contours based on no directionality (Figure 13.2 in the Draft EIS).

Table 9.1 indicates that a reduction in noise impact in terms of population affected can be gained by orienting the aircraft to the south-west whenever that orientation is practicable. In the case of Option C, the south-west orientation reduces the total population affected above 55 dBA, but increases the population affected in the 50 to 55 dBA band. The reduction in size of the noise contours moves a significant population centre at Rossmore from the higher band (over 55 dBA) to the lower band (50 to 55 dBA), thereby increasing the population within the outer band.

Table 9.1 **Night-time Ground Operation Noise Impacts of Second Sydney Airport Operating at 30 Million Passengers Per Year With and Without Typical Orientation Control[1,2]**

	Population Affected[3]					
	Option A		Option B		Option C	
Noise Indicator	No Control	Orientation Control	No Control	Orientation Control	No Control	Orientation Control
50 to 55 dBA	12,000	10,000	12,000	10,000	10,000	11,000
Over 55 dBA	9,000	4,000	8,500	3,500	5,500	2,000

Note: 1. *This table does not take account of the frequency of impacts.*
2. *Assumes temperature inversion conditions.*
3 *Population projection for 2016. Estimates greater than 10,000 rounded to the nearest 1,000; estimates between 1,000 and 10,000 rounded to the nearest 500; estimates below.*

Under both no-control conditions and control by orientation, the 55 dBA noise contour affects a lower population for Option C than for Options A and B. Although the ground operation noise contours are the same for all options, this difference results from the different future land use scenarios adopted for each airport option. In the case of Option C the development of a potential urban village is assumed in the Rossmore area (outside of the 55 dBA contour), while for Options A and B the potential urban village development is assumed near Bringelly (partly within the 55 dBA contour).

It may be possible to implement a night-time curfew for ground running at the Second Sydney Airport, but the practicality of this form of control would need to be investigated.

Noise shielding could be provided by careful location of the run-up bay relative to airport buildings and/or the erection of a special noise barrier around the run-up bay. A barrier of approximately 10 metres in height close to the run-up bay would provide shielding of approximately 10 dBA in the surrounding area. The noise contours shown in Figure 13.2 of the Draft EIS would therefore reduce by 10 dBA and contract substantially in area. If noise shielding of this type could be provided on all sides of the run-up bay, then the impact associated with ground operation at night would be limited to an area on the western side of the airport, encompassing Luddenham and part of Greendale. This would represent a substantial reduction in noise impact compared with that indicated in the Draft EIS.

9.3.2 Further Analysis of Construction Noise

Cumulative Construction Noise Contours

The construction noise assessment reported in the Draft EIS was based on the major works associated with construction of the first parallel runway. Whilst these major works are expected to generate the most noise of any stage of the construction, other stages of construction may occur closer to the airport's boundary or in positions with the potential to affect the noise environment in specific areas. It is also possible that some runway paving would occur at night.

Since calculation of the noise contours presented in the Draft EIS, more information regarding the stages of construction of the Second Sydney Airport has been developed.

Further calculation of the noise impact of a number of stages of construction has been carried out, including earthworks associated with all runways, construction of the two water quality control ponds in the north-eastern corner and relocation of The Northern Road. *Table 9.2* lists the equipment likely to be used during each construction stage and their sound pressure levels.

Table 9.2 Assumptions Regarding Construction Equipment

Equipment	Sound Pressure Levels	Runway Earthworks	Water Quality Control Pond	Northern Road Relocation
Scrapers	119 dBA	✔	✔	✔
Dozers (D9)	117 dBA	✔	✔	✔
Excavators	115 dBA			✔
Compactors	116 dBA	✔	✔	✔
Grader	110 dBA		✔	✔
Water Cart	112 dBA		✔	✔
Trucks	110 dBA	✔	✔	✔
Front-End Loaders	116 dBA			✔

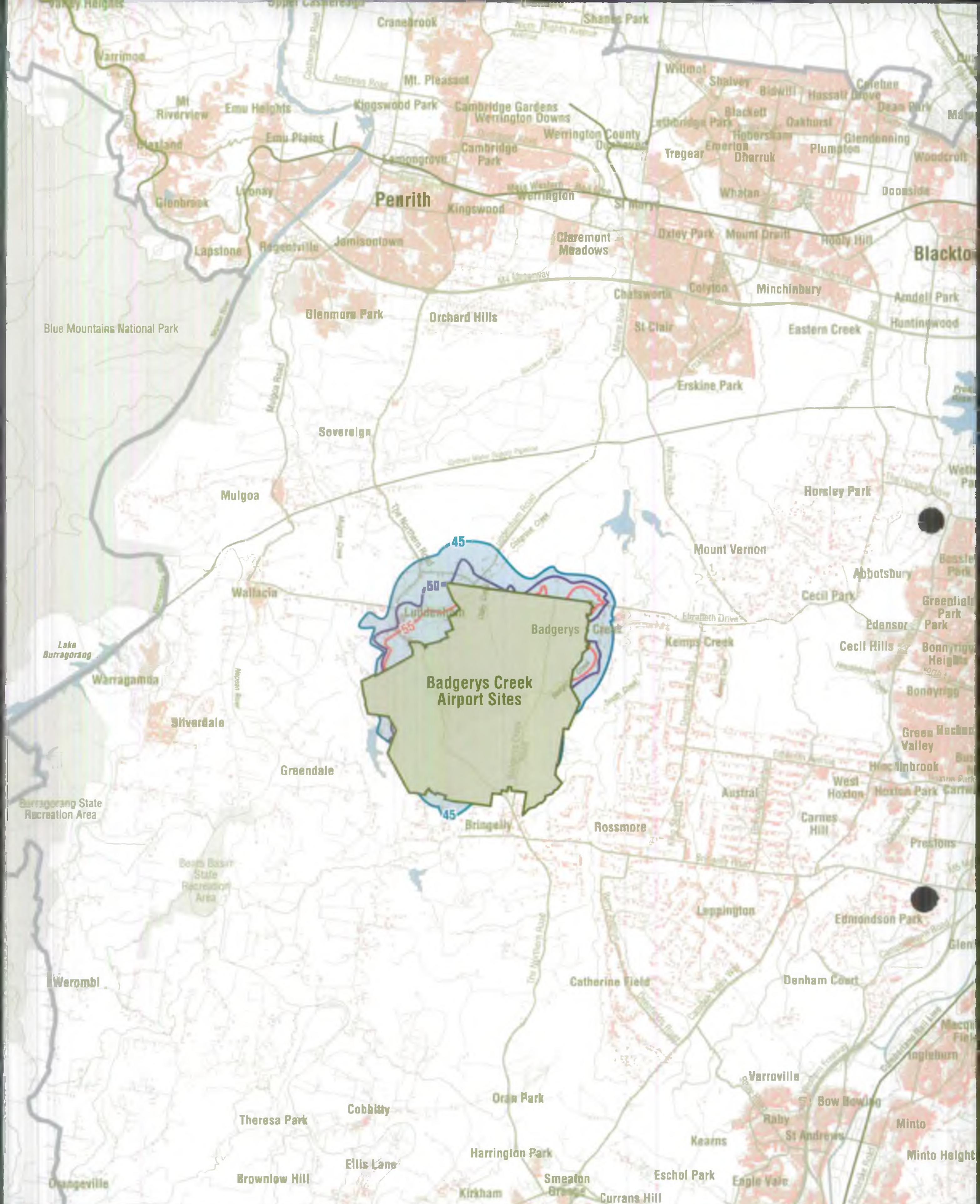
Calculations have been carried out for eleven stages of day time construction associated with runway earthworks, water quality control ponds construction and relocation of The Northern Road. From these stages, cumulative noise contours have been prepared, representing the maximum noise levels that would occur in the surrounding area during the construction of the airport.

Construction work at the airport site would be undertaken between the hours of 7.00 am and 5.00 pm daily, Monday to Saturday. Sunday work would be required from time to time to maintain the construction schedule and may involve the use of heavy plant and equipment. Work outside these hours may include early starting at 6.00 am in the summer months. It may also occasionally be necessary to work until as late as 9.00 pm to complete major concrete pours and other time-critical activities.

The major concrete and asphaltic paving operational to the runways, taxiways and aprons may be undertaken 24 hours per day. These operations require intense use of specialist construction equipment so there are significant advantages in operating two shifts daily.

Calculations have been carried out assuming that trucks, compactors and pavers would be used at a number of locations along the proposed runways. Again, cumulative night-time noise contours have been prepared.

The daytime and night-time noise contours are shown in *Figures* 9.2 and 9.3. The daytime noise contours assume neutral atmospheric conditions, while the night-time contours assume temperature inversion conditions, based on the information discussed in *Section 9.3.1* (relating to ground operation noise).



Noise contour measured in dBA —55—

Area predicted to exceed daytime noise criterion of 45 dBA

Indicates density of dwellings in 1996

Extent of dwelling data

Figure 9.2

Cumulative Construction Noise Contours for Option A, B, and C (Daytime - Neutral Conditions)

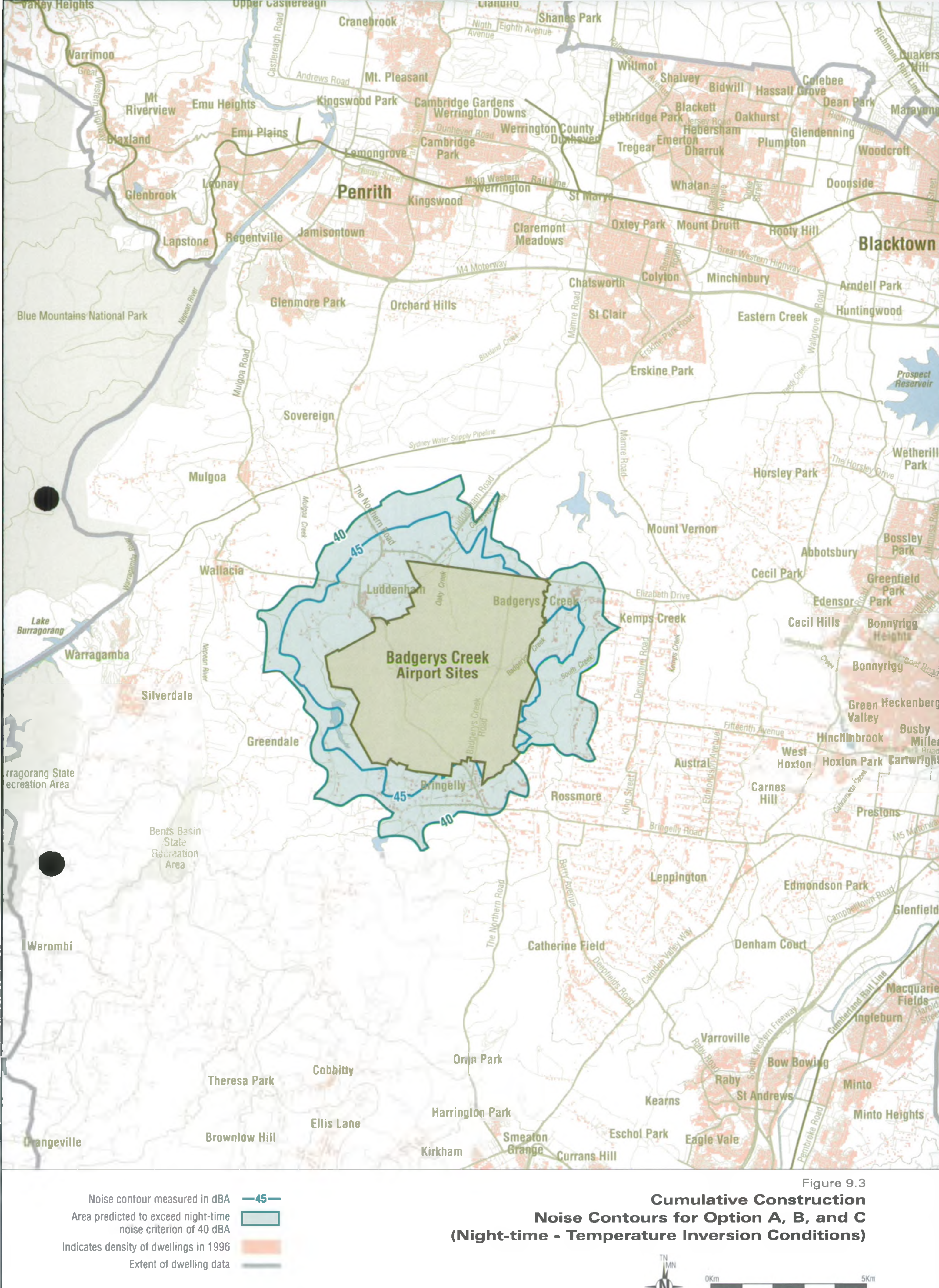


Figure 9.3
Cumulative Construction Noise Contours for Option A, B, and C (Night-time - Temperature Inversion Conditions)

The noise criterion identified in the Draft EIS for daytime construction noise is 45 dBA. This criterion was based on the Environment Protection Authority (1994a) noise guidelines, as detailed in the Draft EIS.

The 45 dBA daytime noise contour in *Figure* 9.2 extends beyond the airport boundary over rural areas and also over Luddenham. A population of approximately 1,200 presently lives within the 45 dBA contour and approximately 450 of these people live within the 50 dBA contour. Therefore, there is potential for up to 1,200 people to be disturbed by construction noise from time to time during some phases of construction during the day.

At night-time, the construction noise criterion would be 40 dBA, five dBA above the adopted background noise level in this area. This criterion is again consistent with Environment Protection Authority guidelines (1994a).

The noise contours in *Figure* 9.3 show that the 40 dBA noise contour extends well outside of the airport boundary, extending over Luddenham and Bringelly as well as areas of relatively sparsely populated land. Currently, there is a population of approximately 2,700 people within the 40 dBA contour and approximately 800 of these people live within the 45 dBA contour. Therefore, there is potential for up to 2,700 people to be disturbed by construction noise from time to time during some phases of night construction work.

So as to control the degree of construction noise impact, a construction noise management plan would be prepared before the commencement of construction. This Plan would identify appropriate time restrictions for noisy operations, engineering noise controls that can be adopted and the noise monitoring regime.Road traffic associated with the construction phase was not assessed in the Draft EIS. Trucks travelling to and from the airport site during construction have the potential to create a noise impact along the main access roads. At this stage in the planning process, limited information is available regarding truck routes and truck numbers (as this would depend on the future construction contractor).

Construction Traffic Noise

It has been estimated (refer *Chapter* 19 of this Supplement) that up to 900 truck movements would be generated by the construction of the airport. These movements would occur over the construction time period of 7.00 am to 5.00 pm resulting in an average of 90 truck movements per hour.

The main purpose for truck access would be to deliver materials, particularly concrete and quarry materials, for construction purposes. At this stage, the source of such materials is not known, but some assumptions have been made regarding the direction of truck travel. At some stage during the construction process it is likely that the following major roads would carry the following percentages of forecast truck movements:

- The Northern Road, north of Elizabeth Drive — 5 percent;
- Elizabeth Drive — 10 percent;
- The Northern Road between Elizabeth Drive and Adams Road — 15 percent;
- The Northern Road between Adams Road and Bringelly Road — 85 percent; and
- Bringelly Road, south of The Northern Road — 80 percent.

These truck movements would result in noise level increases during any hour period, depending on the existing traffic flow during that period. The increases may be compared with the two dBA increment discussed in the Draft EIS for assessment of road traffic noise.

The increase in noise levels have been calculated for each of the 10 hours of the operational day between 7.00 am and 5.00 pm. Generally, increases of less than two dBA are likely to result. However, on Bringelly Road traffic noise levels are likely to increase by more than two dBA as a result of construction traffic during all construction hours. Increases of up to 4.4 dBA during midday to 1.00 pm are to be expected.

On The Northern Road between Adams Road and Bringelly Road, the increases are likely to marginally exceed the two dBA increment between 11.00 am and 2.00 pm.

Where the two dBA increment is likely to be exceeded, a noise impact on adjacent residents is likely. This impact can be reduced by controlling truck numbers within certain hours or by treating the road with roadside noise barriers or a low noise road surface.

9.3.3 Review of Road and Rail Traffic Noise

The Draft EIS identified a number of roads leading to the Second Sydney Airport where traffic noise levels are expected to increase significantly as a result of airport operation. It also identified the likely impact from a new rail link and existing rail lines serving the airport.

At this stage of the planning process, very limited information is available regarding road and rail routes and associated traffic and it is not possible to do a more detailed noise assessment. Any road upgrade (which is likely to be required to allow substantial road traffic flow increases) and any new rail links would be the subject of future environmental impact assessments. These assessments would address in detail the noise impact associated with the proposal.

During preparation of the Draft EIS a paper was prepared regarding the noise assessment of road and rail proposals associated with the proposed airport. This paper was included as Appendix B to *Technical Paper No. 3*. That information is now summarised so as to provide more information than was included in the Draft EIS.

Road Traffic Noise

On the assumption that traffic to the airport would primarily use existing roads, the noise assessment criterion was set as an incremental two dBA increase on existing levels.

Based on preliminary traffic forecasts, a number of roads have been identified as likely to be affected by a noise level increase of more than two dBA as a result of airport traffic when the airport handles 30 million passengers per year. These roads with the estimated increase are shown in *Table* 9.3.

Table 9.3 Noise Impact of Traffic Generated by Second Sydney Airport Operating at 30 Million Passengers Per Year[1]

Road	Section	Noise Level Change (dBA)
Bringelly Road	East of Northern Road	7
Bringelly Road	East of Kings Street	6
Bringelly Road	West of Kings Street	7
Bringelly Road	East of Cowpasture Road	6
Bringelly Road	West of Cowpasture Road	2
Camden Valley Way	South of Bringelly Road	2
Denham Court Road	East of Camden Valley Way	2
Devonshire Road	South of Elizabeth Drive	3
Elizabeth Drive	West of Wallgrove Road	3
Elizabeth Drive	West of Badgerys Creek Rd	6
Elizabeth Drive	West of Devonshire Road	5
Elizabeth Drive	West of Mamre Road	4
Fifteenth Avenue	West of Cowpasture Road	3
Luddenham Road	North of Elizabeth Drive	11
Mamre Road	South of M4	4
The Northern Road	North of Elizabeth Drive	2
The Northern Road	North of Bringelly Road	4

Note: 1 Only increases in traffic noise at two dBA or greater shown.

To eliminate the impact of an increase in noise level exceeding two dBA, the use of a quiet road surface, such as open graded asphaltic concrete, would be sufficient in most cases. In other cases, consideration would be given to the placement of roadside noise barriers to provide noise shielding. Where noise barriers cannot be provided, insulation of dwellings could also be considered.

Rail Noise

Since it is proposed to construct a new rail link to the Second Sydney Airport, noise criteria have been identified for a rail link and also for an existing rail line where rail traffic would increase. For the new link, an overall L_{Aeq}, 24-hour noise criterion of 55 dBA has been set for residential premises (Environment Protection Authority, 1985). For existing rail lines, an incremental increase of two dBA has been set.

For existing lines affected by increased train movements generated by the Second Sydney Airport, the increase in level has been identified and described in *Technical Paper No. 3*. Areas along the East Hills Line would experience increases in noise levels of more than two dBA, up to a maximum six dBA increase.

In regard to the new link, *Table 9.4* shows overall noise levels expected at three distances from the line. These levels are based on calculation of passenger train movements.

Table 9.4 Overall Noise Levels from New Rail Access Link to the Second Sydney Airport

Distance from Rail Link	Overall Noise Levels (dBA)
20 metres	60
50 metres	55
100 metres	52

It can be seen that the noise level criterion would be met at a distance of approximately 50 metres, assuming no shielding between the rail link and the residential location.

It may be possible to align the rail link so that there are no residences closer than 50 metres to the rail line. Where this is not possible, the criterion could be achieved by the erection of noise barriers adjacent to the rail link. It would be appropriate for planning controls to be put in place to prohibit the future development of dwellings within 50 metres of the rail link.

9.4 Overview of Other Noise Impacts

9.4.1 Ground Operation Noise

Apart from aircraft overflight noise discussed in *Chapter* 8 of this Supplement, people living around the airport may be affected by noise generated at the airport itself as a result of such activities as taxiing, the application of reverse thrust and ground test running of aircraft engines. The noise from engine test running has the greatest potential to affect the surrounding area, particularly during high power run-up and at night-time when background noise levels are low and noise can be readily transmitted as a result of probable temperature inversions.

Table 9.5 shows the number of people that are likely to be affected by engine test running at night-time, from time to time depending upon the orientation of the aircraft being tested.

Table 9.5 Night-time Ground Operation Noise Impacts of Second Sydney Airport Operating at 30 Million Passengers Per Year

Noise Indicator	Population Affected[1]		
	Option A	Option B	Option C
50-55 dBA	10,000 to 12,000	10,000 to 12,000	10,000 to 11,000
Over 55 dBA	4,000 to 9,000	3,500 to 8,500	2,000 to 5,500

Note: 1: Population projection for 2016. Estimates greater than 10,000 rounded to the nearest 1,000; estimate between 1,000 and 10,000 rounded to nearest 500.

During a single run-up event, fewer people than shown in the table would be affected, but the populations indicated would be affected from time to time. The noise impact from engine test running could potentially be reduced by careful orientation of the aircraft during this activity (where practicable), implementation of a night-time curfew for such activity and/or providing noise shielding around aircraft run-up bays.

9.4.2 Construction Noise

During construction of a Second Sydney Airport, noise associated with the most noisy construction activities may affect people in the surrounding area. The noise would be generated mostly during the daytime, but some runway paving activities may be carried out at night.

Table 9.6 summarises the number of people that may be affected by construction noise. The effect would not be continuous during the construction period but would occur during those periods when major construction activity occurs at locations close to certain residents. The effects are likely to be the same for all three airport options.

Table 9.6 Cumulative Construction Noise Impacts

Noise Indicator	Population Affected[1]
Day Time[2]	
45 to 50 dBA	700
Over 50 dBA	450
Night-time[3]	
40-45 dBA	1,900
Over 45 dBA	800

Notes:
1. *Estimates rounded to the nearest 50.*
2. *Daytime construction noise criterion is 45 dBA.*
3. *Night-time construction noise criterion is 40 dBA*

Noise from trucks during construction would be likely to impact on residents living adjacent to Bringelly Road. Noise mitigation measures would need to be considered.

9.4.3 Road and Rail Traffic Noise

The increase in traffic to an operating airport may require the upgrading of a number of associated roads. People living next to a number of these roads would be affected by a significant noise impact as a result of the increased traffic, unless noise control measures were incorporated within the road upgrade. A quiet road surface or roadside noise barrier could be used to negate the noise impact.

If a rail link were constructed to the Second Sydney Airport, increased rail movement on the East Hills Line may result in a noise impact upon those people living adjacent to the rail link. Noise from the new rail link would not affect people providing they live more than 50 metres from the rail line. Noise control measures would be required to reduce noise impacts on people living closer than 50 metres to the new rail link.

PART F

Physical and Biological Impacts

Chapter 10

Meteorology

Chapter 10
Meteorology

10.1 Summary of the Draft Environmental Impact Statement

The Draft EIS described the meteorology of the Sydney basin and the Badgerys Creek area in particular. It included an analysis of the meteorological factors which would influence the useability of the proposed airport, the dispersion of air pollutants and the transmission of aircraft noise.

The meteorological analysis for the Draft EIS was hampered by a lack of site-specific data and had to rely on extrapolating data from the nearest sites from which data was available. In the circumstances, quantitative assessments of the extent to which some meteorological conditions would affect airport operations were not undertaken and preliminary conclusions only were drawn.

The strength and direction of wind influences how often a runway can be used as aircraft movements during strong cross winds can be dangerous. It was estimated that, for all airport options, runway useability for large aircraft would exceed the Australian planning goal of 99.8 percent for capital city airports, but the operation of aircraft with lower cross wind capabilities would be slightly restricted. Option A would have a slightly lower runway useability than the other Options because it would not have a cross wind runway.

Additional study would be required to assess the influence of wind shear and mechanical turbulence on runway availability.

Weather conditions other than wind can also affect airport operations. Air traffic procedures for dealing with poor visibility, such as in heavy rain or fog, have been developed by Airservices Australia in conjunction with the Civil Aviation Safety Authority.

Badgerys Creek experiences an estimated 700 to 800 millimetres of rain each year, on average, and occasional high intensity rainfall, usually associated with thunderstorms. Runway useability would not, however, be reduced significantly by precipitation. Because of its proximity to the Great Dividing Range, an airport at Badgerys Creek might experience thunderstorms which would arrive with relatively little warning. Hazardous low altitude wind shear is often associated with thunderstorms.

Low cloud events at Badgerys Creek were estimated not to exceed eight per month in December, January and February with less than four such events per month at other times.

The Draft EIS discussed briefly the influence of meteorology on air quality; this subject was considered in more detail in *Chapter 11* of this Supplement.

10.2 Summary of Issues Related to Meteorology

10.2.1 Issues Raised in Submissions

Availability of Meteorological Data

It was argued in submissions from the NSW State Government and the Western Sydney Alliance amongst others that the data used for the Draft EIS was inadequate. Many of these submissions stated that the Bureau of Meteorology recommends a time span of 30 years for climatological studies. Also, it was stated that data collection sites were too far away from Badgerys Creek to be accurate. Some submissions suggested that a thorough meteorological analysis based on reliable long-term data was required before development of an airport can proceed. Accurate data was considered essential in order to establish flight paths, noise impact and air quality.

Another issue raised in submissions was the lack of data on vertical variations in wind speed and air temperature (vertical profile data) for western Sydney. This issue is discussed in *Chapter 11* of this Supplement.

Influence of Meteorology on Airport Operations

In addition to local councils in western Sydney, the Holroyd Association Against Airport Noise and the Camden Residents Action Group also suggested that because temperature inversions could take several hours to subside in winter, fogs were quite likely to occur. It was also noted that visual observations of fog occurrences were only taken at 9.00 am and 3.00 pm, whereas fog forms typically around sunrise.

It was also suggested that there was an anomaly in regard to the wind impacts on runway useability for all of the airport options: that is, the Draft EIS showed that the stronger the cross wind, the greater the utilisation of the airport.

Another concern focused on the possibility of wind shear and turbulence forming in the westerlies approaching Badgerys Creek from the Blue Mountains.

Submissions on the influence of meteorology on air quality are discussed in *Chapter 11* of this Supplement.

10.2.2 Issues Raised by the Auditor

There was no comment in the Auditor's report on the analysis of the influence of meteorological factors on airport operations, although there was a comment on the use of meteorological data for the air quality analysis (see *Chapter 11*).

10.3 Responses to Meteorological Issues

10.3.1 Availability of Meteorological Data

The Draft EIS noted that the meteorological analysis was restricted by a lack of site specific data and for this reason only preliminary conclusions could be drawn. The principal reason for this limitation is that the meteorological analysis for the Draft EIS had to rely on existing data sources.

It would take several years to collect statistically significant, site-specific data for a detailed analysis of the meteorological conditions at Badgerys Creek. The process of site-specific data collection began in 1995 when the Bureau of Meteorology installed an automatic weather station on the site. The data collected with this station are used by the Bureau for day to day forecasting purposes and, over time, will provide quality climatological data. Wind data from the automatic weather station in the three years from 1996 to 1998 were used in the air quality analysis for this Supplement (refer to *Chapter 11*).

10.3.2 Airport Useability in Cross Winds

Table 14.1 in the Draft EIS led some readers to conclude that runway useability would increase with the strength of the cross wind. To help clarify this situation the table is reproduced as *Table 10.1* below with revised headings to clarify that the data refer to the 'cross wind capabilities' of aircraft. The table confirms that runway useability increases for aircraft with higher cross wind capabilities.

Table 10.1 Airport Useability for Different Aircraft Types

	Cross Wind Landing		
Airport Option	10 knots	13 knots	20 knots
Option A	94.15%	97.25%	99.84%
Option B	97.75%	99.30%	99.96%
Option C	99.23%	99.91%	99.99%

Source: Second Sydney Airport Planners, 1997a.

The wind data collected since 1996 by the Bureau of Meteorology's automatic weather station at Badgerys Creek could be used to check the data in *Table 10.1*. However, further analysis of runway useability is unnecessary in view of the fact that, even for small aircraft, there would be only slight operational restrictions due to cross winds.

During the preparation of the Draft EIS it became apparent that the then-Department of Aviation had measured wind speed and direction at Bringelly over several years as part of the *Second Sydney Airport Site Selection Programme Draft Environmental Impact Statement* and *Supplement* (Kinhill Stearns, 1985a; 1985b). Since the current Draft EIS was published in December 1997, this data has been traced (they refer to the period 1977 to 1982) and could also be used to refine the data in *Table 10.1*.

10.3.3 Fog

The only records of fog at Badgerys Creek are those taken from the McMaster Experimental Research Farm, approximately four kilometres to the north of the airport sites. The records show that fog reduced visibility to less than 1,000 metres on ten days per year on average, with a maximum of 22 days in one year. These observations were based on a period covering 17 years, taken at 9.00 am and 3.00 pm. The records underestimate the frequency of fog, as fog occurs most frequently before or around sunrise.

Fog does not necessarily preclude operations by aircraft at an airport. *The Australian Aeronautical Information Publication* (Airservices Australia, 1995) specifies the minimum standards for take-off and landing at airports, based on the category of aircraft, the number of crew, airport lighting and the type and category of radio navigation aids being used. Additionally, major airline operators may specify minimum specifications for their particular operations at an airport. These specifications take account of additional factors, including the type of aircraft, crew training and currency requirements.

Subject to some variations as indicated above, the minimum landing standards for runways equipped with an Instrument Landing System (Category 1) is about 800 metres visibility and/or a cloud ceiling of about 200 feet (61 metres). The minimum take-off standard is about 500 metres visibility.

Prior to take-off, or prior to when an aircraft reaches the minimum standard for visibility for landing, the pilot in command is responsible for assessing whether the meteorological conditions are equal to or better than the minimum prescribed for take-off or landing. A pilot must not take-off, or except in emergency, land, or continue, an approach if the meteorological conditions are less than the prescribed minima.

In conclusion, based on the available data, airport useability would not be impacted substantially by fog.

10.3.4 Wind Shear and Mechanical Turbulence

The term 'vertical wind shear' describes a difference in wind speed, wind direction (or both) over a short vertical distance and is often associated with increases in air temperature with height (temperature inversions) or with strong winds just above the ground surface. Low-level wind shear also occurs owing to cold air drainage on slopes.

Mechanical turbulence is an 'overturning' of the air caused by frictional drag at the earth's surface. The rougher the surface, the greater the mechanical turbulence. The Great Dividing Range west of Badgerys Creek can generate significant turbulence, depending on wind speeds and stability.

There are several different manifestations of turbulence. In certain situations, 'mountain waves' and 'rotors' will develop. Mountain waves are vertical oscillations in the airflow in the lee of the mountains. Rotors, which are rotating cylinders of air under a wave, may also occur. Both these features can be hazardous to aircraft. In certain situations both mountain waves and rotors can develop.

Advice from the Bureau of Meteorology is that vertical wind shear and mechanical turbulence can develop at Badgerys Creek when there is strong westerly flow over the Great Dividing Range and when surface winds are strong. The extent to which these meteorological conditions would influence airport operations is unknown.

The Bureau advises that additional studies and additional instruments are needed to adequately investigate wind shear and mechanical turbulence. Such studies would need to be undertaken before airport operations began.

A Doppler weather radar and a wind vertical profiler will be installed at or near Sydney Airport in 1999 and, while the siting is not optimum for Badgerys Creek, these should provide low-level data for the general Sydney area. The siting of a vertical wind profiler at Badgerys Creek for at least one year would be essential. In addition, the application of high resolution numerical weather prediction models and the use of the Aerosonde monitoring system may provide further useful data.

If, on the basis of this further work, there is evidence that there would be significant safety concern or operational issues, then monitoring equipment would be installed with the construction of the airport providing real-time advice on weather conditions to controllers and pilots. This equipment would ideally comprise:

- Doppler weather radar;
- Low-level Windshear Alert System; and
- Vertical Wind Profiler with Radio Acoustic Sounding System.

In summary, the technology to monitor wind shear and mechanical turbulence is available and, if required, could be used to minimise safety risks and to help manage airport operations.

10.4 Overview of Meteorology

Meteorological factors such as wind speed and direction, rainfall, inversion layers and mixing heights would influence the operation of the proposed airport, as well as the dispersion and transportation of air pollutants and the transmission of aircraft noise.

The meteorological analysis was limited by the availability of site-specific data and had to rely on extrapolating data from the nearest representative sites. In some areas it was only possible to draw preliminary conclusions and additional data may need to be collected in the future to refine some of the analysis.

The seasonal distribution of winds at Badgerys Creek is characterised by dominant south-westerly winds in autumn and spring. In winter there is an increase in the frequency of winds from the west-north-west and north-west directions.

Cross winds would only slightly restrict use of the runway. It is estimated that runway useability for larger aircraft would exceed the Australian planning goal of 99.8 per cent for capital city airports, but the operation of smaller aircraft would be slightly restricted for all airport options. Option A would have a slightly lower runway useability than the other options because it does not have a cross runway.

Badgerys Creek experiences an estimated annual rainfall of 700 to 800 millimetres with occasional high intensity rainfall, usually associated with thunderstorms. Because of its proximity to the Great Dividing Range, an airport at Badgerys Creek might experience thunderstorms which would arrive with relatively little warning. Hazardous low altitude wind shear is likely near thunderstorms.

The available records show that fogs at Badgerys Creek reduce the visibility to less than 1,000 metres on ten days per year, on average. While this may be an underestimate of the incidence of fog at Badgerys Creek, it is unlikely that airport operations would be affected significantly by fog.

On average, low cloud events are estimated not to exceed eight per month in December, January and February and less than four per month for most other months.

It is likely that wind shear and mechanical turbulence would develop at Badgerys Creek when there is strong westerly wind flow over the Great Dividing Range and when surface winds are strong. The possible influence of these conditions on airport operations is unknown at this stage and further work is required. The technology to monitor wind shear and mechanical turbulence is available and, if required, would be used to minimise safety risks and to help manage airport operations.

As with any airport, there would be times when flying operations at Badgerys Creek would be restricted by bad weather. Air traffic procedures for dealing with poor visibility at airports are developed by Airservices Australia in conjunction with the Civil Aviation Safety Authority.

Further meteorological studies and monitoring would be required once the final runway configuration has been selected and before airport operations begin.

Chapter 11

Air Quality

Chapter 11
Air Quality

11.1 Summary of the Draft Environmental Impact Statement

11.1.1 Summary of Air Quality Issues in Sydney

The Sydney region's main pollution problems are photochemical smog and brown haze. Photochemical smog occurs mainly in summer, while brown haze is a winter phenomenon. Over the past decade, brown haze has been occurring with less intensity, partly as a result of Government policies prohibiting backyard burning and because of improved emission controls on industry and motor vehicles (Roads and Traffic Authority, 1995).

Motor vehicle emissions are a major contributor to air pollution in Sydney. They mainly comprise hydrocarbons, oxides of nitrogen and carbon monoxide. Improvements in motor vehicle technology have resulted in reduced amounts of these emissions from cars manufactured since 1985. Significant improvements in overall motor vehicle emissions will occur as older vehicles are retired and post-1985 vehicles become more dominant.

Air monitoring data collected by the Environment Protection Authority indicates that air quality is acceptable for the majority of the time in most areas of Sydney. Occasional breaches of the ozone guideline for NSW (10 parts per 100 million) occur but only one reading in excess of the nitrogen dioxide goal (16 parts per 100 million applicable at the time of preparation of the Draft EIS) had been recorded in Sydney since 1990. Maximum 24-hour concentrations of airborne particulate matter are generally less than one third of the Environment Protection Authority's goal of 150 micrograms per cubic metre (applicable to the time of preparation of the Draft EIS). It is, however, recognised that the influence of local topography and air currents can carry pollutants towards western Sydney, where they can be slow to disperse under certain weather conditions.

11.1.2 Methodology and Background Data

Existing air quality in western Sydney was described using monitoring data published in the Environment Protection Authority quarterly reports for the period 1992 to 1995. The following parameters were used to assess the air quality impacts of the Second Sydney Airport: particulate matter below 10 microns in diameter (particulate matter); carbon monoxide; ozone; nitrogen dioxide; and sulphur dioxide. Not all of these parameters are measured at each of the Environment Protection Authority's monitoring stations.

Air quality impacts were assessed by predicting the air pollutant emissions produced by the construction and operation of each of the airport options, and then applying a range of modelling techniques to calculate increases in ground level concentrations of various air pollutants. These techniques included Fugitive Dust Model computer software for modelling the deposition of dust during construction and the AUSPLUME software for assessing the impact of airport operations on ground level concentrations within 10 kilometres of the airport sites.

The Lagrangian Atmospheric Dispersion Model (LADM) was used to carry out trajectory modelling of ozone formation using background air chemistry data from two events that had resulted in high levels of photochemical smog in western Sydney. The model combined airport emissions with this background air chemistry data and wind directions it had generated internally and predicted emissions for each of the airport options.

A second approach, referred to as footprint analysis, was used to provide a comparison with the results of trajectory modelling. This was undertaken using a limited data set of air quality and meteorological records obtained from the Bureau of Meteorology and private industry. Limitations of the dataset arose due to uncertainties in wind directions in some of the Environment Protection Authority data for the period July 1994 to June 1995.

An assessment of the potential impacts owing to changes in population and motor vehicle traffic expected to be associated with the operation of the airport options was also made. Potential odours from aircraft fuel and a possible sewage treatment plant were also modelled.

11.1.3 Airport Emissions

An emission inventory was prepared for various sources of pollutants from airport operations. These included aircraft exhaust, motor vehicle operation within the airport, combustion of gaseous fuels in boilers, evaporative losses from fuel storage tanks, and losses due to refuelling and maintenance operations. The emission rates were used by the various modelling techniques to predict ground level concentrations of air-toxic compounds, oxides of nitrogen, carbon monoxide, sulphur dioxide, ozone and fine particulate matter less than 10 microns.

11.1.4 Air Quality Impacts

The principal impacts arising from the construction of the airport would be an increase in levels of dust, due to earthmoving activities, and wind erosion of exposed surfaces. Other effects from exhaust emissions of earthworks plant and gaseous emissions during detonation of explosives would be minor by comparison. Dispersion modelling showed that dust deposition rates within one to two kilometres of the airport boundary would potentially exceed the generally allowable limit of two grams per square metre per month.

Peak daily concentrations of airborne fine particulate matter could also increase by more than 100 micrograms per cubic metre, up to five kilometres from the airport boundary. This would only occur under worst-case conditions, such as when earthmoving activities were taking place close to the boundary. It could potentially result in dust being deposited onto washing being dried and into swimming pools and rainwater tanks.

Airport operations would increase ground level concentrations of a wide range of local and regional pollutants. The Draft EIS predicted increases in concentrations of ozone, nitrogen dioxide, particulate matter, carbon monoxide and sulphur dioxide would be similar for the three airport options (Options A, B and C). Adding these predicted increases to typical maximum background levels near the boundary of the airport indicated that while ozone concentrations would occasionally exceed the goal values, the concentrations of other pollutants would not.

Changes in urban development and the volume and distribution of motor vehicle traffic would result in increases in air pollutant emissions over and above those generated by aircraft and other sources within the airport boundaries. Increases would primarily be as a result of motor vehicle traffic along the main road links to the airport sites, but the resulting emissions would probably be spread over a wide area of Sydney. Motor vehicle emissions of nitrogen dioxide would be likely to amplify the increases in ozone levels predicted for the airport alone by 20 to 30 percent, and potentially expand the area affected by ozone impacts.

Local impacts such as odours from airport operations were also modelled. Odours could result from storage and handling of aircraft fuel, aircraft exhaust emissions of hydrocarbons and from treatment of airport waste water. Modelling undertaken for the Draft EIS predicted that kerosene-type odours would be detected at distances of up to three kilometres from the airport boundary for 0.5 percent of the time, or 44 hours per year. If a sewage treatment plant was constructed to service the airport, odours from the plant would be able to be detected for 44 hours or more per year at distances of up to 500 metres from the airport boundary.

The Draft EIS concluded that there is significant uncertainty regarding the vertical temperature and wind profile at Badgerys Creek. It was noted that it would be prudent to undertake sensitivity analyses using different vertical profile assumptions.

11.2 Summary of Air Quality Issues

11.2.1 Issues Raised in Submissions

Sydney Air Quality

As well as general concern about the impacts of a Second Sydney Airport on existing air quality, in particular the incidence of brown haze and photochemical smog (ozone), it was suggested in submissions that links between meteorology, topography and existing poor air quality in western Sydney were not well documented in the Draft EIS. The Western Sydney Alliance submission pointed to the *NSW State of the Environment Report 1997* (Environment Protection Authority, 1997a) which projects that significant reductions in ozone precursors, particularly oxides of nitrogen, would be required to counter the air pollution associated with population growth in western Sydney. It is stated that western Sydney is in an oxide of nitrogen limited photochemical regime and is highly susceptible to increased ozone events.

Methodology

Modelling Assumptions and Background Data

Submissions from the Australian Conservation Foundation, the Western Sydney Alliance and the NRMA Limited, among other submissions, stated that the Metropolitan Air Quality Study (MAQS) model should have been used for modelling air quality impacts. These submissions suggested that alternative and less sophisticated models were used. It is also stated that the Lagrangian Atmospheric Dispersion Model is unreliable as a method to predict ozone impacts. Accordingly submissions on the Draft EIS concluded that the methodology adopted for predicting air quality impacts was either flawed or inadequate.

In addition, the NSW Government and Western Sydney Alliance commented that the number of pollution events relied on for the Draft EIS assessment was too small. More specifically, the use of two historical days with high background pollutant levels to predict a worse case scenario, was considered questionable. Further, running the model for 24-hours for each of the two days, when it should have been run for 48 hours, was inadequate to take into account diurnal effects. Also, levels of uncertainty associated with the prediction of ozone impacts should have been stated.

Submissions from Communities Against an Airport in Western Sydney and the Western Sydney Alliance indicated that the emissions inventory did not include all important sources and that the level of aircraft emissions had therefore been understated. Airport related pollution sources noted as not being specifically included in the emissions inventory included internal roadways, public and employee carparks, freeway, aircraft maintenance and engine test cells, natural gas combustions in boilers and heaters, emergency diesel and plant, airside vehicles and plant.

Submissions from individuals stated that the effects of topography on dispersion of air pollutants were underestimated with emphasis placed on the potential for accumulation of pollutants due to a combination of a westerly drainage flow and stable atmospheric conditions.

The submission from the Western Sydney Alliance, among others, concluded that background levels of air pollution appeared to have been significantly understated in the Draft EIS, therefore contributing to an underestimate of the projected pollutant levels.

Submissions on the Draft EIS also stated that inadequate meteorological data had been used as a basis for the air quality modelling. Submissions on the Draft EIS recommended that air quality impacts should be re-assessed using 1996 and 1997 air quality and meteorological data from the Environment Protection Authority Bringelly monitoring station and other adjacent stations.

Projected Air Quality Impacts

The NSW Government suggested that in addition to indicating the increase in peak concentrations of photochemical pollution, the increased frequency of exceedence should also have been noted in the Draft EIS. Any further increases in ozone concentrations as a consequence of the emissions from the airport or motor vehicles would not be acceptable, according to the Camden Residents Action Group, among other individuals, who made submissions on the Draft EIS.

The NSW Government and the Western Sydney Alliance suggested that the estimates of increased hospitalisation and death contained in the Draft EIS were likely to be underestimated due to the inadequacies described above relating to the assessment of pollutant impacts. Following on from comments in submissions that the number of people affected by air pollution had been underestimated, submissions suggested that levels of particulate, nitrogen dioxide and sulphur dioxide pollution had also been underestimated.

Future Air Quality Goals

According to the NSW Government submission the Draft EIS failed to take into consideration future air quality goals for nitrogen dioxide and particulate matter, or the NSW Government's stated long-term goal for ozone. These goals are considered to be likely to be more stringent than current goals, in accordance with the recently announced National Environment Protection Measures. Further, it is stated that current NSW Government policy requires that new industrial developments within the Sydney basin not increase the overall emissions of oxide of nitrogen, which the NSW Government submission stated the proposal does not satisfy.

Aircraft Emissions

As noted previously submissions on the Draft EIS indicated that the level of aircraft emissions had been understated in the Draft EIS. There are also unspecified concerns expressed in submissions about the contribution that aircraft make to air pollution generally.

The submission from Qantas suggested that the contribution by aircraft to air pollution is small and endorsed the assessment contained in the Draft EIS.

Motor Vehicle Emissions

Comments were made in submissions that inadequate consideration had been given to the contribution to air pollution by motor vehicles, including any increase in motor vehicle emissions generated by the airport. Concern is also expressed that the Draft EIS had failed to consider the effect of the change in air quality on existing and anticipated residential and industrial areas.

Submissions on the Draft EIS also suggested that no explanation is given for the assumptions made in calculating emissions predicted for associated development and motor vehicle traffic, both of which were not included in contours of predicted concentrations above background levels. An objection is also expressed in submissions against any increase in the contribution to air pollution made by motor vehicles generated by the proposal.

Submissions from Ashfield, Canterbury, Botany Bay and Marrickville Councils suggested that the Draft EIS failed to consider the air quality benefits (due to reduced travel to work) of providing a major employment source in western Sydney.

Greenhouse Gas Emissions

In addition to a concern regarding increased greenhouse gas emissions generally, submissions on the Draft EIS suggested that the issue of increased greenhouse gas emissions associated with development of the airport was not investigated. In particular, submissions suggested that there would be an ongoing greenhouse gas impact due to the clearing of land for airport construction.

Fuel Dumping

Concerns were expressed in submissions about possible fuel dumping and the potential for accidental discharge of hydraulic fluids and engine oil from aircraft. Objections were stated to a possible dumping of fuel over urban or rural areas and suggestions were made that fuel dumping should only occur over desert regions.

Construction Impacts

Submissions on the Draft EIS stated that inadequate consideration had been given to the contribution of construction activity to air pollution. This was based on the Draft EIS, which indicated that airport construction would potentially result in impacts in excess of Environment Protection Authority guidelines up to five kilometres beyond the boundary of the airport.

Odour

The NSW Government submission, among others, suggested that impact assessment for odour was based on limited emissions data and the lack of a detailed design for the sewage treatment plant. These inadequacies, according to this and other submissions, made the results of the odour impact assessment inconclusive.

Environmental Management

Submissions on the Draft EIS, including those from the NSW Government and the Western Sydney Alliance, considered that the description of mitigation measures for air quality management was superficial and lacking detail, and was therefore inadequate. It was suggested that tools were available to assist in quantitatively assessing the effectiveness of mitigation measures and that these should have been used. Further, submissions on the Draft EIS indicated that air quality management should have also involved health monitoring strategies.

Ashfield, Canterbury, Botany Bay, Lane Cove, Marrickville and Rockdale City Councils, among other individual submissions on the Draft EIS, suggested that the air quality impacts of the airport could be managed. These submissions pointed to the conclusions of the Draft EIS that relevant air quality goals would not be exceeded and resultant impacts on regional air quality would be no worse or even better by comparison to the further expansion of Sydney Airport.

Concerns were expressed in individual submissions on the Draft EIS about what compensation would be available, and who would be responsible for providing this compensation, to people adversely affected by the air pollution effects of the airport.

Other Air Quality Issues

Summary of Potential Air Quality Impacts

Submissions on the Draft EIS suggested that the summary of potential air quality impacts, as well as the overall air quality assessment contained in the Draft EIS, was inadequate. A general level of concern was raised in submissions regarding the potential impacts of the airport on air pollution, although more specific concerns such as those outlined above are not raised.

Air Pollution Impacts on Flora and Fauna

The submission by Fairfield Residents Against Airport Noise, among other submissions, indicated that no consideration had been given in the Draft EIS to the impacts of air pollution on flora and fauna.

Health Impacts

A range of issues were raised in submissions regarding the possible health impacts arising from air pollution generated by the airport. In recognition of the considerable concern within the community about these issues a separate chapter has been included in this Supplement to address health issues. Accordingly, health issues which have been listed under the broad heading of air quality are summarised and addressed in *Chapter 23*.

11.2.2 Issues Raised by the Auditor

The Auditor concluded that the overall approach of the Draft EIS was reasonable, but better meteorological data and modelling techniques were available in comparison to those used. The Auditor indicated that the airshed model developed for the Metropolitan Air Quality Model should have been used for the Draft EIS assessment. The Auditor also considered that the extent to which impacts of airport-related traffic and emissions from associated developments were included in the assessment to be unclear, despite this being of major importance.

11.3 Air Quality Goals

11.3.1 Background

Air quality guidelines used in the Draft EIS for assessing air quality impacts were referenced from the World Health Organisation, United States Environment Protection Agency and the National Health and Medical Research Council. The Draft EIS concluded that the concentrations of carbon monoxide, sulphur dioxide, nitrogen dioxide and particulate matter would not exceed relevant air quality guidelines. However, it concluded that concentrations of ozone would exceed the relevant ambient air quality guidelines in certain locations on a number of occasions each year.

11.3.2 National Environment Protection Measures

Ambient air quality guidelines in NSW have changed since the Draft EIS was prepared. The *National Environmental Protection Measures for Ambient Air Quality* (National Environment Protection Council, 1998) was released on 26 June 1998. They were developed by the National Environmental Protection Council in accordance with the requirements of the *Commonwealth National Environmental Protection Council Act, 1994*.

The goal of the National Environmental Protection Measure is to achieve specified compliance with National Environmental Protection Standards within 10 years of commencement.

The National Environmental Protection Measures provides ambient air quality standards for the following pollutants:

- carbon monoxide;
- nitrogen dioxide;
- photochemical oxidants (as ozone);
- sulphur dioxide;
- lead; and
- particulate matter less than 10 microns.

Goals and standards are summarised in *Table 11.1*.

Table 11.1 National Environmental Protection Measure Standards and Goals

Pollutant	Averaging Period	Maximum Allowable Concentration	Maximum Allowable Exceedences
Carbon monoxide	8 hours	9.0 parts per million	1 day per year
Nitrogen dioxide	1 hour 1 year	12 parts per hundred million 3 parts per hundred million	1 day per year none
Photochemical oxidants (as ozone)	1 hour 4 hours	10 parts per hundred million 8 parts per hundred million	1 day per year 1 day per year
Sulphur dioxide	1 hour 1 day 1 year	20 parts per hundred million 8 parts per hundred million 2 parts per hundred million	1 day per year 1 day per year none
Lead	1 year	0.50 micrograms per cubic metre	none
Particulate matter less than 10 microns	1 day	50 micrograms per cubic metre	5 days per year

Source: National Environment Protection Council, 1998

11.3.3 NSW Interim Air Quality Goals

The NSW Government proposed interim air quality goals in its publication *Action for Air* which was released as part of the NSW Government's 25-year air quality management plan (Environment Protection Authority, 1998a). *Action for Air* was published prior to the finalisation of the National Environmental Protection Measure standards.

However, interim air quality goals for ozone, nitrogen dioxide and particulate matter less than 10 microns were generally in accordance with the National Environmental Protection Measures standards. For example, the interim goal for nitrogen dioxide for an averaging period of one hour was 12.5 parts per hundred million compared to the National Environmental Protection Measures standard of 12 parts per hundred million.

Further changes to existing ambient air quality guidelines are inevitable. The National Environmental Protection Council (1998) has identified several future actions that are required to further facilitate the objectives of the National Environmental Protection Measures. These include:

- commencement of a review by 2001 of the particulate standard, in particular the need for a standard for particulate matter less than 2.5 microns. The United States Environment Protection Agency has recently introduced a standard for particulate matter less than 2.5 microns set at 15 micrograms per cubic metre for an annual average and 65 micrograms per cubic metre for a maximum 24-hour average;
- commencement of a review by 2003 of the practicality of achieving a one hour average standard for photochemical oxidants measured as ozone of eight parts per hundred million within the major urban airsheds. This would be consistent with the current guidelines set by the World Health Organisation and the European Union; and
- commencement of a review of the practicality of developing a 10 minute sulphur dioxide standard by 2003. The World Health Organisation has set a 10 minute standard for sulphur dioxide of 17.5 parts per hundred million.

Action for Air (Environment Protection Authority, 1998) outlines long-term goals for ozone, nitrogen dioxide and particulate matter less than 10 microns which are consistent with the current World Health Organisation goals. The same document also states that *"over the 25 years of the Action for Air Plan, there will undoubtably be further health research undertaken and better understanding of the health effects. In order to build a comprehensive picture of air quality in the region, the Government intends to report against a range of health-related goals"*.

This implies that future changes of air quality goals by the World Health Organisation, United States Environment Protection Agency and the European Union might be reflected in the National Environmental Protection Measures standards and the ambient air quality goals adopted by the Environment Protection Authority.

11.4 Modelling of Air Quality Impacts

11.4.1 Meteorological and Air Quality Data

Background

On the basis of the air quality analysis undertaken for the Draft EIS, it was concluded that sufficient basis for decision-making in terms of air quality impacts had been established. The Draft EIS however, did indicate that it would be prudent to obtain further data and carry out additional modelling, particularly in relation to the vertical profile of the atmosphere in western Sydney and the extent of ozone impacts. Since the preparation of the Draft EIS new meteorological data has become available, which was not available at that time. In addition, the release of the *National Environment Protection Measure for Ambient Air Quality* (National Environment Protection Council, 1998) has resulted in new goals and standards for some of the air quality parameters set in the Draft EIS.

In the absence of more vertical profile data, and taking into consideration the recommendation of the Auditor, sensitivity testing has been undertaken on the effect of the vertical profile on the atmosphere above the sites of the airport options. This approach and the new air quality modelling are consistent with a precautionary approach to determining environmental impacts. Details of the new modelling are included in *Appendix D1* of this Supplement.

Air quality modelling undertaken for the Draft EIS was based on a mixed data set including meteorological data from the Macquarie University monitoring station at Badgerys Creek and air quality data from the Environment Protection Authority's monitoring station at Campbelltown. Monitoring data from the nearby Environment Protection Authority's monitoring station at Bringelly was not suitable for modelling, due to difficulties in resolving orientation problems with wind monitoring data.

In the Draft EIS it was recommended that further analysis of pollutant concentrations measured at air quality monitoring stations in the vicinity of Badgerys Creek should be undertaken and analysis of ozone impacts using one year of meteorological and air quality data from Environment Protection Authority should also be carried out. This was intended to improve the accuracy of the existing air quality analysis.

It was also recommended that it would be prudent to undertake a sensitivity analysis of the results of the air quality study. This would be advisable because of the lack of vertical profile data and would involve using different assumptions about mixing depth in the modelling process.

Consideration of Available Monitoring Data

The AUSPLUME computer package used for local air quality dispersion modelling requires a data set containing wind speed directions to be input into the model.

Three possible meteorological data sets were considered for use in air quality modelling work:

- Macquarie University data from its Badgerys Creek monitoring station;
- Environment Protection Authority data from its Bringelly monitoring station; and
- Bureau of Meteorology data from its Badgerys Creek monitoring station.

Criteria which could be used when selecting the most appropriate data set for use in air quality modelling:

- the length of data records available;
- the reliability of the monitoring data results (quality assurance);
- the location of the station and its elevation in comparison to the sites of the airport options, but in particular the effective height of aircraft emissions; and
- the representativeness of the data of conditions occurring at the emission source, that is, the sites of the airport options.

In terms of the length of records available, the Macquarie University monitoring site at Badgerys Creek was only operating for a limited period (1990 to 1992), and no records are available for the July 1996 to June 1997 period for which air quality monitoring data was obtained. Meteorological data from this station was used for the Draft EIS because of the unsuitability of other data sets available at that time.

Meteorological data from the Environment Protection Authority's Bringelly site covers the same June 1996 to July 1997 period for which air quality monitoring data was obtained. Data from the Bureau of Meteorology site at Badgerys Creek is available for the three year period from January 1996 to January 1999.

Studies undertaken for the Draft EIS (Second Sydney Airport Planners, 1997a) indicated that levels of runways would be approximately 70 metres to 90 metres above sea level for the runways, rising to the north or to the north-east depending on the airport option. Therefore the average ground level in the vicinity of the airport site would be approximately 80 metres above sea level.

The Environment Protection Authority's monitoring station is located on Ramsay Road, Bringelly 2.5 kilometres south-east of where the elevation is approximately 55 metres above sea level. It is situated in the South Creek Valley, and its data would be representative of conditions in the lower-lying areas of the valley, below the elevation of the airport site. The Macquarie University monitoring station site is located at the northern end of the airport site at an elevation of 100 metres above sea level.

The Bureau of Meteorology Badgerys Creek site is at one end of the proposed airport site and is at an elevation of 81 metres. This is approximately the level of the airport runways. A disadvantage of using data from the Bureau of Meteorology station in preference to data from the Environment Protection Authority's Bringelly station is that the measuring equipment has a higher stall speed (0.73 metres per second) than the Environment Protection Authority's Bringelly station (0.3 metres per second). However, the meteorological conditions experienced at the Bureau of Meteorology's Badgerys Creek site are more representative of what would occur at the airport than the Environment Protection Authority's Bringelly site, which is located in a valley approximately 2.5 kilometres to the south-east.

Figures 1 and *2* in *Appendix D1* illustrate wind speed and frequency versus direction for the Environment Protection Authority Bringelly meteorological data and Bureau of Meteorology Badgerys Creek data respectively for the period July 1996 to June 1997. *Figure 3* of *Appendix D1* compares the frequency of wind speeds for these two data sets, as well as for the Macquarie University dataset, which was used for the Draft EIS.

In assessing peak air quality concentration impacts the outcome is controlled by the most severe conditions for wind blowing from the source to each receptor location, therefore low wind speeds are very important.

Wind velocity records for the Bringelly site show frequent occurrences of poor dispersion conditions for wind directions from the south-west quadrant. Approximately 35 percent of the monitoring period recorded wind speeds of one metre per second or less and for the winter months, wind speeds seldom exceeded 2.5 metres per second. While the winds were most commonly from the south-west quadrant, low wind speeds (less than 0.5 metres per second) occurred for the full range of compass directions.

Wind velocity records for the Bureau of Meteorology site at Badgerys Creek also show a high frequency of winds from the south-west quadrant. Low wind speed events (less than one metre per second) occurred from all sectors, although south-west and west–south-west directions had the highest frequencies. Ten percent of the records were zero wind conditions, however this high frequency of apparent calm conditions is likely to be due to the comparatively high stall speed (0.73 metres per second) of the particular instrument used at the monitoring station.

Selection of Monitoring Data

For this Supplement, air quality impacts have been reassessed using 1996 and 1997 air quality data from Bringelly and surrounding Environment Protection Authority monitoring stations located in the vicinity of the proposed Second Sydney Airport. This included hourly air quality and meteorological data for the stations at Bringelly, St Marys, Blacktown, Liverpool, Camden and Campbelltown. Data for the period July 1996 to June 1997 was the most recent data which had been quality assured by Environment Protection Authority.

Meteorological records from the Bureau of Meteorology and the Macquarie University monitoring stations at Badgerys Creek are considered to be representative of conditions which would prevail at the proposed airport sites; while conditions at the Environment Protection Authority monitoring station at Bringelly are considered more representative of those that would occur at the floor of the South Creek Valley. The Macquarie University monitoring station is located in an elevated area. As a result, wind speeds recorded at this station and used in the Draft EIS air quality assessment might have been unrepresentative of calmer conditions that would prevail more generally over the proposed airport site. On the basis of these factors, it was considered that the Bureau of Meteorology monitoring station at Badgerys Creek was the most appropriate of the meteorological stations available to provide meteorological modelling data for air quality dispersion modelling.

11.4.2 Modelling Methodology

The computer package AUSPLUME Version 4 was used for local scale air dispersion modelling. The assumptions concerning major modelling parameters included: a surface roughness height of 0.6 metres; and wind profile exponents based on the Irwin Urban Scheme. Terrain and building wake effects were not modelled.

The proposed airport site is at an elevation of approximately 80 metres above sea level in comparison to surrounding areas, which are of an elevation of approximately 50 metres above sea level. This means that it is conservative to assume flat terrain for dispersion modelling.

Building wake effects can lead to both higher and lower ground level concentrations. These have not been modelled as detailed site plans would be necessary to permit this to be done.

For this Supplement, as for the Draft EIS, over 100 area sources of emissions were used for modelling. Simulating area sources in the computer package AUSPLUME involves orientating a single line source perpendicular to the wind. This method of simulation can result in non-representative concentrations at receptors close to the source (V&C Environmental Consultants, 1995), however, the use of area sources is considered to be appropriate, given that the primary focus of local scale dispersion modelling for the Second Sydney Airport is to investigate air quality impacts some distance from the airport sites rather than within the airport boundaries.

The preferred take-off direction was assumed to have a northerly component for each of the airport configurations. This assumption was made after analysis of meteorological data for Badgerys Creek revealed that between 84 percent and 92 percent of wind directions respectively were suitable for take-off directions with a northerly component. Therefore dispersion modelling was carried out only for the preferred northerly take-off mode (*Airport Operation 1*).

This approach is considered reasonable given that the aircraft operating modes that have the largest impact on ground level concentrations (taxi/idle and take-off) do not alter position significantly according to the direction of take-off. The aircraft operating modes which do change their location significantly depending on take-off direction (climb out and approach) have only minimal impact on ground level pollutant concentrations.

The receptor grid size and density chosen for each of the airport sites was based on the proximity of residential areas and other important features such as major water storages. The receptor grid for the sites of the airport options consists of 3,000 receptor locations spaced 500 metres apart, covering an area of approximately 720 square kilometres.

The local scale dispersion modelling includes allowances for pollution produced by motor vehicle traffic external to the airport site, which would occur as a result of the operation of the proposed airport. However, assessment of long-term health impacts have been restricted to the effects of emissions from the airport itself, as emissions from related motor vehicle traffic extend well beyond the area influenced by airport emissions.

Dispersion modelling carried out using the AUSPLUME program provides a means for assessing increases in concentrations due to anticipated pollutant emissions. To compare these increases with criteria adopted in NSW for acceptable ground level concentrations of various pollutants, it is necessary to estimate the background concentrations on which these increases would be superimposed.

For the Draft EIS, conservative assessments of background air quality were developed by considering available monitoring data in the vicinity of Badgerys Creek. Additional information about existing air quality in the Badgerys Creek area was obtained for this Supplement, including air quality data from the new Environment Protection Authority monitoring station at Bringelly. This information was used to establish background concentrations for the pollutants monitored (nitrogen dioxide, ozone, oxides of nitrogen and particulate matter less than 10 microns in diameter).

The plume calculation procedure produced by the Victorian Environment Protection Authority (1983) as part of the *State Environment Protection Policy* (the Air Environment) states that 70 percentile one hour average concentration may be taken as representative of the existing background concentration due to diffused sources.

Table 11.2 summarises the 60, 70, 80, 90, 95 and 99 percentile one hour average concentrations for nitrogen dioxide, ozone and particulate matter less than 10 microns recorded at the Environment Protection Authority's Bringelly monitoring station for the period July 1996 to June 1997. The average concentrations for ozone, particulate matter less than 10 microns and nitrogen dioxide for this time period were 1.4 parts per hundred million, 15.6 parts per hundred million and 1.2 parts per hundred million respectively.

Table 11.2 Percentile Concentrations of Pollutants Monitored at Bringelly (July 1996 to June 1997)

Percentile	Ozone Concentration (hourly data, parts per hundred million)	Particulate Matter Less Than 10 Microns Concentration (hourly/daily data, micrograms per cubic metre)	Oxides of Nitrogen Concentration (hourly data, parts per hundred million)	Nitrogen Dioxide Concentration (hourly data, parts per hundred million)
60	1.6	16.0/16.2	1.0	0.6
70	2.0	19.0/18.7	1.5	0.8
80	2.4	23.0/25.8	2.0	1.0
90	3.0	29.8/25.8	2.9	1.4
95	3.8	36.8/28.0	3.8	1.8
99	5.5	50.5/33.2	5.5	2.7

The adopted background values are summarised in *Table 11.3*. Air quality data from the Environment Protection Authority Bringelly station was used for the assessment of background air quality, as this is the closest station, approximately two kilometres to the proposed airport boundary. The next nearest site, at St Marys, is approximately 12 kilometres from the proposed airport boundary.

Table 11.3 Adopted Background Concentration

Parameter	Adopted Background Concentration	Source
Hourly ozone (parts per hundred million)	2.0	70 percentile hourly concentration, Bringelly Monitoring Station
Daily particulate matter less than 10 microns in diameter (micrograms per cubic metre)	19	70 percentile hourly concentration, Bringelly Monitoring Station
Average particulate matter less than 10 microns in diameter (micrograms per cubic metre)	16	Average concentration, Bringelly Monitoring Station
Oxides of nitrogen (parts per hundred million)	1.5	70 percentile hourly concentration, Bringelly Monitoring Station
Nitrogen dioxide (parts per hundred million)	0.8	70 percentile hourly concentration, Bringelly Monitoring Station
Hourly carbon monoxide (parts per million)	5.0	Draft EIS
Hourly sulphur dioxide (parts per hundred million)	0.9	Maximum hourly average concentration measured April 1996 to December 1996, Bringelly Monitoring Station

During the preparation of the Draft EIS, the required hourly records for a statistical treatment of the Bringelly data were not available. In the absence of such data, a relatively conservative approach was adopted for the Draft EIS. The statistical process adopted for the assessment of background conditions for this Supplement is considered to give a more realistic assessment of background conditions.

11.4.3 Sources of Emissions

Sources of emissions considered in this Supplement included aircraft, airport-related sources and motor vehicle traffic associated with operation of the Second Sydney Airport. *Table 11.4* shows the relative contributions of airport-related sources and motor vehicles.

Table 11.4 Air Pollutant Emissions Due to Airport-related Sources and Motor Vehicles

Pollutant	Emissions (kilograms per day)	
	Emissions Predicted for Airport-related Sources Only[1]	Increased Regional Emissions Due to Motor Vehicles[2]
Hydrocarbons	2,470	9,000
Oxides of nitrogen	12,000	5,800
Carbon monoxide	8,470	40,000
Sulphur dioxide	590	320
Particulate matter less than 10 microns	1,170	590

Source: Technical Paper No. 6, Appendix C.
Notes: 1. Assumes airport operating at 30 million passengers per year.
2. Assumes non-airport generated background traffic in 2016 and airport generated traffic with the airport operating at 30 million passengers per year.

Regional emissions related to motor vehicle travel outside the airport were assessed for this Supplement. This assessment takes account of current Australian Design Rule motor vehicle emission control regulations. This is a more refined treatment than was adopted in the Draft EIS, where the effect of the current regulations was not included in the assessment of regional emissions from motor vehicles.

11.4.4 Local Scale Air Quality Dispersion Modelling

Summary of Modelling Results

Ground level pollutant concentrations were modelled using a range of averaging times depending on the criteria used for particular pollutants. These ranged from one-hour through to eight-hour, daily and long-term averages. This was to enable direct comparisons to be made with the relevant air quality criteria adopted by the Environment Protection Authority and other authorities. These criteria are shown in *Table 11.5*. Pollutants modelled were as follows:

- nitrogen dioxide;
- particulate matter less than 10 microns in diameter;
- sulphur dioxide; and
- carbon monoxide.

Table 11.5 presents a summary of the air quality impacts predicted for the proposed Second Sydney Airport operating at 30 million passengers per year. The predicted impacts take account of airport emissions from aircraft, airport-related sources and motor vehicle traffic associated with the operation of the airport. This differs from the Draft EIS in that motor vehicle traffic associated with the airport was not combined with the assessment of air quality parameters in the Draft EIS to produce a cumulative impact.

Table 11.5 **Predicted Increases in Ground Level Concentrations of Air Pollutants Due to Operation of the Second Sydney Airport (Operating at 30 Million Passengers Per Year)**

Parameter	Goal	Background	Predicted Increase Above Background (Total)		
			Option A	Option B	Option C
One-hour Carbon Monoxide (parts per billion)	25[5]	5[1]	5 (10)	6 (11)	6 (11)
Eight-hour Carbon Monoxide (parts per million)	9[4]	3[1]	1.5 (4.5)	1.5 (4.5)	2.0 (5.0)
One-hour Nitrogen Dioxide (parts per hundred million)	12[4]	0.8[2]	13.2 (14)[3]	11.2 (12)	11 (11.8)
Average Nitrogen Dioxide (parts per hundred million)	3[4]	0.6[2]	3.4 (4)[3]	2.6 (3.2)[3]	2.2 (2.8)
One-hour Sulphur Dioxide (parts per hundred million)	20[4]	0.9[2]	5 (6)	5 (6)	5 (6)
Average Sulphur Dioxide (parts per hundred million)	2[4]	0.1[2]	0.2 (0.3)	0.2 (0.3)	0.2 (0.3)
Daily Particulates Below 10 Microns (micrograms per cubic metre)	50[6]	19[2]	60 (79)[3]	40 (59)[3]	40 (59)[3]
Average Particulates Below 10 Microns (micrograms per cubic metre)	50[4]	16[2]	10 (26)	5 (21)	4 (20)
One-hour Ozone (parts per hundred million)	10[4]	2[2]	1[7]	1[7]	1[7]

Notes:

1. *Background values adopted in Technical Paper No. 6.*
2. *Background values based on NSW Environment Protection Authority monitoring records for the Bringelly air quality monitoring station.*
3. *Exceedance of goal.*
4. *National Environment Protection Measure (NEPM) goal.*
5. *World Heath Organisation Goal.*
6. *United States Environment Protection Agency Goal.*
7. *Predicted increases for ozone apply at times of high background ozone concentration and would represent conditions exceeding the goal.*

As discussed in *Section 11.3.2*, there have been changes to the ambient air quality guidelines in NSW since the Draft EIS was produced. The *National Environmental Protection Measure for Ambient Air Quality* (National Environment Protection Council, 1998) was released on 26 June 1998, and was adopted for this Supplement. Where National Environment Protection Council goals were not available, relevant international goals for ambient air quality were adopted, as for the Draft EIS.

From the results presented in *Table 11.5* it can be seen that there are exceedences of goals for hourly nitrogen dioxide, fine particulate matter and hourly ozone. For nitrogen dioxide and fine particulate matter these exceedences are restricted to the immediate vicinity of the airport. In the case of ozone, the adversely affected area is predicted to be to the west of the airport, while for the other pollutants impacts are greatest adjacent to the airport boundary. Results for each of the modelled parameters are discussed below.

Nitrogen Dioxide

In the Draft EIS, it was assumed that 10 percent of total oxides of nitrogen would be converted to nitrogen dioxide. This was based on a review of monthly monitoring data presented in the Environment Protection Authority quarterly monitoring reports for several stations. Conversion of the oxides of nitrogen to nitrogen dioxide takes place in the atmosphere at a rate and to an extent which depends on the prevailing air chemistry. For example, the presence of ozone in the background air results in rapid oxidation of nitric oxide to nitrogen dioxide. Modelling of these chemical processes is difficult. A review of the rate at which oxides of nitrogen convert to nitrogen dioxide is contained in *Appendix D2* of this Supplement.

Estimating ground level concentrations of nitrogen dioxide is complicated by the fact that this transformation of oxides of nitrogen to nitrogen dioxide takes place after emission. At the point of emission, the proportion of nitrogen dioxide is assumed to be of the order of five percent by volume of the total oxides of nitrogen with the remaining amount made up of nitric oxide.

Due to the high level of complexity of the nitric oxide to nitrogen dioxide transformation process, a decision was made for the Supplement to use empirical means to assess the likely extent of transformation. Review of hourly monitoring records for 11 sites in Sydney was carried out to reassess the 10 percent rate assumed for the Draft EIS. The process of assessment, which is described in detail in *Appendix D2* of this Supplement involved developing a relationship between nitrogen dioxide and oxides of nitrogen based on monitoring results recorded within the Sydney airshed. This function permits maximum nitrogen dioxide concentrations to be estimated for a range of concentrations of oxides of nitrogen. *Figure 11.1* illustrates the function developed, in comparison to Blacktown hourly data for July 1996 to June 1997. From this function, nominated concentrations of oxides of nitrogen can be used to determine a range of concentrations for nitrogen dioxide.

Assessing ground level concentrations of nitrogen dioxide involved:

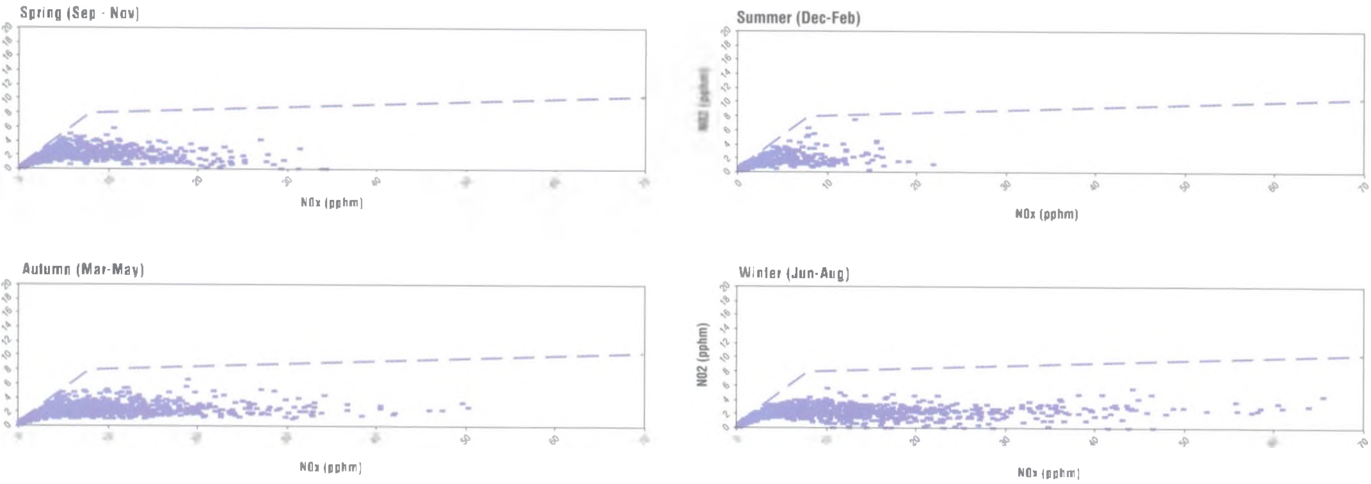
- modelling ground level concentrations of oxides of nitrogen;
- addition of the assessed background concentration of oxides of nitrogen; and
- looking up the nitrogen dioxide concentration of the envelope corresponding to the modelled oxides of nitrogen concentration.

Given that this function represents a practical upper bound to the nitrogen dioxide concentration for conditions prevailing in Sydney at all of the Environment Protection Authority monitoring stations for 1996 to 1997, the procedure outlined above is considered to provide a conservative assessment of nitrogen dioxide concentrations. The procedure can be over-conservative for estimating average nitrogen dioxide concentrations, over longer averaging periods, as it does not take account of the variability of measured nitrogen dioxide concentrations.

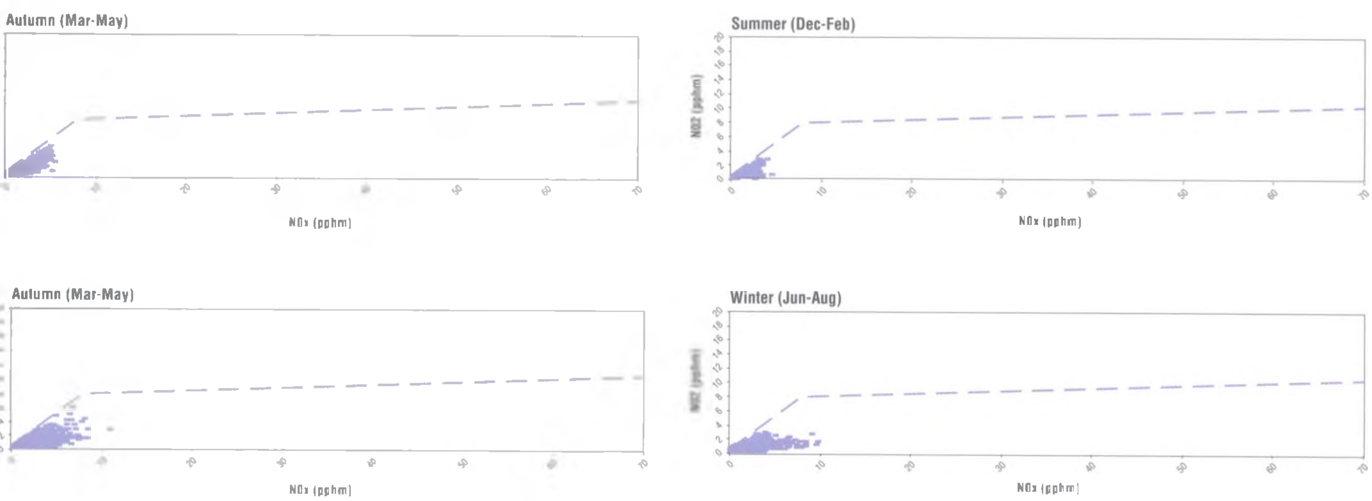
Modelled results for hourly concentrations of nitrogen dioxide are illustrated in *Figure 11.2* for each airport option. They show that under worse case conditions, hourly concentrations of nitrogen dioxide above the 12 parts per hundred million goal would impact on areas within one kilometre of the airport boundary. Similar, but smaller areas of exceedences for long-term average nitrogen dioxide concentrations have been predicted and are shown as *Figures* 7A to 7C in *Appendix D1*, although these are considered to be an over-estimate of the impact on long-term average nitrogen dioxide because of the variability of measured nitrogen dioxide concentrations.

Particulate Matter

Figure 11.3 illustrates predicted peak increases in 24-hour average concentrations of particulate matter of less than 10 microns in diameter for each airport option.



BOTANY (Hourly Data, July 1996 to June 1997)

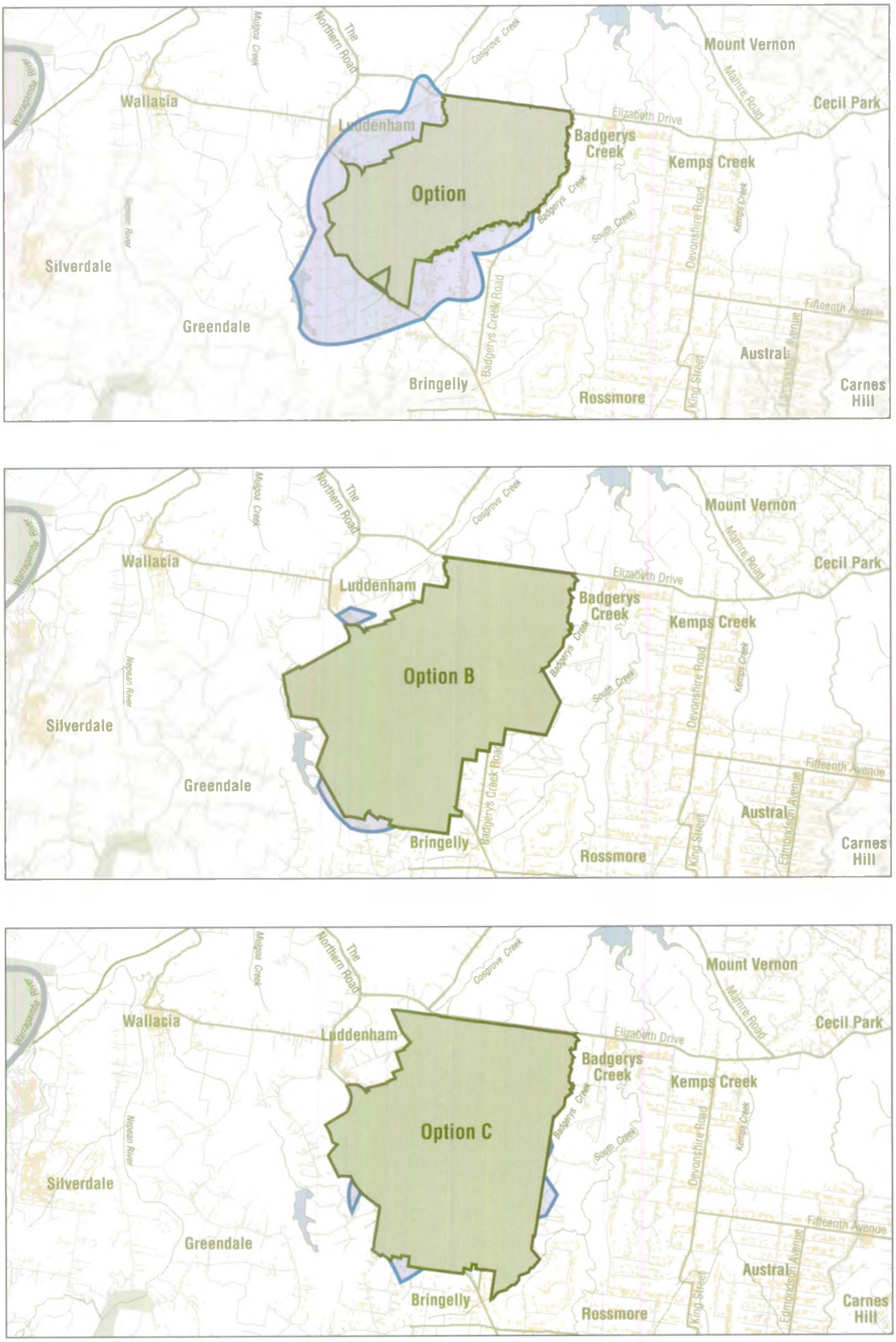


BRINGELLY (Hourly Data, July 1996 to June 1997)

Adopted Envelope — —

Figure 11.1

Graphical Analysis of Nitrogen Oxide Conversion

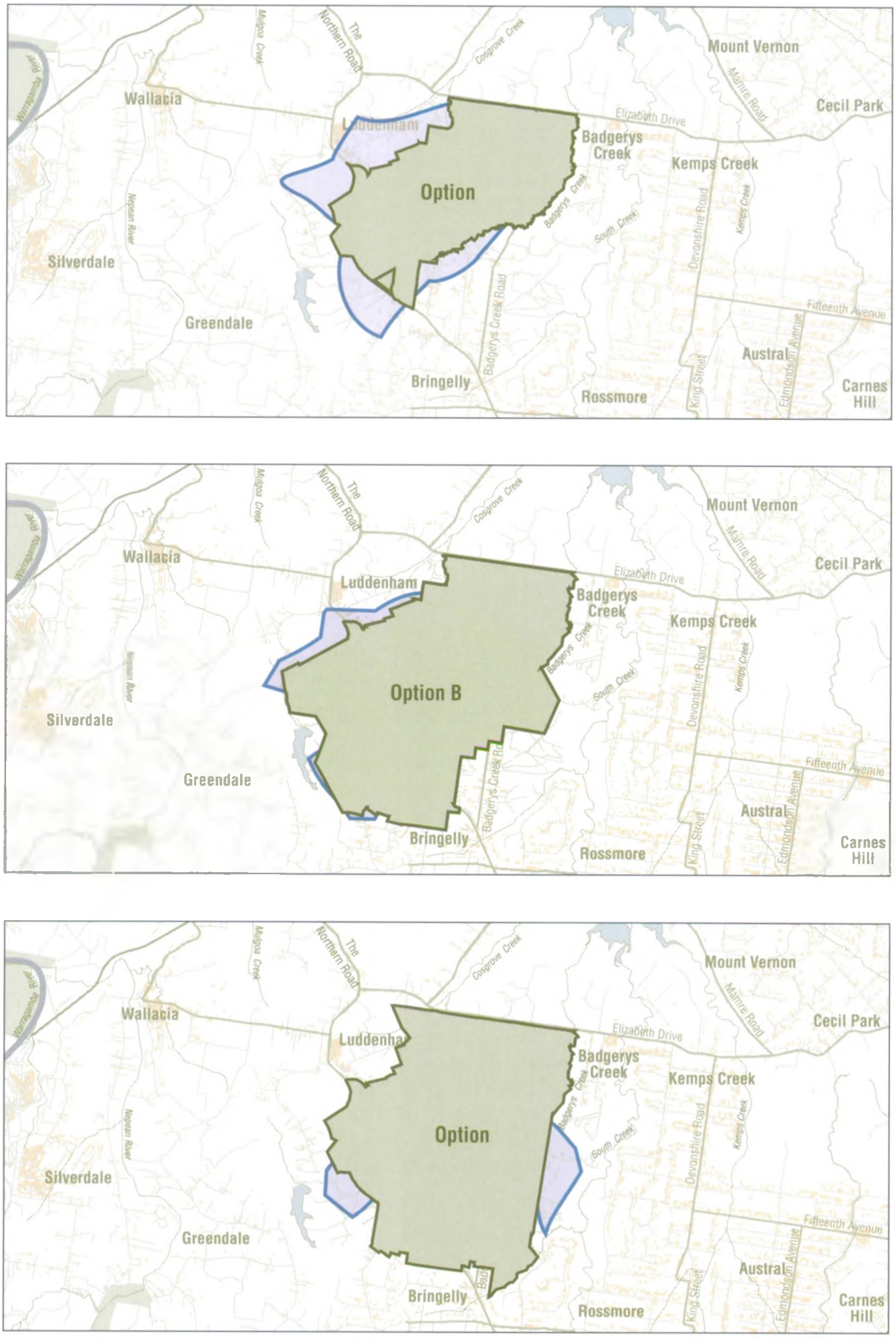


Area predicted to experience exceedence of goal of 12 parts per 100 million (National Environment Protection Council, 1998)

Indicates density of dwellings in 1996

Figure 11.2

Area Predicted to Exceed Peak One Hour Nitrogen Dioxide Goal for Options A, B and C (30 million passengers per year)



Area predicted to experience exceedence of goal of 50 microgram per cubic metre (National Environment Protection Council, 1998)

Indicates density of dwellings in 1996

Figure 11.3

Area Predicted to Exceed Peak 24-Hour Particulates Goal for Options A, B and C (30 million passengers per year)

Concentrations of these particulate matter above the guideline of 50 micrograms per cubic metre (24-hour average) would occur up to one kilometre from the airport boundary in some directions. Modelled increases in annual average particulate emissions are illustrated in *Figures* 9A to 9C in *Appendix D1*. Predicted annual average concentrations are below the current guideline of 50 micrograms per cubic metre beyond the boundary of the airport for each option. Increases in concentrations of fine particulate matter have also been used to assess impacts of the proposed airport emissions on respiratory health. This is discussed in *Chapter 23* of this Supplement.

Sulphur Dioxide

Peak hourly sulphur dioxide concentrations of less than six parts per hundred million are estimated to occur beyond the airport boundary. This is below the applicable one-hour goal of 20 parts per hundred million as shown on *Figures 13A* to *13C* in *Appendix D1*.

Figures 14A to *14C* in *Appendix D1* illustrate potential increases in average sulphur dioxide concentrations. They indicate that there would not be exceedances of the goal (two parts per hundred million). Increases in concentrations of sulphur dioxide have also been used to assess impacts of the proposed airport emissions on respiratory health, which is reported in *Chapter 23*.

Carbon Monoxide

Predicted impacts of the airport and motor vehicle traffic from increased concentrations of carbon monoxide are illustrated in *Figures* 4A to 5C in *Appendix D1*. Modelling indicates that peak increases in carbon monoxide concentrations of up to six parts per million (one-hourly) and two parts per million (eight-hourly) would impact areas near the airport boundary. These impacts are due primarily to motor vehicle emissions and would occur in the vicinity of the main entrance to the airport off Elizabeth Drive. However, the predicted increases would not raise existing carbon monoxide concentrations above the goals of 25 parts per million (one-hourly) and nine parts per million (eight-hourly) respectively.

Conclusions and Comparison with Draft EIS Results

The results of dispersion modelling carried out for this Supplement show higher predicted ground level air quality impacts than those presented in the Draft EIS. The main reasons for these increases in predicted impacts are that a different meteorological data set was used for this Supplement and that emissions from associated motor vehicle traffic have also been included in the analysis. As mentioned previously, meteorological data used for this Supplement was obtained from the Bureau of Meteorology's Badgerys Creek monitoring station. Use of this dataset has resulted in less favourable dispersion conditions that were assumed in the Draft EIS, which used meteorological data recorded at the Macquarie University Badgerys Creek monitoring station.

Nitrogen Dioxide

Nitrogen dioxide impacts predicted for the Supplement are greater than those predicted in the Draft EIS. In addition to a different meteorological dataset and inclusion of motor vehicle emissions, a different approach was adopted for converting oxides of nitrogen to nitrogen dioxide than for the Draft EIS. Additional studies were carried out to improve the estimate of the likely conversion rate of emissions of oxides of nitrogen to nitrogen dioxide. These studies involved reviewing published literature and reviewing hourly air quality records for monitoring stations in western Sydney and monitoring stations in the vicinity of Sydney Airport.

On the basis of this work, a different approach for assessment of nitrogen dioxide concentrations in the vicinity of the Second Sydney Airport was adopted. This empirical approach is illustrated in *Figure 11.1* and also in *Appendix D2*. The revised approach is considered conservative as it relates modelled concentrations of oxides of nitrogen to the highest corresponding nitrogen dioxide level that could be expected, based on existing monitoring data collected within the Sydney airshed.

As mentioned, for the Draft EIS only airport emissions were included in modelled contours. For this Supplement the effects of motor vehicle traffic outside of the airport boundary was also taken into account in producing air quality contours. This has resulted in a rise in peak oxides of nitrogen concentrations in the range of five to 15 parts per hundred million over a broad region.

The net result of a different nitrogen dioxide conversion rate and inclusion of motor vehicle emissions in the vicinity of the airport means that the predicted increase in nitrogen dioxide concentrations in the vicinity of the airport is approximately two-fold greater in this Supplement than was predicted in the Draft EIS. This is illustrated in *Figure 11.2*. Predicted average ground level nitrogen dioxide concentrations obtained for this Supplement are also greater than those predicted for the Draft EIS, owing to the increased frequency of low wind speed and poor dispersion conditions in the meteorological records used for the analysis. The adopted conversion rate of oxides of nitrogen to nitrogen dioxide is conservative for assessment of average concentrations.

Since the Draft EIS was issued the National Environmental Protection Measure for ambient air quality has been released (National Environment Protection Council, 1998). This has established national standards for air quality for a range of pollutants. The National Environmental Protection Measure standard for hourly average nitrogen dioxide was set at 12 parts per hundred million, which is more stringent than the former Environment Protection Authority goal of 16 parts per hundred million.

The net result of this combination of increased predicted nitrogen dioxide concentrations and application of a more stringent goal is that a zone up to two kilometres from the airport boundary is predicted to be subjected to peak ground level concentrations in excess of the National Environmental Protection Measure standard. Exceedences of the goal for average concentrations of nitrogen dioxide of the order of three parts per hundred million are predicted to occur close to the proposed airport boundary, for all three options.

Particulate Matter

Figure 11.3 shows a zone of predicted peak 24-hour ground level particulate matter concentrations in excess of the recent National Environmental Protection Measure (National Environment Protection Council, 1998) for ambient air quality of 50 micrograms per cubic metre. The zone of predicted exceedence of the goal, indicated by the 30 microgram per cubic metre contour, extends up to one kilometre from the airport boundary. The predicted concentrations are due to the combined effect of the airport and motor vehicle traffic associated with operation of the airport. The contours presented on *Figures* 8A to 8C of *Appendix D1* show a strong bias to the north-east of the airport owing to a combination of high frequency of light winds and the presence of additional road traffic along Luddenham Road to the north of the airport site and along Elizabeth Drive to the east of the airport sites.

Increases in particulate matter concentrations (less than 10 microns) of up to 60 micrograms per cubic metre are predicted in the immediate vicinity of the airport sites. Increases of 10 micrograms per cubic metre are predicted up to 15 kilometres distant from the airport sites as shown on *Figures* 8A to 8C of *Appendix D1*. The predicted increases adjacent to the airport boundary are greatest for Option A owing to the closer proximity of aircraft emissions to the airport boundary compared with Options B and C. Impacts at distance from the airport site are similar for the three options.

Increases in peak concentrations are significantly greater than those presented in the Draft EIS. This is due to the higher proportion of low speed winds in the Bureau of Meteorology data used for this Supplement in comparison with the Macquarie University data that was used for the Draft EIS, and the inclusion of the impacts due to motor vehicle traffic associated with operation of the airport.

Sulphur Dioxide

Increases of up to five parts per hundred million are predicted in ground level concentrations of one-hour sulphur dioxide at the airport boundary. However, these impacts are not anticipated to result in exceedence of the National Environmental Protection Measure (National Environment Protection Council, 1998) for ambient air quality standard of 20 parts per million. These impacts, which include impacts due to the proposed airport and related motor vehicle traffic, are slightly greater than predicted in the Draft EIS.

Carbon Monoxide

Increases of five parts per million in peak hourly carbon monoxide are predicted to occur at the northern boundary of the airport site. As with other pollutants, impacts are greatest to the north-east of the site owing to the high frequency of low speed south-easterly early morning drainage flows, combined with the effects of motor vehicle traffic flows along the connected arterial roads. However, exceedence of the Environment Protection Authority goal of 25 parts per million for peak hourly carbon monoxide concentrations is not generally expected. Dispersion modelling presented in *Appendix D3* of the impacts of a single road link indicate that localised exceedences of the carbon monoxide goal could occur in the immediate vicinity of busy roads during peak periods.

As for the other pollutants, the contours have a north-easterly orientation. *Figures* 4A to 4C in *Appendix D1* show the influence of the Luddenham Road link to the proposed airport to the north of the airport. The effects of motor vehicle emissions are more significant for carbon monoxide than for other pollutants since carbon monoxide forms a higher proportion of motor vehicle emissions than of airport-related emissions.

11.4.5 Analysis of Ozone Impacts

Previous Modelling Work

Estimates of the impact of secondary pollutants (such as ozone) requires consideration of the interaction between the airport primary pollutants, background air constituents and air transported into the region from other parts of the Sydney airshed. For the Draft EIS assessments of ozone impact were made using two methods:

- footprint analysis involving trajectory modelling of a wide range of events using observed wind speed data and air quality data; and

- numerical modelling of winds using the CSIRO LADM program for two selected events for which measured ozone concentrations were high in western Sydney.

In both cases emissions from the airport including aircraft emissions in flight up to a height of 1,000 metres were considered but emissions from airport related traffic was not included. The footprint analysis was limited for the Draft EIS because of limitations in the data available for use at that time. Air quality was assessed using records from Campbelltown and wind speed and direction was derived from the Macquarie University monitoring records for Badgerys Creek for 1992.

Recent Modelling Work

Assessment of ozone was reviewed during preparation of this Supplement by carrying out additional footprint analysis as presented in *Appendix D4*. This made use of air quality and wind velocity data from the Environment Protection Authority's monitoring stations in the vicinity of Badgerys Creek (Bringelly, St Marys, Campbelltown, Liverpool, Blacktown and Camden). For this work the effect of emissions from airport related motor vehicle traffic was included. LADM analysis incorporating airport related motor vehicle traffic was not repeated as it was considered that this would not add significantly to the quality of the assessment of the region impacted.

A statistical box model of ozone generation was used for footprint analysis. This methodology essentially applies a semi-empirical photochemical assessment model along air particle trajectories through each monitoring location, taking into account the additional emissions into a given box-slice of the trajectory from airport related motor traffic and the change in mixing height caused by temporal and spatial variability.

The box-model used for the modelling followed conventional techniques used for conservative pollutants and was supplemented with the following features:

- incorporation of available meteorological information, including various diagnostic models to interpolate wind speed and direction, temperature, mixing height and key regional determinants for coastal locations, such as sea-breeze dispersion and shoreline fumigation;
- use of the Integrated Empirical Rate photochemical model along trajectories passing through each monitoring location;
- use of the *Sydney Metropolitan Air Quality Study* emissions inventory to calculate the necessary Integrated Empirical Rate parameters of smog-produced and emitted nitrogen oxides, followed by a partitioning of estimated smog-produced into ozone and other pathways; and
- statistical interpolation and evaluation of the results.

A wind velocity interpolation scheme which is an extension of the common inverse-square procedure, commonly used in diagnostic windfield schemes was used to interpret hour by hour wind speed distribution in the region surrounding the airport.

The model evaluates the trajectories of surface air through each monitoring site together with estimates of mixing depth at each location to set the size of the box into which are emitted further emissions from the various sources (as described in the emissions inventory). The incident air into the upwind side of the box is mixed with the pollutants emitted into the box to give the average concentration of each type of pollutant. From this, the Integrated Empirical Rate methodology (Johnson, 1993) is

Numerical modelling carried out by CSIRO (1997) presents the modelled wind velocity distribution taking account of the topographic effects. Modelling for two high ozone events (4 February, 1991 and 9 February, 1994) showed that ground level transport of emissions from the airport would be limited to a distance of 50 kilometres to the west of the airport. Given the nature of the topography it is reasonable to assume that the westward extent of airport air quality impacts is 50 kilometres. This interpretation is reflected in the assessment of the extent of ozone impacts presented in *Figure 11.4*.

For the period July 1996 to June 1997 eleven high ozone events (modelled as exceeding eight parts per hundred million) were identified. For these events the greatest increase in maximum hourly ozone predicted as a result of airport emissions was 1.1 parts per hundred million. In general predicted increases were less than 0.5 parts per hundred million. For each event the zone affected would be of the order of 10 kilometres in width down gradient from the airport. *Figure 20* in *Appendix D1* shows the predicted extent of increased ozone for an event which occurred on 9 February, 1994 based on results of LADM modelling presented in the Draft EIS. From this figure it is clear that for particular events only a fraction of the area potentially subject to ozone impacts would be affected.

For the period analysed (July 1996 to June 1997), synoptic conditions favouring the development of high ozone occurred on 12 occasions. This agrees well with the number of high ozone events which occurred in that period. The average number of times per year that synoptic conditions favour high ozone is 25. Based on these results ozone impacts due to operation of the proposed airport are predicted to be significant about 25 times per year on average, with increases typically up to one part per hundred million in ground level concentrations.

As mentioned previously, two different cases were analysed to determine the sensitivity of zone predictions to mixing heights. *Table 11.6* presents the impact of the change in mixing height assumption in terms of modelled peak ozone for each of the high ozone events during the year of simulation.

Table 11.6 Sensitivity of Ozone Concentration to Mixing Height

Event Date	Sea Breeze Ignored		Sea Breeze	
	Post Sea Breeze Mixing Height (metres)	Peak Ozone Concentration (parts per hundred million)	Post Sea Breeze Mixing Height (metres)	Peak Ozone Concentration (parts per hundred million)
16 November 1996	1,700	9.0	548	10.4
15 December 1996	2,000	8.6	288	8.7
24 December 1996	1,700	8.1	480	8.1
22 January 1997	2,000	13.1	426	13.6
1 February 1997	1,900	9.9	286	9.9
6 February 1997	1,900	10.3	403	11.1
8 February 1997	1,900	10.4	270	10.8
22 February 1997	1,900	9.5	1,946	9.5
26 February 1997	1,800	11.9	438	12.4
1 March 1997	1,900	9.4	322	10.2
15 March 1997	1,900	8.7	288	9.3

These results indicate that the assumption of mixing height does not strongly influence the predicted ozone concentration. Despite this finding it is recommended that routine measurement of vertical wind and temperature profiles be a part of the monitoring program for the proposed airport. This would provide valuable information regarding the structure of night-time and early morning flows as well as sea-breeze conditions and lead to improved understanding of conditions which may lead to poor air quality in the vicinity of the airport.

Comparison with Results from Draft EIS

Assessment of the ozone impact of the Second Sydney Airport has been upgraded for this Supplement to include the impact of airport related traffic, the sensitivity of estimates to boundary-layer temperature and wind profiles and the use of very recent and detailed air quality and meteorological monitoring in western Sydney. These revisions facilitate a more realistic interpretation of the airport's impact, while maintaining a conservative predictive approach. A similar modelling methodology has been utilised, but now extended to the consideration of all days in a given year (1996/97), with airport emissions at their maximum level.

Box modelling undertaken without airport emissions predicted that the existing maximum and mean ozone exposures would be greater for areas to the west of the airport, mainly due to the continued aging of imported urban air and the lack of titrating nitrogen oxide emissions in the essentially rural areas. The airport would add to this ozone exposure on those 20 to 30 hours per year when a set of conditions for further ozone generation is satisfied.

Box modelling also shows that airport emissions would give rise to significant increases in ozone levels within the plume downwind of the airport, on those few hours per year when photochemically old air reaches the western Sydney basin in the late afternoon. The increments range up to 1.3 parts per hundred million. For the hours corresponding to maximum ambient background ozone concentrations on such days, the increments are typically much less (0.2 to 0.3 parts per hundred million), with only one increment over one part per hundred million for 1996-97 observed background levels. These ozone increments occur typically 20 to 40 kilometres downwind of the airport within a plume of width four to eight kilometres wide. Most events are for easterly winds, and the highest total ozone concentrations are predicted to occur to the west of the proposed airport as shown in *Figure 11.4*.

For the trajectories determined by the 1996/97 air quality and meteorological data, the airport emissions would lead to an additional three exceedences of the hourly ozone guideline for areas 25 kilometres west of the airport. This is a small change compared to the situation predicted in the Draft EIS (33 hours per year).

11.5 Other Local Air Quality Impacts

11.5.1 Hydrocarbon Odours

The potential impact of hydrocarbon odours from the airport was reassessed for this Supplement. As part of this work, odour complaint data from Sydney Airport was reviewed. This is discussed in *Appendix D5*.

Complaint data was obtained from the Airservices Australia database for 77 suburbs in the vicinity of Sydney Airport for the period mid-1995 to mid-1998. These complaints typically related to kerosene-type odours, the smell of aviation fuel or general aircraft fumes. A total of 277 odour complaints were recorded from 24 August 1995 to 29 September 1998, with the number of complaints received in summer and autumn being slightly higher than those received in winter and spring.

The number of odour complainants recorded was less than one complainant per 10,000 people at a distance of greater than 10 kilometres from Sydney Airport. The maximum frequency of odour complaints (excluding Kurnell) was 1.2 complainants per 1,000 people per year, while Kurnell recorded five complainants per 1,000 people per year.

In the *Draft Environmental Impact Statement - Proposed Third Runway Sydney (Kingsford Smith) Airport* (Kinhill, 1990) peak hydrocarbon concentrations were modelled in the vicinity of Sydney Airport. The modelled peak hydrocarbon concentration shown decreased approximately linearly with increasing distance from the airport, and reduced to less than 0.25 milligrams per cubic metre at approximately 9.5 kilometres from the airport.

Odour impacts for the Second Sydney Airport were modelled for this Supplement using the same methodology as adopted for the Draft EIS. Results of modelling for each airport option are presented in *Figure 11.5*. Areas where there would be an annual exceedence of two odour units (which has been taken as a nuisance level) for more than 44 hours per year are indicated. This analysis predicts odour impacts for greater than 44 hours per year would extend a maximum distance of approximately four kilometres from the Second Sydney Airport.

11.5.2 Odours from Proposed Sewage Treatment Plant

Odour emissions from the proposed sewage treatment plant used to service the Second Sydney Airport were also reassessed as part of the preparation of this Supplement. This is discussed in *Appendix D6*. It was concluded that the sewage treatment plant proposed would be a technologically advanced facility with odour control being an integral component of plant design and management.

The Environment Protection Authority has established a design criterion of two odour detection units to be exceeded not more than 0.5 percent of the year (approximately 44 hours) for odour impacts. The two odour detection unit threshold is equivalent to a 0.67 odour unit recognition threshold.

Under normal operating conditions, the potential for odour impacts on surrounding areas is considered to be negligible in terms of the Environment Protection Authority criterion. Even under operating conditions in the event of a plant breakdown, the potential for odour impact on areas outside the airport boundary is considered to be low. *Figures 11.6* to *11.8* show the number of hours for which a level of 0.67 odour units would be exceeded outside the airport boundary, due to the sewage treatment plant. Most affected would be areas to the east of the sites of the airport options.

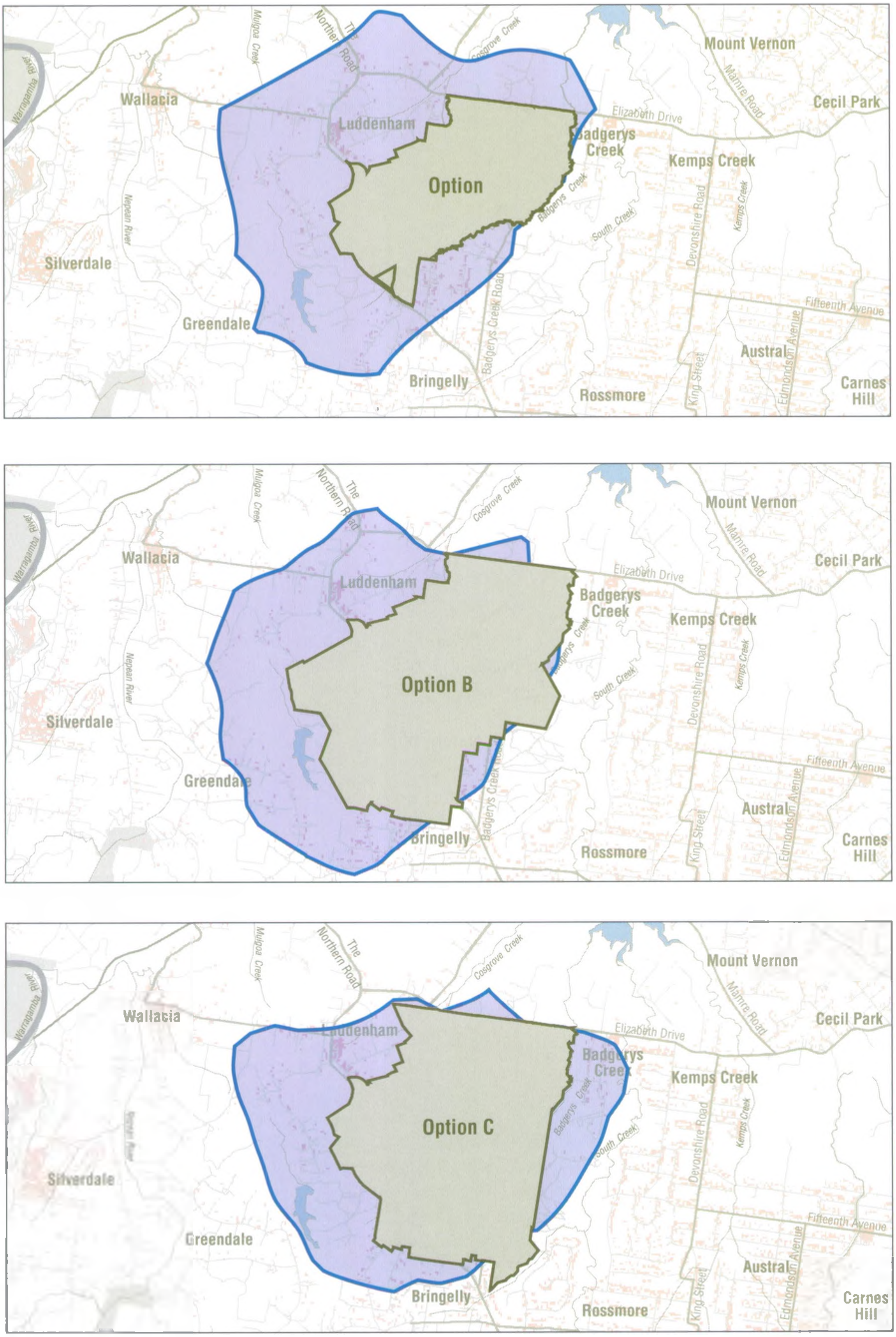
Behind a distance of two kilometres from the treatment plant, the frequency of exceedence of 0.67 odour units would be less than one hour per year. Similar impacts are predicted for each airport option.

11.6 Overview of Responses to Air Quality Issues

11.6.1 Sydney Air Quality

General

Concerns were expressed in submissions to the Draft EIS about a range of air pollutants, including ozone, nitrogen dioxide, brown haze and photochemical smog. These concerns related to the likely impact development and operation of the Second Sydney Airport on Sydney's air quality.



Area predicted to experience more than 44 hours per year of two odour units

Indicates density of dwellings in 1996

Figure 11.5
Annual Exceedence of Two Odours Units due to Hydrocarbons for Options A, B and C (30 million passengers per year)

TN MN N

0Km 5Km

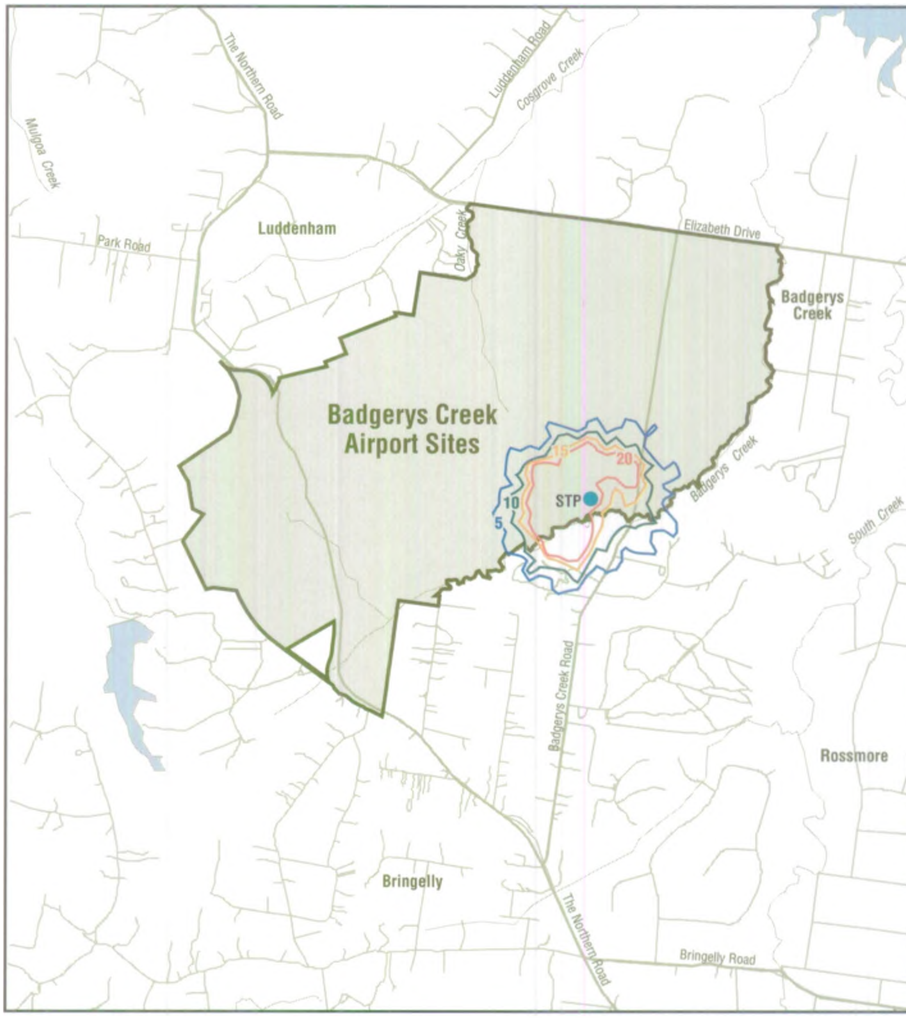


Figure 11.6

Frequency of Exceedance of 0.67 Odour Units due to Sewage Treatment Plant for Option A

The manner in which various air pollutants emitted by human activities react in the atmosphere to cause potentially harmful environmental effects is complex. Not surprisingly there appears to be some confusion over the contribution each pollutant makes in relation to air quality impacts. Photochemical smog and brown haze are the main regional air pollutants in greater metropolitan Sydney, which includes Newcastle and Wollongong. A discussion of these pollutants and the processes which cause them was provided in *Technical Paper No. 6*. A summary of this discussion was provided in Chapter 15 of the Draft EIS.

As well as general concerns about existing air quality it was suggested in submissions that links between meteorology, topography and existing poor air quality in western Sydney were not well documented in the Draft EIS.

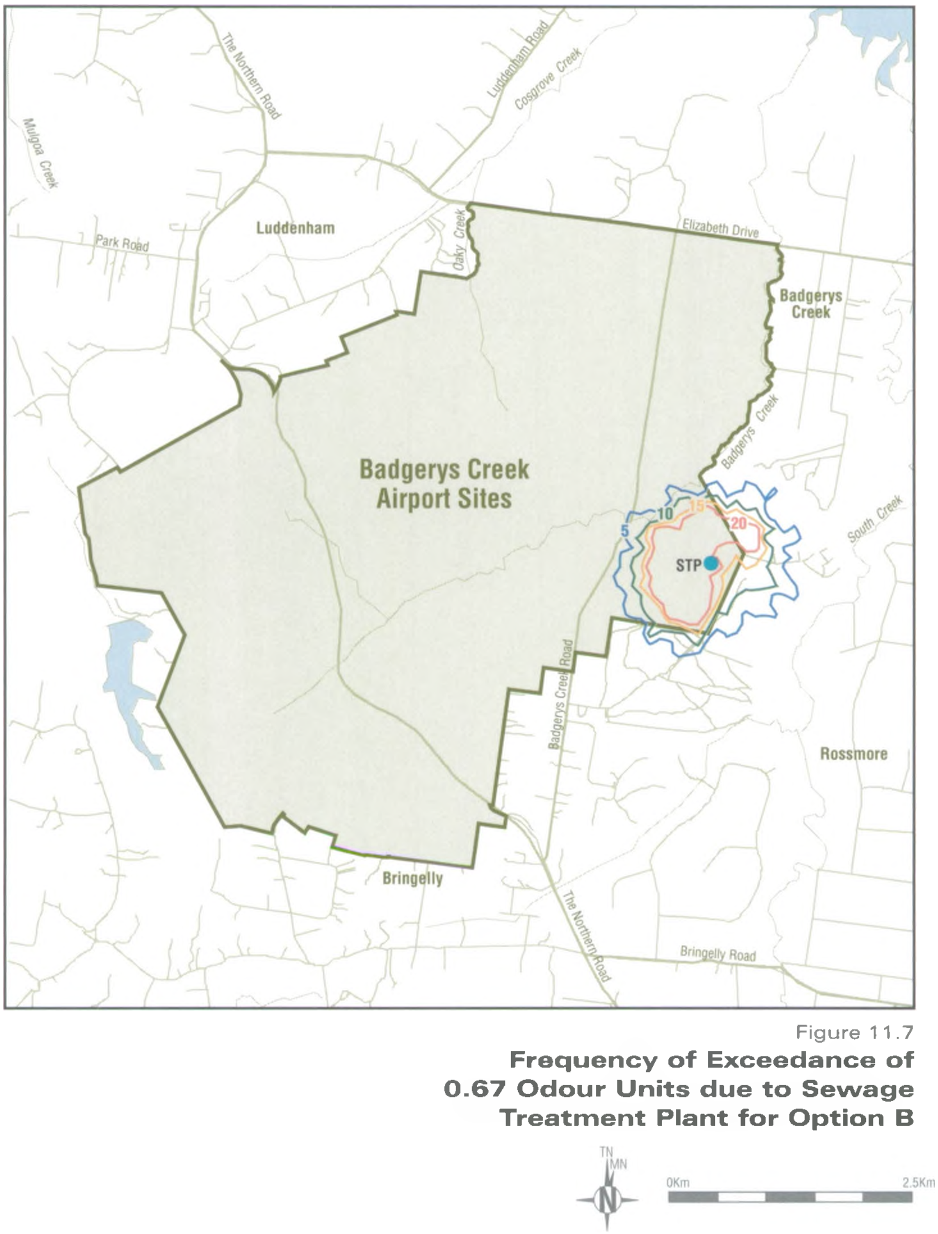


Figure 11.7
Frequency of Exceedance of 0.67 Odour Units due to Sewage Treatment Plant for Option B

Further air dispersion modelling work has been undertaken with an updated meteorological dataset and this, along with a more detailed discussion of the links between meteorology, topography and existing air quality is covered in *Sections 11.4* and *11.5*.

Ozone Events

It was pointed out in submissions that the *NSW State of the Environment Report 1997* (Environment Protection Authority, 1997a) projects significant population growth in western Sydney, and that significant reductions in ozone precursors, particularly oxides of nitrogen would be required to counter the air pollution associated with this growth.

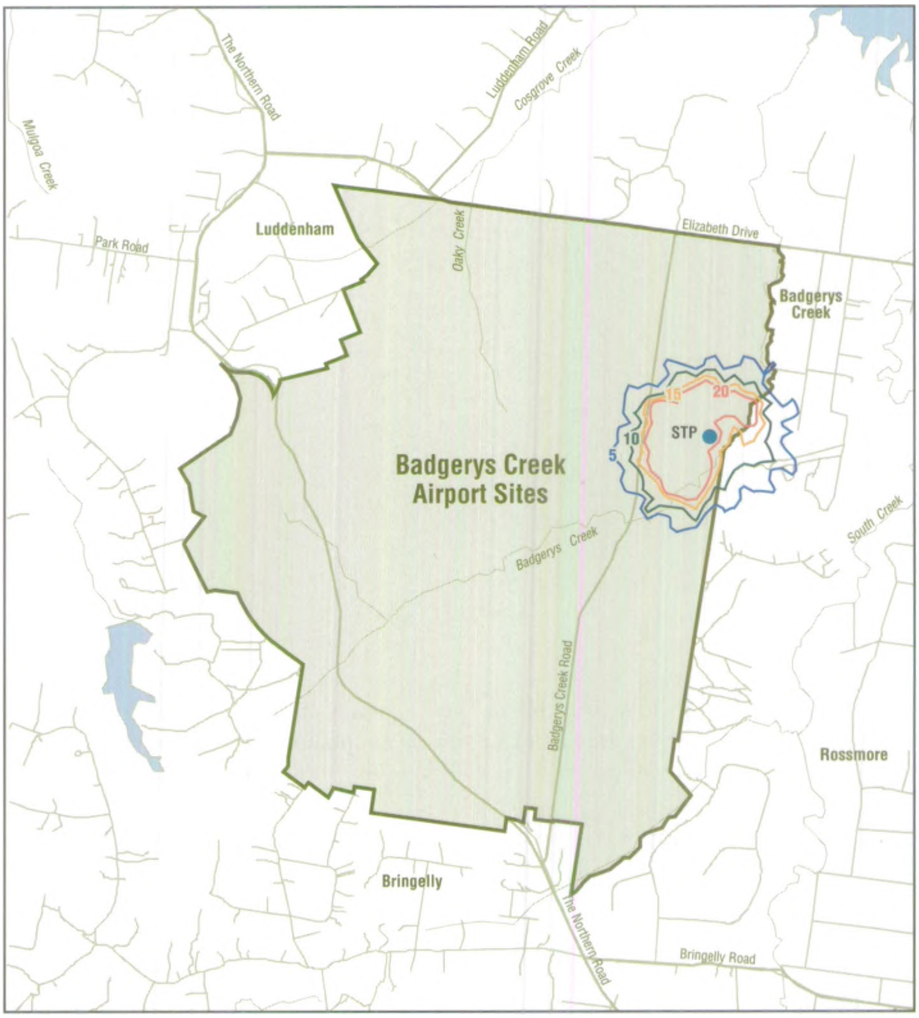


Figure 11.8
Frequency of Exceedance of 0.67 Odour Units due to Sewage Treatment Plant for Option C

In the Draft EIS, it was reported that there has been a gradual decline in the peak monthly levels of nitrogen dioxide, which was considered to be due to improvements in motor vehicle emission control technology. This trend is likely to continue, with gradual phasing out of older motor vehicles and adoption of stricter motor vehicle emission control standards in future.

The Western Sydney Alliance also stated that western Sydney is in an oxides of nitrogen limited photochemical regime and is highly susceptible to increased ozone events. The Draft EIS indicated that occasional exceedences of ozone guidelines occurred in Sydney during the 1990s, in a wide area from the coast to western Sydney. The potential for increased levels of nitrogen dioxide to occur in the vicinity of the sites of the airport options and contribute to increased ozone events is discussed in *Section 11.4.5*. One factor which influences the likely concentrations of nitrogen dioxide is the conversion rate of oxides of nitrogen to nitrogen dioxide. Further investigations have been undertaken in respect to this conversion rate and the results are reported in *Section 11.4.4*.

11.6.2 Methodology

Use of MAQS Model

Submissions included suggestions that the Metropolitan Air Quality Study (MAQS) model should have been used for modelling air quality impacts. The Auditor stated that one of the major shortcomings of the Draft EIS was that analysis of regional impacts and associated developments depended on less sophisticated (but nevertheless valid) methods than the MAQS airshed model, because access to the MAQS model was not possible.

Although it was planned to use the MAQS model, access to the model was not provided by the Environment Protection Authority and independent establishment of a comparable airshed model was not practical. Regional dispersion modelling was carried out using LADM, a sophisticated modelling tool employed for the MAQS study, coupled with an air chemistry model used in the MAQS study. This model was used to predict ozone impacts for two historical events which resulted in high ozone levels. In addition, the frequency and location of ozone impacts was addressed using a simpler model employing air quality and wind monitoring data for a one year period, together with an air chemistry model used in the MAQS study. These tools are considered to provide a reasonable basis for assessment of ozone impacts due to airport operations.

In response to these concerns a review of alternative air dispersion models is provided in *Appendix D7* of this Supplement.

Vertical Profiling

The Auditor acknowledged the need stated in the Draft EIS to undertake further analysis of pollutant concentrations, using data from monitoring stations in the vicinity of Badgerys Creek, to improve the accuracy of existing analysis. There were concerns expressed in submissions that vertical profiling of the atmosphere has not been carried out for an extended period at the sites of the airport options. The Draft EIS recommended that a sensitivity analysis of the results of the air quality study be undertaken, because of the lack of vertical profile data. This analysis would use different assumptions about mixing depths in the modelling process.

A vertical profiling sensitivity analysis has been undertaken as part of the remodelling of ozone impacts with an updated meteorological dataset. This is reported in *Section 11.4.5* of this Chapter.

Air Dispersion Modelling

Some submissions commented that the use of two historical days with high background pollutant levels, to predict a worst-case scenario, was questionable. The Auditor questioned whether meteorological data for two days was sufficient to describe the regional air pollution pattern in the Sydney Basin. Use of the LADM model for ozone modelling is also criticised in some submissions. Comments were also made that the ozone modelling was run for only 24-hours on the two days, when it should have been run for 48 hours, to take into account diurnal effects.

Ozone impacts were assessed for a full year of records as part of the work carried out for this Supplement. Modelling for additional events using the LADM software was considered impractical. The two events which were assessed in the Draft EIS were based on high ozone events which were carefully selected as part of the Sydney Metropolitan Air Quality Study. The relevance of the LADM results for interpretation of ozone impact is discussed in *Section 11.4.5* of this Chapter.

Emission Sources

It was stated in submissions that the emissions inventory in the Draft EIS did not include all important sources and that the level of aircraft emissions had therefore been understated. The emissions inventory for the Draft EIS was provided in Appendix C of *Technical Paper No. 6*. It included estimates of all important sources of emissions, such as internal roadways, airside vehicles and plant, aircraft maintenance and boilers.

Effects of Topography

Submissions suggested that the effects of topography on dispersion of air pollutants were understated. Due to the greater elevation of the sites of the airport options compared to surrounding areas, a conservative assumption of flat terrain was adopted for the purpose of air dispersion modelling. The limitations of the models used for this assessment and other available models are discussed in *Appendix D7* of this Supplement.

The potential for accumulation of pollutants due to a combination of a westerly drainage flow and stable atmospheric conditions also received emphasis in submissions. Impacts of meteorology and topography on air pollution have been taken into account in the modelling work reported in *Sections 11.4* and *11.5* of this Chapter.

Reassessment of Air Quality Impacts

Submissions stated that inadequate meteorological data was used for air quality modelling. A number of submissions recommended that air quality impacts should be reassessed using 1996 and 1997 air quality/meteorology data from Bringelly and adjacent stations. It was argued in submissions that air quality indicators averaged over longer periods might be more significant than the one-hour values presented in the Draft EIS. Criticisms were also made that background pollution levels have been understated and therefore projected pollutant levels had been underestimated.

Re-modelling of air quality impacts using updated meteorological data, which is reported in *Sections 11.4* and *11.5* of this Chapter, addresses these issues.

Future Air Quality Goals

Submissions on the Draft EIS indicated that no account was taken of future air quality goals for nitrogen dioxide and particulate matter, which are likely to be more stringent than current goals, in accordance with the recently announced National Environment Protection Measures (National Environment Protection Council, 1998). These new guidelines are discussed in *Section 11.3.2*, and their impact on air quality modelling results is discussed in *Sections 11.4* and *11.5* of this Chapter.

Submissions also suggested that the airport proposal does not comply with NSW Government policy applicable to large industrial developments which would require no increase in the overall emissions of oxides of nitrogen. The aim of the Environment Protection Authority is to limit and progressively reduce emissions of oxides of nitrogen to achieve a long-term cap on emissions at 1998 licence levels for scheduled premises. For new facilities, the Environment Protection Authority will seek emission limits consistent with best available technology dependent on an economic impact analysis of the cost of achieving these limits. Conformance with the sentiment of this policy requires that a new airport employ this best practice in limiting emissions of oxides of nitrogen.

Odour Impacts

Submissions also suggested that the odour assessment carried out for the Draft EIS was not adequate, because the size of the area affected and its location were not specified. The sources and impacts of hydrocarbon odours which would potentially arise from the Second Sydney Airport are discussed in *Section 11.5*.

Sewage Treatment Plant Odours

Submissions stated that odour studies were inconclusive since the odour impact assessment was based on limited emissions data and there was a lack of detailed design data for this sewage treatment plant. Further concept design work has been undertaken for this Supplement, and an assessment has been made of the potential air quality impacts. This is reported in *Section 11.5*.

Motor Vehicles and Associated Development

Comments were made in submissions that inadequate consideration was given to the contribution to air pollution by motor vehicles, including any increase in motor vehicle emissions attributable to the airport. Concern was also expressed regarding a failure to consider the effect of changes in air quality on existing and anticipated residential and industrial areas.

It was also suggested in submissions that no explanation was given for the assumptions made in calculating emissions predicted in the Draft EIS for associated development and motor vehicle traffic and that associated development and motor vehicles were not included in contours of predicted concentrations above background levels. The Auditor commented that it was not clear whether modelling included those inputs, although it did appear that changes in motor vehicle traffic had been included in the assessment of ozone concentration changes.

Motor vehicle emissions that could result from traffic associated with the Second Sydney Airport were assessed in Section 15.5.2 of the Draft EIS and are further discussed, having used updated meteorological data in *Section 11.4.3* of this Chapter.

Emissions would also be expected from residential and commercial areas that could be developed after the Second Sydney Airport commences operating. In the Draft EIS, it was stated that less than 10 percent of the increase in hydrocarbons and less than one percent of increased oxides of nitrogen and carbon monoxide would result from non-vehicle sources. Area based emissions are therefore small in comparison to those of motor vehicles (generally an order of magnitude lower). For this reason, further detailed analysis was not undertaken for this Supplement.

The significance of comparing airport emissions with an urban area of 20 square kilometres was not stated in the Draft EIS, according to submissions. Emissions from an urban area of approximately the same size as the airport site were estimated and shown in the Draft EIS. This data was provided to provide some context for the reader to understand the scope of emissions.

Greenhouse Gases

Submissions indicated that the issue of increased greenhouse gas emissions was not investigated fully, and that there would be ongoing greenhouse gas impacts due to clearing of land for airport construction. Impacts related to greenhouse gases were discussed in Section 15.5.3 of the Draft EIS.

Natural undisturbed forests are not usually considered to be sources or sinks for carbon dioxide from human activity, as the net reduction in carbon dioxide from photosynthesis is reasonably in balance with increases in carbon dioxide from decay of dead plant material and other sources. Clearing of land for airport construction would cause a one off impact on greenhouse gases which would be spread out over the construction period. This impact would be mitigated by the implementation of the long-term rehabilitation and revegetation measures outlined in *Chapter 14* of this Supplement.

Annual greenhouse gas emissions from the Second Sydney Airport operating at 30 million passengers per year are predicted to be 633 gigagrams of carbon dioxide equivalent (comprised of emissions of carbon dioxide, methane and nitric oxide). This would be equivalent to 0.3 percent of the total NSW greenhouse gas emissions on the basis of current NSW projections extrapolated to 2016.

11.6.3 Air Quality Impacts

Ozone Affected Areas

One comment made about the air quality modelling results was that the increase in frequency in exceedences of ozone health goal levels should have been stated, and the areas downwind of the airport that would be affected should have been identified, rather than just shown on a map. Impacts on populated areas such as Penrith, St Marys, Camden and Campbelltown should also have been analysed, according to submissions.

The increase in frequency of exceedences of ozone health goal levels was stated in the Draft EIS in Section 15.6.2 and identified by way of a map in Figure 15.10 of the Draft EIS. The Draft EIS concluded that the frequency of exceedence would occur approximately six times per year and that 8,000 people in 2016 would live in the areas estimated to be affected by the increase. Ozone impacts have been remodelled using and updated meteorological dataset as discussed in *Section 11.4.5* of this Chapter. As a result of the re-modelling it is now estimated that 6,000 people would be affected by an increased ozone concentration of at least one part per hundred million approximately 25 times per year. As described in *Section 11.4.5*, these occurrences would typically last for approximately one hour up to a total of 30 hours per year when conditions for further ozone generation are satisfied.

Particulate Matter and Other Pollutants

Submissions suggest that the number of people affected by air pollution has been understated in the Draft EIS and that particulate matter, nitrogen dioxide levels and levels of sulphur dioxide are also underestimated. Conservative assumptions with respect to aircraft particulate emissions have been employed. The resulting emissions estimates are considered to be an over-estimate of likely emissions as discussed in *Appendix D3* of this Supplement.

The population estimates on which the air quality impacts are based are described in *Chapter 7* of this Supplement. A review of these estimates has found that the 1996 population on which future population estimates are based represent a slight over-estimate by comparison to the 1995 Australian Bureau of Statistics Census.

The numbers of people whose health is likely to be affected by air pollutants is discussed in *Chapter 23* of this Supplement.

Impacts of Construction

According to submissions, inadequate consideration has been given to the contribution of construction activities to air pollution. Appendix H of *Technical Paper No. 6* contained a detailed assessment of the potential impact of airport construction on air quality.

Dust impacts due to construction would depend on the scheduling and nature of the construction program. A high level of monitoring and control would be required given the size of the project. As no further planning of the construction program has been undertaken since preparation of the Draft EIS it was considered inappropriate to carry out revisions to construction dust impact assessments for this Supplement.

Fuel Dumping

Concerns were expressed about possible fuel dumping locations and about accidental discharge of hydraulic fluids and engine oil from aircraft. Fuel dumping is discussed in *Chapter 20* of this Supplement, which indicates that fuel dumping procedures would continue to be carried out over the ocean, or if over land, at altitudes greater than 1,800 metres to ensure the fuel is completely vapourised.

Levels of Uncertainty

The high level of uncertainty associated with modelling results was not stated in the Draft EIS, according to submissions, even though it affected the reliability of health impact predictions. Uncertainties associated with modelling are discussed in *Appendix D1* which describes dispersion modelling. Uncertainties with vertical windspeed are temperature profiles are discussed in relation to ozone modelling in *Section 11.4.5* of this Chapter.

11.6.4 Other Air Quality Issues

Flora and Fauna Impacts

Comments in submissions suggested no consideration had been given in the Draft EIS to the impacts of air pollution on flora and fauna. A discussion of hazards and risks to flora and fauna arising from exposure to pollutants associated with the proposed airport is contained in *Chapter 16* of this Supplement.

Management of Air Quality

Submissions also stated that the section of the Draft EIS regarding management of air quality was inadequate because it did not include quantitative assessment of the effectiveness of mitigation measures proposed. It was also suggested that management of air quality issues should involve health monitoring strategies.

Methods of managing and mitigating air pollution impacts are discussed in *Section 11.7*, while health monitoring strategies are discussed in *Chapter 23* of this Supplement.

11.7 Environmental Management

11.7.1 Description of Environmental Management Measures

Introduction

Increased emissions of hydrocarbons, oxides of nitrogen, carbon monoxide, sulphur dioxide and particulate matter, predominantly from aircraft exhaust and land-side motor vehicles, would be associated with the Second Sydney Airport. Air quality management would therefore be an essential component of the Airport Environment Strategy for the Second Sydney Airport as described in *Chapter 25* and *Appendix* M of this Supplement.

Procedures to Reduce Emissions

Emissions would arise from a number of different activities at the airport:

- aircraft operations;
- auxiliary power units;
- ground support system;
- fuelling and fuel storage;
- land-side vehicles;
- airside vehicles and plant; and
- sewage treatment plant.

Procedures to reduce emissions from these sources are detailed below.

Aircraft Operations

Mitigation measures for reducing aircraft emissions have been described by the Federal Aviation Authority (1997). Measures which should be considered for incorporation into the Airport Environment Strategy to reduce emissions from aircraft would include reduced engine taxiing and idling, de-rating of take-off power and reduced use of reverse engine thrust. Operating less engines during taxiing and idling would reduce hydrocarbon and carbon monoxide emissions, however, for some aircraft reduced engine idle and taxiing is not feasible due to control and safety concerns. Therefore this measure would only be undertaken at the discretion of the pilot.

De-rating of aircraft power involves reducing engine thrust to the minimum necessary, taking into account the meteorological conditions, aircraft type and weight. Minimising the power setting of the engine reduces the oxides of nitrogen emissions. Again implementing this measure is dependent on safety and noise mitigation considerations and it would be undertaken at the discretion of the pilot.

Reverse thrust is a high powered operation used to slow aircraft to taxiing speed after landing. The use of wheel brakes on long runways rather than reverse thrust would reduce emissions of oxides of nitrogen, but this may lead to increased hydrocarbon emissions due to increased time of the runway and/or longer idle and taxi times. Again the use of reverse thrust would be undertaken at the pilot's discretion and would be dependent on safety considerations.

Other aircraft mitigation measures to reduce pollution from aircraft exhaust would include:

- certifying turbine powered aircraft and aircraft engines to standards relating to fuel venting, smoke emission and gaseous emissions;
- ensuring efficient use of the taxiway system; and
- encouraging aircraft traffic control to delay engine start-up at the terminal, wherever possible, in the event of any delays.

Auxiliary Power Units

Emissions from auxiliary power units can be reduced by turning off the auxiliary power units while the aircraft is docked at the gate and replacing them with power supply from terminal base facilities. A centralised ground power system for both aircraft power and air conditioning would be required. Studies at Tullamarine Airport in Melbourne (V&C Environmental Consultants, 1995) have indicated that the majority of domestic aircraft leave their auxiliary power units switched on to operate the air conditioners, due to the short turn-around time of these aircraft.

Ground Support System

Reductions in emissions from ground support systems would be achieved by replacing those of diesel or petrol with alternative fuels such as electricity, compressed natural gas, liquefied natural gas and liquefied petroleum gas (commonly propane). Conversion to the use of electricity for fuelling of ground support systems, however, would result in the greatest reduction in emissions. Benefits of conversion to other alternative fuels could be evaluated by comparing the emissions factors of two engines of the same size that use the different fuels.

Fuelling and Fuel Storage

Issues that would need to be addressed in the Airport Environment Strategy for minimising emissions from fuelling and fuel storage would include staff training to prevent and minimise the occurrence of fuel spills and provision and maintenance of appropriate equipment and supplies. It would also be important to prepare a liquid spill manual as part of an emergency response plan, to minimise spill response and clean up times. Installation of a vapour recovery system on the jet fuel storage tanks and use of vapour recovery units for aircraft refuelling would also assist in reducing emissions. In addition a vapour return line could be installed for all mobile tankers to permit recovery of vapours from empty fuel tanks.

Land-Side Vehicles

The land-side motor vehicle fleet would be expected to be the greatest source of hydrocarbons and carbon monoxide and the second largest source of oxides of nitrogen, sulphur dioxide and particulate matter emissions at the Second Sydney Airport. This fleet would include vehicles transporting passengers and employees to and from the airport. Therefore, the Airport Environment Strategy should include strategies to minimise the use of land-side vehicles at the Second Sydney Airport and promote the use of public transport. These strategies should include the provision of rail and shuttle bus links to and from the airport and the publication and promotion of timetables and transport links. Economic incentives could also be considered for airport employees who commute as single occupants of vehicles. This could include increased parking rates to encourage the use of public transport.

Airside Vehicles and Plant

Airside vehicles include all vehicles utilised by airport staff to support aircraft operations. It is expected that airside vehicles and mobile plant would make relatively minor contributions to the total emissions based on experience at Melbourne Airport (V&C Environment Consultants, 1995). However, emissions from airside vehicles and plant could be reduced by the use of electrically powered vehicles and plant rather than those fuelled by diesel, petrol, LPG and conventional fuels. The feasibility of using electrically powered vehicles could be assessed as part of the Airport Environment Strategy.

Airport Plant and Maintenance Activities

To reduce emissions from airport plant and maintenance activities all fuel-burning plant and equipment on the airport site needs to be regularly maintained and emissions tested. Low-emission engines such as those powered by electricity, liquefied petroleum gas or compressed natural gas should be used in the ground-support fleet. Solvent-based paints should be minimised by the use of water-based paints for taxiway markings. Chemical products should be recovered and recycled where possible. Licences and approvals required under the Ozone Act should be obtained and all conditions should be complied with. Strategies should be developed in the Airport Environment Strategy to minimise emissions from other sources including:

- emissions of oxides of nitrogen from heaters and boilers;
- emissions of solvent vapours from work rooms; and
- emissions from catering facilities.

The Airport Environment Strategy should also discuss fire-fighting training including pollution control facilities. Fire-fighting training should be conducted on days when meteorological conditions promote dispersion of emissions.

11.7.2 Air Quality Monitoring

Description of Air Quality Monitoring

Air quality monitoring is an essential component of environmental management at the airport and should be outlined in detail in the Airport Environment Strategy. Collection of validated background air quality data is essential prior to construction of the airport. Ongoing monitoring is also important to assess the effectiveness of operational procedures in minimising air quality impacts of each identified airport source. It would also provide information on pollutant concentration trends and enable a database to be prepared. This database could be used for researching urban land use and transportation planning as well as developing and evaluating air pollution abatement strategies and developing and validating air quality diffusion models. Ambient air quality guidelines should be reviewed regularly to ensure that the most updated guidelines are used for comparison with air quality monitoring data. Air quality monitoring stations should be located near the airport site. In selecting an appropriate site for air quality monitoring stations the following should be taken into consideration:

- non-airport-related sources of emissions should not be located between the airport and the airport monitoring station;
- major non-airport-related emission sources should not be located upwind of the airport and the site should be located such that the winds carry airport emissions to the station on a relatively frequent basis; and

- the site should be sufficiently distant from the runways or other individual emission sources to provide an indication of average emissions from the entire airport.

In addition the site should have mains power connected and should be secure. Sites selected should be compared with the requirements of *Australian Standard 2922 - 1987* which covers the siting of ambient air quality monitoring stations. This Standard provides guidance for the siting of the site with respect to the collection of data for specific pollutants, including particulate matter, sulphur dioxide, nitrogen oxides, hydrocarbons and ozone. While monitoring stations to be sited in areas which are likely to receive the greatest impact, stations should also be placed in surrounding residential areas wherever possible.

Other considerations in setting up the air quality monitoring system include the pollutants that can be measured, the ability of the measurement method to measure average pollution levels over a large area and also the ability of the method to measure several pollutants simultaneously. The cost of the method relative to other available technologies including establishment costs is also important as is the level of maintenance required. Of prime importance is the sensitivity of the method relative to guideline levels for the pollutants to be measured. At a minimum, air quality monitoring stations should measure the following criteria pollutants:

- nitrogen oxides;
- carbon monoxide;
- ozone;
- particulate matter;
- sulphur dioxide; and
- hydrocarbons.

Wind speed, wind direction, net radiation, temperature lapse rate, wind direction fluctuations and other parameters that would allow the determination of atmospheric stability, should also be recorded at the monitoring stations. Field odour assessments should also be undertaken periodically by trained odour assessors. It should be noted that the collection of meteorological data for dispersion studies requires specialised equipment, which is different from equipment used for routine weather observations required for climate recording or weather forecasting. Other pollutants that should be measured are those which are listed in the Regulations under the *Airports Act, 1998.*

Recording Complaints

As part of the air quality monitoring system an effective system for recording air quality and odour complaints would be important. The system should include establishment of a toll free number for complaints and use of trained staff to register complaints, record the complaints appropriately (including detailed comments) and record the response provided to the complainant. The process for receiving and investigating complaints should include entering detailed information into a database, including the name and address of the complainant and the time and location of the odour/air quality problem, together with a description of the duration, intensity and alleged source of the problem and (where possible) the meteorological conditions at the time. Regular reports should be prepared summarising and analysing the data, particularly any recurring trends in the data. Odour complaints should be recorded separately from other air pollution complaints and care should be taken to record the meteorological data due to the anticipated correlation between lower wind speeds and higher temperatures with odour problems. This data could be used to formulate an odour map and help manage odour issues associated with the airport.

The data would need to be collected over a relatively long time period to ensure the seasonal variations in complaints/odour conditions are assessed. These seasonal variations may be related to the volatility of kerosene in summer, and the lower wind speeds and more constant wind directions in winter. The number of complaints may also increase in summer due to the increased percentage of time spent by the community outdoors.

As odour complaints may involve the Environment Protection Authority and local councils as well as Commonwealth authorities responsible for investigation of pollution complaints, the system for recorded complaints needs to be simple, effective and centralised to ensure complaints are recorded correctly and are not duplicated.

11.7.3 Community Participation

Community input into the preparation of the Airport Environment Strategy would be an integral part of the process. To assist in this a community liaison forum could be established by the airport lessee, allowing local residents to be part of an ongoing process of evaluation and assessment of the proposed environmental management procedures for the Second Sydney Airport.

11.8 Overview of Air Quality

Sydney's major regional air quality problems are photochemical smog and brown haze. The Environment Protection Authority regards carbon monoxide, sulphur dioxide, lead and air toxics as indicators of potential local air quality impacts arising from particular developments.

Carbon monoxide is produced in motor vehicle and aircraft exhaust. Sulphur dioxide is an acidic gas which, when mixed with water, forms acids that can cause irritation to breathing. It is produced by combustion of fuel containing sulphur. Lead is a poison that can accumulate in the body with continuing exposure. As a result of various initiatives to reduce concentrations of these air quality indicators, recorded levels are generally within accepted goals.

Ozone, nitrogen dioxide and fine particulate matter are considered to be regional air pollutants and contribute to problems of photochemical smog and brown haze. Ozone levels in Sydney have occasionally exceeded air quality goals, while levels of nitrogen dioxide and fine particulate matter have in the past regularly exceeded the current National Environment Protection Council goals.

Construction of the airport options would generate dust and fine airborne particulate matter. Dust and fine particulate levels could exceed appropriate goals outside the airport boundaries. Extensive dust management measures would be required during construction of the airport to reduce these impacts to an acceptable level.

Increased concentrations of nitrogen dioxide, fine particulate matter, carbon monoxide and sulphur dioxide are predicted due to airport operations. Exceedences of hourly goals set by the National Environment Protection Council for nitrogen dioxide and fine particulate matter are predicted outside the airport boundary.

The operation of any one of the airport options would increase ozone concentrations in areas already experiencing occasional occurrences of high background ozone levels. Ozone at ground level can irritate eyes and air passages and might interact with allergies to trigger asthma attacks. Health impacts are also predicted due to increased levels of air toxics and particulate matter associated with aircraft emissions. These health impacts are described in *Chapter 23*.

The number of people exposed to air quality that does not meet relevant goals due to operation of the airport are set out in *Table 11.7*.

Table 11.7 People Exposed to Air Quality that Does Not Meet Relevant Goals Due to the Second Sydney Airport[1] Operating at 30 Million Passengers Per Year

Predicted Impact	Population Affected[2,3]		
	Option A	Option B	Option C
Number of people exposed to peak hourly ozone concentrations of more than 10 parts per 100 million	6,000	6,000	6,000
Number of people exposed to peak hourly nitrogen dioxide concentrations of more than 12 parts per 100 million	500	100	less than 100
Number of people exposed to peak 24-hour particulate matter[4] concentrations of more than 50 micrograms per cubic metre	300	100	less than 100
Number of people who would be able to detect kerosene odours for more than 44 hours per year	1,500	1,000	1,000

Notes:
1. *Effects of motor vehicles are included in the estimates in this table.*
2. *Based on population projections for 2016.*
3. *There are limitations in the accuracy of predicting future populations. Estimates of population greater than 10,000 have been rounded to the nearest 1,000; estimates of population between 1,000 and 10,000 have been rounded to the nearest 500; and estimates of population less than 1,000 have been rounded to the nearest 100. Estimates of population less than 100 are expressed as less than 100.*
4. *Particulate matter less than 10 microns.*

Some residents living near the airport options would experience kerosene odours from operation of the airport which would be detectable for more than 44 hours per year. The number of people of predicted to be able to detect significant kerosene odours emitted from each of the airport options is also provided in *Table 11.7*.

All airport options would increase peak ozone concentration in areas where ozone levels occasionally currently exceed the Environment Protection Authority goal of 10 parts per one hundred million. The number of people exposed to an increase in ground level ozone concentrations greater then 10 parts per hundred million would be approximately the same for all three airport options.

Chapter 12

Geology, Soils and Mineral Resources

Chapter 12
Geology, Soils and Mineral Resources

12.1 Summary of the Draft Environmental Impact Statement

12.1.1 Geology and Mineral Resources

Geological references consulted for the Draft EIS indicate that most of the site surface is underlain by either the Bringelly Shale Unit of the Wianamatta Group, or unconsolidated Quaternary age sediments. The Wianamatta Group has a maximum thickness of approximately 140 metres under the sites of the airport options. Bringelly Shale comprises the following rock types:

- claystone and siltstone;
- laminite;
- sandstone;
- coal and highly carbonaceous claystone; and
- tuff.

A major dyke is located at the south-west corner of the site within an area covered by Options A, B and C (Luddenham Dyke). This dyke tends north-west and comprises basalt and dolerite intruding the sedimentary rocks of the Wianamatta Group.

The Draft EIS identifies three coal seams of the Illawarra Coal Measures underlying the sites of the airport options at depths in excess of 800 metres. The resource comprises medium ash thermal, and coking or coking blend coal. Underground mining of this coal resource would result in subsidence, although indications are that mining would be costly and difficult and, possibly, might not even be feasible.

12.1.2 Soils

The unconsolidated Quaternary age sediments occur as accumulated surface deposits along watercourses including Badgerys Creek. These sediments typically comprise fine grained sands, silts and clays. Soils at the sites of the airport options have been mapped by the NSW Soil Conservation Service and classified into three Landscape Units:

- Luddenham;
- Blacktown; and
- South Creek.

Each of the landscape units has recognisable consistency in topography, soil type, materials, depth, fertility and erosion characteristics as discussed in the Draft EIS.

12.2 Summary of Geology, Soils and Mineral Resources Issues

12.2.1 Issues Raised in Submissions

Methodology and Scope of the Assessment

Concerns raised in submissions focussed on the scope of the assessment and the lack of site specific data and/or adequate consideration of geology and soil impacts. The absence of soil sampling and analysis to assess soil contamination by agricultural pesticides and chemicals that might have occurred at the airport sites was raised as an issue by Communities Against an Airport in Western Sydney. A discussion of soil chemical properties (for example, the potential corrosive effect of soils on buried pipelines and structures) was noted as a shortcoming of the Soil Landscape Unit method used to characterise the soils at the airport sites. Other deficiencies noted in submissions included: the lack of a soil erosion survey; insufficient detail on soil management and erosion control during construction; and inadequate assessment on the geological and mineral resources at the site.

Geological and Mineral Resources

Concerns regarding the sterilisation of the geological and mineral resources at the sites of the airport options were raised by the Western Sydney Alliance and others. Some were concerned that the Draft EIS undervalued the sterilisation of coal reserves within the Illawarra Coal Measures. More detail was also called for in respect of the basalt resource associated with the Luddenham Dyke and the light firing clay and shale deposits.

Soils

In addition to those issues related to soils identified above, concerns were raised in submissions regarding soil management during construction and the impact of certain soil properties. Issues raised included: the potential for acid sulphate soils; erosion, dispersive and chemical properties of soils; and the potential for existing soil contamination.

12.2.2 Issues Raised by the Auditor

The Auditor found that, because the Second Sydney Airport would involve major earthworks, additional information was required addressing the issues of erosion potential and control, the chemical properties of the soil, the potential for soil contamination, the types and volumes of fill, and the need for any land monitoring programs.

The Auditor found that mineral resource issues had been adequately covered.

12.3 Response to Geology, Soils and Mineral Resource Issues

12.3.1 Methodology and Scope of Assessment

Geological conditions at the sites of the airport options are stable. Land uses within the boundaries of the airport sites are predominantly agricultural and rural/residential, as described in Chapter 10 of the Draft EIS. Detailed assessment of the soil and geological conditions that underlie the sites of the airport options is contained in the Sydney Second Airport Concept Design Report Volume 3, Geotechnical Investigation *Part A* and *Part B* (Coffey Partners International, 1991).

This report includes the results of investigations that involved a range of field and laboratory techniques, including test pit excavation, drilled bore holes, seismic refraction survey, terrain evaluation using aerial photographs, ground truthing and tests to determine engineering properties and rock sample strength and durability properties.

Most of the geological and soil references consulted in the 1991 report were also consulted for the Draft EIS and this Supplement. These references included geological and soil maps prepared by various government organisations.

A comprehensive assessment of the soils at the site of Option A was also prepared in 1991 (Soil Conservation Service of NSW, 1991). The soil types found at the site of Option A were described in detail and erosion and sediment control measures, design guidelines, stockpile management, and soil stabilisation rehabilitation were identified.

Due their direct relationship with the design, some of the issues raised in submissions would more appropriately be considered at the detailed design stage. For instance, detailed geotechnical investigations involving soil sampling and laboratory analysis would be undertaken to determine the chemical properties of soils and their effect on buried structures. Based on previous investigations, the chemical properties of the soils at the sites of the airport options are considered to be typical of soils generally found within the Sydney metropolitan area and, accordingly, no significant issues are anticipated which cannot be dealt with at the detailed design stage. Soil sampling to determine the level of contamination with pesticides and agricultural chemicals would normally be undertaken after completion of a comprehensive test study that indicates whether contamination might have occurred. For the sites of the airport options, potential soil contamination from these sources would be initially assessed by an examination of current and past zoning, and from the development of a site history using research of land title records and interviews with past and current property users. Areas that were identified as potentially contaminated above NSW Environment Protection Authority guideline levels would then be further investigated, and the soil sample analysed.

During the geotechnical investigations undertaken in 1991 (Coffey Partners International, 1991), soils at the site of Option A were assessed as part of a terrain evaluation and soil landscape study. This soil landscape study used the Penrith 1:100,000 Geology Map consulted for the Draft EIS and the results are therefore similar. An important component of the terrain evaluation (Coffey Partners International, 1991) was the consideration of the soils at the site of Option A. This involved interpretation of aerial photographs, plotting of geological and soil boundaries onto topographical sheets, walk-over surveys and correlations with sub-surface investigation results.

12.3.2 Mineral Resources

Light Firing Clay and Shale Resource

Areas surrounding the sites of the airport options are identified by *Sydney Regional Environmental Plan No. 9 - Extractive Industries*, as having deposits of clay and shale of regional significance. The principal aim of this plan is to ensure that existing extractive mineral resources of regional significance are protected, and that the existence of the resource is taken into account when considering proposals for development. The sites of the airport options overlap approximately five percent of the clay/shale resource identified in the plan.

A possible light firing clay and shale quarry identified in Schedule 1 of the *Sydney Regional Environmental Plan No. 9* is located at Lot 3 DP 623799 Adams Road, Luddenham. The proposed quarry site is located west of Oaky Creek, south of Elizabeth Drive. Road access is from Adams Road. The proposed quarry does not fall within the proposed boundaries of Options A or B, but does fall within the boundary of Option C, in an area identified for approach lighting.

Three EISs have been prepared for the site, the most recent in 1995 (R A Cole Town Planning, 1995). The development application which accompanied the latest EIS was refused by Liverpool Council for reasons unrelated to the airport proposal. The 1995 EIS calculated reserves of the resource to be 7.3 million tonnes. The light firing material occurs below a depth of about four metres and is proposed to be quarried over a period of approximately 12 years. The depth of excavation has been estimated to be 25 to 32 metres.

While development of the quarry might not be precluded under Options A and B for the airport, it is likely that, due to the proximity of the quarry to the airport boundary, limitations would be imposed on the quarry's operation. In response to requests for comments on the proposal, the Federal Airports Corporation in 1995 expressed concern regarding the proposal in relation to the then-proposed general aviation airport at Badgerys Creek and considered that the following issues should be addressed: height restrictions (approximately 45 metres above ground level); pollution control – air, water quality and noise; likelihood that access by the airport's roads to the quarry would be restricted; and the need to control bird and wildlife populations.

The location of the proposed quarry, immediately north of the western-most north-south runway in an area dedicated to approach lights, would otherwise sterilise the resources of light firing clay and shale which fall within the boundary of Option C. Given the likely timeframe until airport operations begin, it would be possible to quarry a portion of the resource over a shorter period.

Advice from the NSW Department of Mineral Resources (dated 2 June, 1997) received during preparation of the Draft EIS and contained at Appendix A of *Technical Paper No. 9* which states that the clay/shale resources at Badgerys Creek were investigated in a drilling programme at the time of the original proposal to site the second airport there. The conclusion was that no potentially economic deposits of light firing clay/shale were delineated within the proposal and the potential for the discovery of such resources is considered to be low. It should be noted that this advice related only to Option A. Only Options B and C overlap, by approximately five percent, the clay and shale resource identification in *Sydney Regional Environmental Plan No. 9*.

Basalt Resource

No sites containing sources of coarse aggregate considered to be regionally significant under *Sydney Regional Environmental Plan No. 9 - Extractive Industries*, are located within the sites of the airport options.

The main potential basalt resource at the site of the airport options is the Luddenham Dyke. Dyke characteristics were investigated (Coffey and Partners International, 1991) using vertical and angled bore holes. The width of the dyke ranges between six metres and 12 metres, with the higher parts of the ridge dipping to the south-west at about 85 degrees, that is, near vertically. A disused basalt quarry located immediately to the east of The Northern Road, approximately midway between the northern and southern extent of the site of the airport options.

Owing to its relatively narrow width and depth, the Luddenham Dyke is considered a resource only suited to quarrying activities generally only near the surface. It is noted the disused basalt quarry is located along a section of the Luddenham Dyke where its width is reportedly at a maximum. The possibility exists to quarry this resource in areas affected by bulk excavation works and retain the product for use in construction works, depending on the depth of the dyke and the extent of excavation at that location

Coal Resource

The Draft EIS indicated that the known seams of coal which underlie the sites of the airport options are considered to be difficult to mine. This is owing to the considerable depth (more than 800 metres) and narrowness of the seams. Coal mining is not currently undertaken in the surrounding areas. It is arguable in these circumstances whether mining the resource is likely to be either economically viable or technically feasible. Proceeding with the proposed Sydney Second Airport would sterilise between 63 and 84 million tonnes of this coal resource across the entire site, depending on the option. This assessment is based entirely on advice provided during the preparation of the Draft EIS by the NSW Department of Mineral Resources.

Sterilisation of Mineral Resources

The potential impact arising from the sterilisation of known mineral resources at the sites of the airport options is low. The quantities of regionally significant clay/shale resource within the sites is a small proportion of the total resource identified under *Sydney Regional Environmental Plan No. 9*. Mining of this resource or the basalt resource is not necessarily precluded under any of the airport options and opportunities to mine these resources would be further investigated during planning for construction. The feasibility and economic viability of mining the type of coal resource identified at this location has yet to be demonstrated in Australia.

12.3.3 Soils

Potential for Acid Sulphate Soils

Acid sulphate soils contain iron sulphide which can generate sulphuric acid in the presence of oxygen and water. The resulting acidic leachate can dissolve clay soil particles thereby releasing aluminium and iron. Heavy metals could also be produced as part of the reaction.

For any adverse environmental impact to occur, potential sulphate acid soils or actual acid sulphate soils and appropriate conditions need to exist. Acid sulphate soils are likely to occur in sediments of recent (Holocene) geological age, soil horizons with a surface level less than five metres Australian Height Datum and in marine or estuarine depositional environments.

Topographic information contained on the 1:25,000 scale Warragamba (9030-3-S) and Penrith (9030-3-N) sheets indicates that the elevation of the sites of the airport options is between approximately 40 metres and 120 metres (Australian Height Datum) above mean sea level. These levels indicate a low probability of potential acid sulphate soil and actual acid sulphate soil are not likely to be present at the sites of the airport options.

Reference to the Department of Land and Water Conservation Acid Sulphate Soils Map Index shows that an Acid Sulphate Risk Map covering the site of the airport options has not been prepared. The western boundary of the closest sheet (Liverpool) is located approximately two kilometres east of the site of the airport options.

Information on acid sulphate soils is also shown on the Soil Landscape Series Sheets prepared by the Department of Land and Water Conservation. The sheet relevant to the site of the airport options is the Penrith Sheet (9030), prepared at a scale of 1:100,000. This sheet identifies the Luddenham, Blacktown and South Creek soil landscape units for the area. Acid sulphate soils have not been associated as a limitation with these landscape units by the Department of Land and Water Conservation.

Apart from Quaternary Age alluvium deposits along Badgerys and Cosgrove Creeks, the site soils comprise residual material formed from the in situ weathering of the underlying parent bedrock. Residual soils are also not Potential Acid Sulphate Soils or Actual Acid Sulphate Soils.

Owing to the elevation of the sites for the airport options, sediments in creeks and gullies would have been sourced from a process involving the weathering of parent bedrock and the transportation of residual soils. This process is not expected to be an environment that results in the formation of acid sulphate soils. In the event that acid sulphate soils were identified on the site during construction, the soil would be managed in accordance with the measures outlined in *Section 12.3.5*.

Erodability, Sedimentation and Dispersiveness

Development of the site of the airport options would result in substantial site disturbance. Previous investigations have been carried out to determine and assess soil characteristics in the area (Soil Conservation Service of NSW, 1991).

This investigation has recognised soil erosion as an existing feature of the Blacktown Landscape Unit, South Creek Landscape Unit and the Luddenham Soil Landscape Unit. For each soil landscape unit the level of existing erosion is relatively low, significant and of high potential respectively. Soil erosion is localised to areas of inadequate surface vegetation, areas of existing disturbance, stream banks and water flow. Measures which could be undertaken to mitigate the effects of soil erosion are identified in *Chapter 25* of this Supplement.

Soil dispersiveness is the tendency of a clay soil to form a colloidal cloud in the presence of water. The main consequence of a potentially dispersive soil for any engineering works is the potential for piping failures of embankments and water retaining structures constructed with these types of soils. Dispersive soil laboratory testing was undertaken (Coffey Partners International, 1991) for the Badgerys Creek Second Sydney Airport Concept Design Report. Results indicate, for the samples tested, soils to be moderately to slightly dispersive with Emerson Dispersion Classes of two and three. The soil samples were taken from various test-pit excavations located in the area of Bringelly shale west of Badgerys Creek. Dispersive soils have been used successfully for construction provided this characteristic is recognised and appropriate measures are undertaken during the design and construction phases. To counter the effects of soil dispersion, measures that would be adopted include the selection of non-dispersive or low-dispersive material for construction, addition of lime or gypsum during construction, and adequate soil compaction during construction. Use of a potentially dispersive soil generally requires compaction of the soil during construction at a moisture content above its Optimum Moisture Content. This requirement is normally specified in the engineering documents prepared for construction and controlled by normal quality procedures. This requirement would normally be specified in an erosion and sedimentation control plan as outlined in *Section 12.3.5*.

Soil Contamination

Soil contamination at the sites of the airport options is expected to be limited to the impacts from agricultural activities. The levels of agricultural chemicals and pesticides is expected to be low. This is because most of the sites of the airport options have been used for either extensive grazing or for the production of vegetables for human consumption.

The extent of contamination from the use of agricultural chemicals including pesticides would be reviewed during the detailed design stage, on the basis of current and past zonings, a search of land title records and interviews with current and past land users to develop a site history for each property of concern. Site specific investigations would then be undertaken for sites or areas that are identified as potentially contaminated. Identified areas of contamination would be remediated in accordance with the relevant NSW Environment Protection Authority guidelines (Environment Protection Authority, 1994c; 1995; and 1997) and the *Australian and New Zealand Guidelines for the Assessment of Contaminated Sites* (Australia and New Zealand Environment Conservation Council and National Health and Medical Research Council, 1992). Assessment of soil contamination includes consideration of the end use of the particular site. For example, development of an airport would not be considered to be as sensitive a land use as a residential development.

It is intended to achieve a balance of cut and fill during construction of the airport as described in Chapter 9 of the Draft EIS. Should it become necessary to import fill, only material meeting the relevant NSW Environment Protection Authority guidelines (Environment Protection Authority, 1997) would be sourced.

Construction Material

Appropriate planning is required to reduce the potential adverse environmental impacts from the use of soil and rock construction material. Although the preliminary construction program for Options A, B and C aims for an overall balance of cut and fill, that is, no excess excavated material, the staging of the project could result in a significant amount of site excavated material stockpiled on site during the construction period. The main concerns associated with large site stockpiles are the potential for erosion, generation of wind borne dust, and subsequent possible sedimentation.

Construction of Stage 1 of both Options A and C respectively would require the importation of three and two million cubic metres of earthworks, in excess of the estimated cut volumes. These differences in cut and fill volumes for both these options are maintained at the completion of the master plan. Option B aims for balanced cut and fill at the completion of the master plan, however, there is an excess of 19 million cubic metres of cut material at the completion of Stage 1. All the Stage 1 Option B material removed during construction would be placed as bulk compacted earthworks during Stage 1. This approach would assist in minimising the cost of double handling material from site stockpiles and reducing the quantity of stockpiled material requiring environmental management.

A management plan would be prepared prior to construction to address these issues together with appropriate construction scheduling to reducing any adverse impacts.

Clay Soil Reactivity

Reactive clay soils are prone to shrink-swell movements with changes in soil moisture content. The engineering consequences of reactive clay soils are recognised and have been incorporated into *Australian Standard 2870 - Residential Slabs and Footing Code.*

This code enables classification of a soil subsurface profile into various classes as a basis for footing design and the type of structure that may be constructed. The classes range from Class A, for a sand and/or rock profile, to Class E, for extremely reactive clay sites. The impact of clay soil reactive is an issue that would be assessed during the detailed design stage.

During the geotechnical investigation undertaken for the *Badgerys Creek Second Sydney Airport Concept Design Report* (Coffey Partners International, 1991) selected soil samples were tested to determine shrink/swell parameters to assess clay soil reactivity. This resulted in the areas tested being classified as moderately to highly reactive (Class M to Class H). If specific soil testing is not available or not undertaken, *Australian Standard 2870* also enables classification of a soil profile on the basis of the depth of the clay soil profile.

Clay soil reactivity would be assessed during the detailed design stage.

Slope Instability

Slope stability issues were discussed in *Technical Paper No. 7* of the Draft EIS. As noted, an area of potential slope instability is located on parts of a ridge line that extends southwards from Luddenham and at the western extent of the airport options.

Seismic Activity

The *Earthquake Hazard Map of NSW* contained in *Australian Standard 1170.4-1993*, shows no variation in the earthquake coefficient for the entire Sydney region. This indicates the site of the airport options should be considered no more earthquake prone than the Sydney region in general. During detailed preliminary design, the design requirements contained in *Australian Standard 1170.4, Part 4* should be considered together with the effect of various types of subsurface conditions which would include shallow rock and lesser strength materials.

Chemical Properties

The chemical properties of uncontaminated soils within the Option A, B and C area are expected to be typical for soils in the Sydney area and not result in any significant design limitation for buried structures and pipelines. These chemical properties would be assessed at the detailed design stage.

12.3.4 Environmental Management

Management of Acid Sulphate Soils

An Acid Sulphate Soil Management Plan is required if acid sulphate soils are present at the site of the airport options and are disturbed by the construction process.

The NSW Acid Sulphate Soil Management Advisory Committee (1998) *Acid Sulphate Soil Manual* details the requirements for an acid sulphate soil management plan. As part of the process, the extent of actual acid sulphate soils and potential acid sulphate soils is to be defined. A desktop assessment including reference to acid sulphate soil risk maps and site inspection(s), followed by a subsurface investigation and soil and water analysis should be undertaken if acid sulphate soils are suspected. An acid sulphate soil management plan should include details on:

- existing soil and groundwater conditions;
- site specific management issues and potential impacts;

- recommended management measures for both construction and operational phases;
- monitoring requirements; and
- contingencies should monitoring indicate a significant impact.

A number of procedures may be undertaken for both the construction and operational phases to minimise the impacts of acid sulphate soils. These procedures include:

- avoidance;
- oxidation prevention by water table control, in situ capping or removal and burial below the water table;
- acid neutralisation by the uses of alkaline agents such as agricultural lime;
- leachate treatment; and
- disposal of landfill.

Erosion Control

Specific methods which exist to manage erosion and sedimentation impacts are identified in the *Second Sydney Airport at Badgerys Creek Concept Design Report* (Soil Conservation Service of NSW, 1991). To control soil erosion within environmentally acceptable limits an erosion and sediment control plan is required for the construction and optional phases of the project together with appropriate civil design that includes diversion banks and channels, and sediment basins.

The erosion and sediment control plan would be prepared at the detailed preliminary design stage. The erosion and sediment control plan is required to consider erosion and sediment issues for stockpiles of imported and site excavated material, cuttings and embankments, construction roads and excavation. Methods that may be adopted include the construction of diversion banks and channels, sediment basins, the use of sediment traps during construction, and revegetation.

Protection of exposed soil faces may be undertaken by a number of methods including hydromulching, or installation of rip-rap and gabions. Appropriate construction scheduling should also be determined during the planning stage to reduce site erosion and sedimentation.

Management of Potential Soil Contamination

If contamination is confirmed at the site of the airport options, management could include the development of a remediation action plan as part of the environmental management plan for construction as described in *Chapter 25*. This plan would include references to relevant guidelines for the treatment and management of contaminated soils (Australia and New Zealand Environment Conservation Council and National Health and Medical Research Council, 1992; Environment Protection Authority, 1994c; 1995; 1997; and 1998c).

12.4 Overview of Geology, Soils and Mineral Resources

The geological and soil conditions at the site of the airport options were determined from published reference material and from examination of results of geotechnical investigations. The near surface geological conditions generally comprise sedimentary rocks of the Wianamatta group with small areas of Quaternary Age sediments that have accumulated as surficial deposits along creeks.

Known mineral resources at the sites of the airport options include light firing clay and shale, basalt and coal. Three coal seams of the Illawarra coal measures underlie the site at a depth exceeding 800 metres. Due to the depth and the thickness of the seams, the NSW Department of Mineral Resources considers the mining of this resource not to be technologically feasible and economically viable.

Light firing clays and shales are identified in the area surrounding the sites of the airport options by *Sydney Regional Environmental Plan No. 9 - Extractive Industries*. The portion of the resource contained within the sites of the airport options is estimated to be approximately five percent. Extraction of part of this resource may be possible before the airport becomes operational to avoid its sterilisation.

A geological feature of the area, the Luddenham Dyke, has not been identified under *Sydney Regional Environmental Plan No.* 9 and is, therefore, not considered to be a significant potential source of basalt aggregate (Coffey Partners International, 1991).

Acid sulphate soils are unlikely to be present at the sites of the airport options. This is due to the geological age of sediments, the elevation of the site and its distance from the coastline. Further examination of soil chemical properties would be undertaken as part of the detailed design. Although potential does exist for contamination of soil, the predominant agricultural and rural/ residential use of the sites of the airport options are expected to result in low levels of agricultural chemicals and pesticides. More detailed investigations would be undertaken during the detailed design stage following procedures set down by the NSW Environment Protection Authority. Management of imported fill would also be undertaken in accordance with NSW Environment Protection Authority guidelines. Construction scheduling and soil properties indicate the potential for soil erosion and sedimentation. Accordingly, a comprehensive Erosion and Sedimentation Control Plan would be prepared prior to the commencement of construction as part of the environmental management plan.

Chapter 13

Water

Chapter 13
Water

13.1 Summary of the Draft Environmental Impact Statement

13.1.1 Methodology

The Draft EIS made use of data derived from several studies (for example, Second Sydney Airport Planners, 1997a; Taskforce on Planning for the Sub-Region Surrounding Sydney West Airport, 1995; and Sydney Water, 1995), supplemented by additional field surveys of ground and surface water quality. Assessment of flood impacts was based on hydrological work undertaken to assist airport planning and design (Second Sydney Airport Planners, 1997a). Potential for pollution of drinking water supplies by aircraft emissions was assessed by estimating concentrations of indicative compounds and comparing these with water quality guidelines.

13.1.2 Existing Environment

The existing water environment was described in detail in the Draft EIS. In summary, most of the area of the sites of the airport options is located within the upper reaches of the South Creek catchment, which drains into the Hawkesbury Nepean River System.

Creeks flowing through and near the sites are generally of poor water quality. Water quality in the South Creek catchment as a whole is poor, with elevated suspended and dissolved solids, nutrients and coliforms. Three sewage treatment plants discharge into the lower reaches of the South Creek system, providing a continuous flow and source of nutrients.

The Nepean River is important as the location for a wide range of recreational activities and for the supply of potable water and water for agricultural purposes. Water quality in the upper reaches of the Nepean River is good but it deteriorates progressively downstream.

The Hawkesbury River downstream of South Creek is subject to algal blooms and frequently has high levels of turbidity and coliforms.

Lake Burragorang, on the Warragamba River, approximately 10 kilometres west of the airport sites, is the major source of water supply for Sydney.

Groundwater occurs in limited quantities within and near the airport site. It is too saline for most purposes and no users of it were identified.

13.1.3 Impacts on Water

Construction Impacts

In the Draft EIS, the major impact of the construction of the Second Sydney Airport was identified as the filling and replacement with stormwater drains of approximately five kilometres of stream for Option A, 10 kilometres for Option B and 10 kilometres for Option C.

Short-term impacts on water quality from sediment releases might occur during construction and possible longer-term impacts from nutrient loading released from these sediments might occur during operation of the proposal.

Groundwater encountered in construction would be likely to be saline, creating potential for increased salinity in surface water run-off. Overall impacts on the groundwater environment were predicted in the Draft EIS to be minor.

Operational Impacts

The findings of the Draft EIS demonstrated that Second Sydney Airport operation would result in an increase in total run-off of stormwater with a corresponding increase in stream flows. However, flooding risks were not expected to increase as detention ponds would be designed to reduce peak flow rates off the site to less than the pre-development flow rates. Further studies were recommended to confirm that the risk of downstream flooding would not be increased.

Impacts on stream water quality from discharges of treated stormwater would be minor, but there is potential for eutrophication and resultant increased algal growth in local and regional streams if sewage effluent were to be discharged from the airport. Further baseline monitoring of streams was recommended.

Localised changes in groundwater levels were anticipated, but overall impacts were expected to be minor. Installation of a monitoring network was recommended to obtain a thorough understanding of groundwater and enable any risks to be identified.

The Draft EIS indicated that low concentrations of benzene and particulates would occur in Sydney's water supply catchments and storages as a result of aircraft emissions. Predicted concentrations would be considerably less than drinking water and ecosystem protection guidelines. Drinking water from rainwater tanks in urban and semi-urban areas is subject to considerable airborne contamination sourced largely from vehicle emissions. As a general rule in these areas, all drinking water from rainwater tanks should be filtered to reduce levels of airborne and other contaminants.

13.2 Summary of Water Issues

13.2.1 Issues Raised in Submissions

Groundwater

Existing data used to describe and assess groundwater systems was considered by the NSW Government and others not to cover fully the sites of the airport options and to be insufficient to provide a thorough understanding of the groundwater regime. As a consequence, concern was expressed that an adequate evaluation of the impacts of airport construction and operation was not possible.

The NSW Government and Western Sydney Alliance were concerned with the potential for an increase in local groundwater salinity due to airport development and contamination from chemical spills. Their submissions indicated that seepage of saline groundwater into the South Creek system was increasing; this increase has been linked with the alteration of natural drainage patterns and the removal of vegetation. The concern expressed was that major cut and fill operations during construction of the airport would interfere with groundwater flow and might further increase saline discharges. Also, the extensive impervious areas associated with the airport development and potential leakage from detention ponds might impact on groundwater levels and flows.

Surface Water and Hydrology

Methodology and Background Data

The overall assessment of surface water and hydrology issues is the Draft EIS was considered by the NSW Government in its submission to be insufficient to determine adequately the impacts on South Creek and the Hawkesbury Nepean River System.

Other submissions considered it inappropriate to use the results of water quality studies undertaken in the late 1960s as a baseline. It was indicated that these studies were undertaken as a result of complaints about pollution. Concern was also raised regarding the validity of basing the impact assessment on a single water quality survey, supplemented by limited historical data which might not have been indicative of seasonal variability. The samples, which were taken in dry weather conditions during the 1996-97 summer, might not allow reliable conclusions to be drawn concerning wet weather influences.

Water-Related Impacts

The NSW Government, Western Sydney Alliance and others were concerned with the impact on water quality in the Badgerys Creek and South Creek catchments. Nutrient loadings from an airport developed at Badgerys Creek were considered, for example by the South Creek Catchment and Upper Nepean Catchment Management Committees and the Australian Conservation Foundation, to be excessive, particularly as nutrient levels in the South Creek catchment and the Hawkesbury Nepean River System were already of concern and algal blooms had occurred. It was also suggested that modelling and assessment of water quality impacts and nutrient levels undertaken in the Draft EIS were inadequate.

Some submissions indicated that considerable resources have been invested by the NSW Government in reducing nutrient inputs to South Creek under the Sydney Water Corporation's South Creek bubble licences for sewage treatment plants and through the Healthy Rivers Commission process, with further investment planned. Discharges from the airport site are likely to reduce the effectiveness of these management initiatives. As part of these initiatives, water quality modelling was undertaken to develop nutrient management measures for South Creek and extension of this modelling should also be undertaken as part of the EIS. It was also suggested that alternatives to the currently proposed method of sewage treatment and disposal, with higher levels of treatment and effluent re-use, should be investigated.

There was concern that no attempt was made to quantify increases in run-off from the airport site. Further, it was suggested that the efficacy of proposed stormwater management measures was not evaluated nor were increases in stream flow volumes quantified. There was concern that reed beds proposed to be used to filter stormwater could attract birds with associated potential for bird strike. It was suggested that the potential for increased downstream flooding and potential impacts on stream morphology, including scouring of sediments and bank erosion, were not assessed in the Draft EIS.

There was general resistance to any increase in water pollution. It was suggested by the Western Sydney Heritage Committee and the Bents Basin State Recreation Area Trust, among others, that the environmental and economic value of existing water systems was not recognised by the Draft EIS. Some submissions consider insufficient account was taken of impacts on the Georges River catchment.

Drinking Water Supplies

Potential accumulation of polyaromatic hydrocarbons from aircraft emissions in water catchments and storages and the associated level of risk posed by such accumulation to public health was raised as a concern by the NSW Government and Western Sydney Alliance, and individuals and groups such as the Campbelltown Anti-Airport Group. Concerns were also raised over the frequency and magnitude of fuel venting incidents and their impact on water supplies.

The issue of risk to water quality in Warragamba Dam arising from an aircraft crash was also raised.

While the possible contamination of domestic rainwater tanks by aircraft emissions was identified in the Draft EIS as a potential health problem, there was concern that this issue was either not assessed in sufficient detail or the impacts were understated. The issue of impacts on the water quality of agricultural dams was also raised.

One submission makes the claim that Sydney's water supply currently fails the National Health and Medical Research Council standards with respect to bacteria, and that the Draft EIS falsely assumes the current water quality meets these standards.

Environmental Management

Following on from concerns relating to groundwater and surface water/hydrology there was concern over the adequacy of environmental management measures described in the Draft EIS. More detail was called for than is provided in the Draft EIS relating to measures to control erosion and manage the impact of major earthworks (filling and fill material) during construction. Submissions, such as the submission from the Communities Against Anti-Airport in Western Sydney, indicated that the infilling of creeks would be unacceptable.

The NSW Government requested a total water cycle management plan to integrate the management of water supply, groundwater, stormwater and wastewater on the site of the proposed airport. Inter-related to this issue were concerns expressed by the South Creek Catchment Management Committee that insufficient reference was made to relevant water quality goals and concerns that the policy objectives established by the Hawkesbury Nepean Catchment Management Trust would not be achieved by the proposal. It was suggested that better descriptions are required of the methods to limit the export of nutrients.

13.2.2 Issues Raised by the Auditor

The Auditor commented that there was little or no attempt to assess consequences on flooding changes, creek stability and surface water quality. The water quality impacts of nutrients from the airport's sewerage system were considered by the Auditor to be inadequately addressed. The Auditor also considered that further work was required on impacts on rainwater tanks and treatment of run-off. In addition, there was a need to undertake a more detailed study of the groundwater system and to address the disposal of saline groundwater during construction.

13.3 Additional Studies on Water Issues

The potential for downstream flooding was identified in the Draft EIS as an issue requiring further modelling work to confirm the conclusion that peak flow rates off the site would not exceed pre-development flow rates and that water quality management measures could potentially improve the quality of stormwater run-off from the airport sites. Additional studies and investigations of water issues have been conducted for this Supplement, including:

- additional water quality surveys;
- groundwater field investigations and modelling of local and regional groundwater systems;
- investigation of sewage treatment re-use and disposal options;
- re-examination of construction water management and water cycle management during operations;
- assessments of the effectiveness of stormwater management measures and potential downstream flooding and assessment of local and regional water quality impacts; and
- further analysis of the impacts of airborne pollutants emitted by aircraft on water quality.

Figure 13.1 shows the relationship of the airport options to the Hawkesbury Nepean River System and South Creek Catchment.

13.4 Groundwater Studies

13.4.1 Results of Further Field Investigations and Modelling

The Draft EIS relied on information obtained from observations at existing drill holes and previous studies. Further groundwater field investigations were conducted at the sites of the proposed airport options to better understand the hydrogeological characteristics. A groundwater model using hydraulic parameters obtained in the field program was developed to assess the impact of the airport development. A detailed explanation of the site investigation and groundwater modelling results is presented in *Appendix E1* of this Supplement.

Geological Setting

The geology of the site of the airport options is shown in *Figure 13.2*. The site is underlain by Bringelly Shale of mid-Triassic age, the uppermost unit of the Wianamatta Group. A basalt and dolerite dyke of Jurassic age intrudes the Bringelly Shale and forms a prominent north-west to south-east trending ridge across the site. The Luddenham Dyke extends approximately 8.5 kilometres and attains a maximum thickness of 10 to 12 metres, dipping to the south-west at approximately 85 degrees (Jones and Clark, 1987). Alluvium of Quaternary age typically consisting of sand, silt and clay overlies the Bringelly Shale along Badgerys Creek, Thompsons Creek and Oaky Creek.

Field Investigation Results

Two aquifers occur at the sites of the proposed airport options: a shallow aquifer within the Quaternary alluvium (the alluvial aquifer) and a deep regional aquifer within the Bringelly Shale (the Bringelly Shale aquifer). Minor perched groundwater is also present within the weathered shale profile, although, these weathered lenses are not continuous and do not form an aquifer.

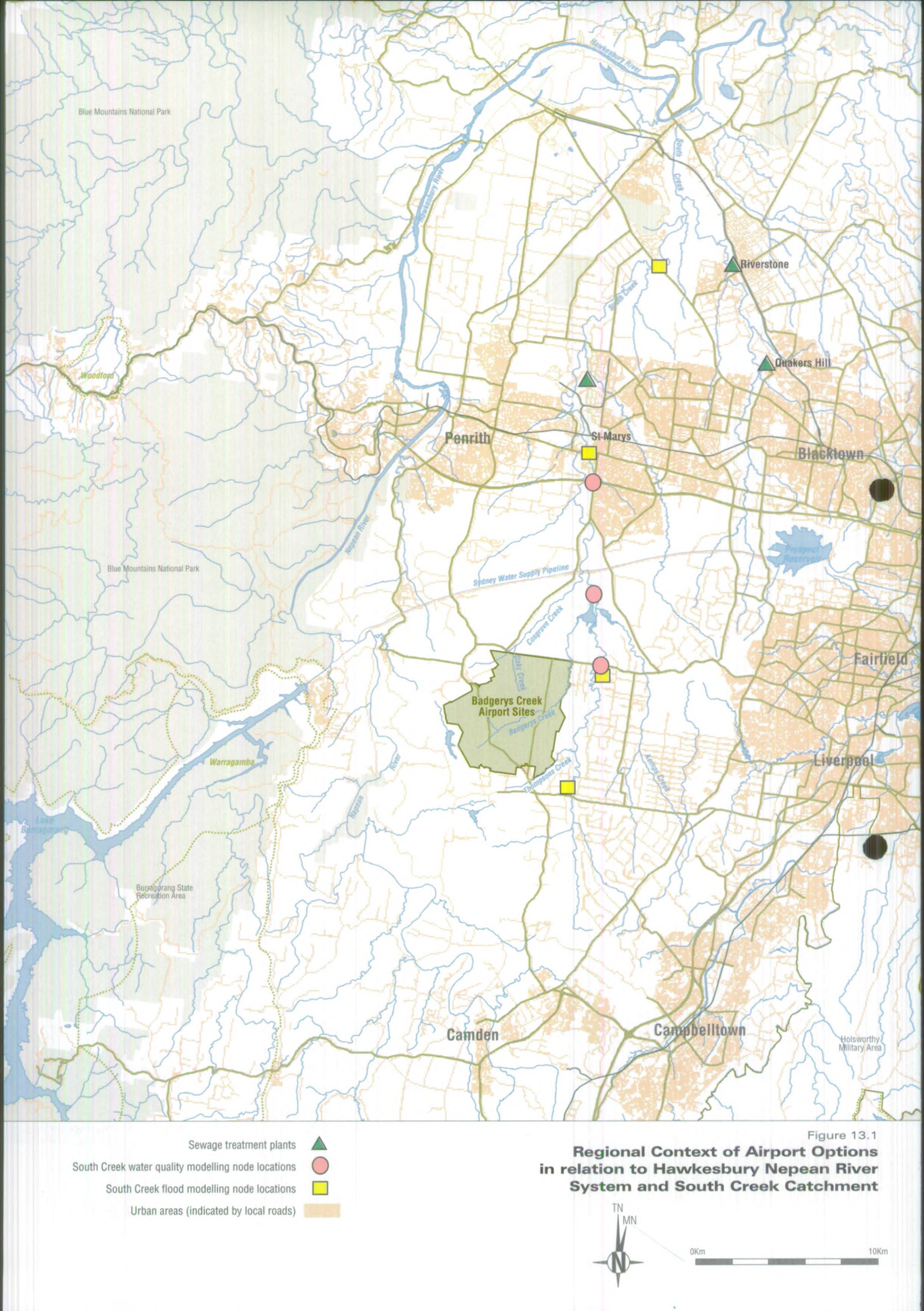


Figure 13.1

Regional Context of Airport Options in relation to Hawkesbury Nepean River System and South Creek Catchment

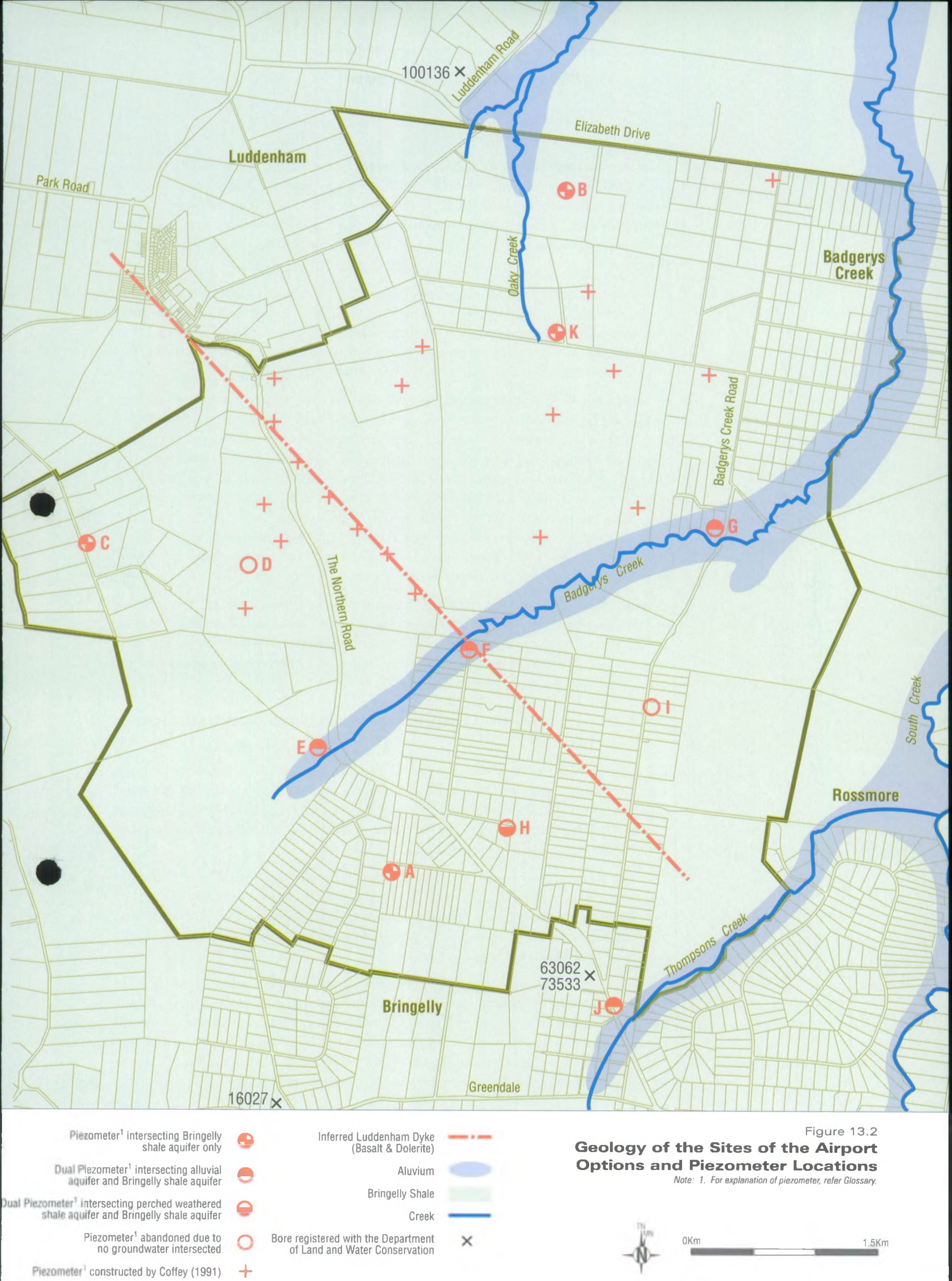


Figure 13.2

Geology of the Sites of the Airport Options and Piezometer Locations

Note: 1. For explanation of piezometer, refer Glossary.

Investigation of Department of Land and Water Conservation records indicates that both aquifer systems have low yield and high salinity and that there are no uses of water from these systems. Rainfall is the only source of recharge of each aquifer. Infiltration rates into the clayey subsoils across the site is low, ranging from 0.01 and 0.001 metres per day. Consequently, very little of the rainfall on the site percolates to the water table.

Groundwater quality within the alluvial and Bringelly Shale aquifers is saline, with mean respective salinity between 12,000 and 14,800 milligrams per litre total dissolved solids. The groundwater quality between the two aquifers does not differ significantly, which is not unexpected, since the chemical characteristics of the alluvium are similar to the clays derived from weathered shale.

In September 1998, at the time of field investigations, the water table in the alluvium was located within one to four metres of the ground surface and within one metre of the creek water levels. These water levels indicated a degree of connection and suggested groundwater flow to the streams. The regional aquifer system in the Bringelly Shale was typically intersected at depths greater than 20 metres with a potentiometric surface approximately two metres below the water table level within the alluvial aquifer. These differential heads suggested poor hydraulic interconnection between the two groundwater systems, with the potential for downward leakage from the alluvium to the shale but with no possibility of upward movement of saline groundwater from the shale.

Groundwater in the alluvial aquifer flows in a north-easterly direction towards the creeks and, ultimately, into South Creek, as shown in *Figure 13.3*. Groundwater flow in the Bringelly Shale aquifer is more complex, being predominantly in a south-westerly and north-easterly direction away from a groundwater mound centred on the Luddenham Dyke, as shown in *Figure 13.4*.

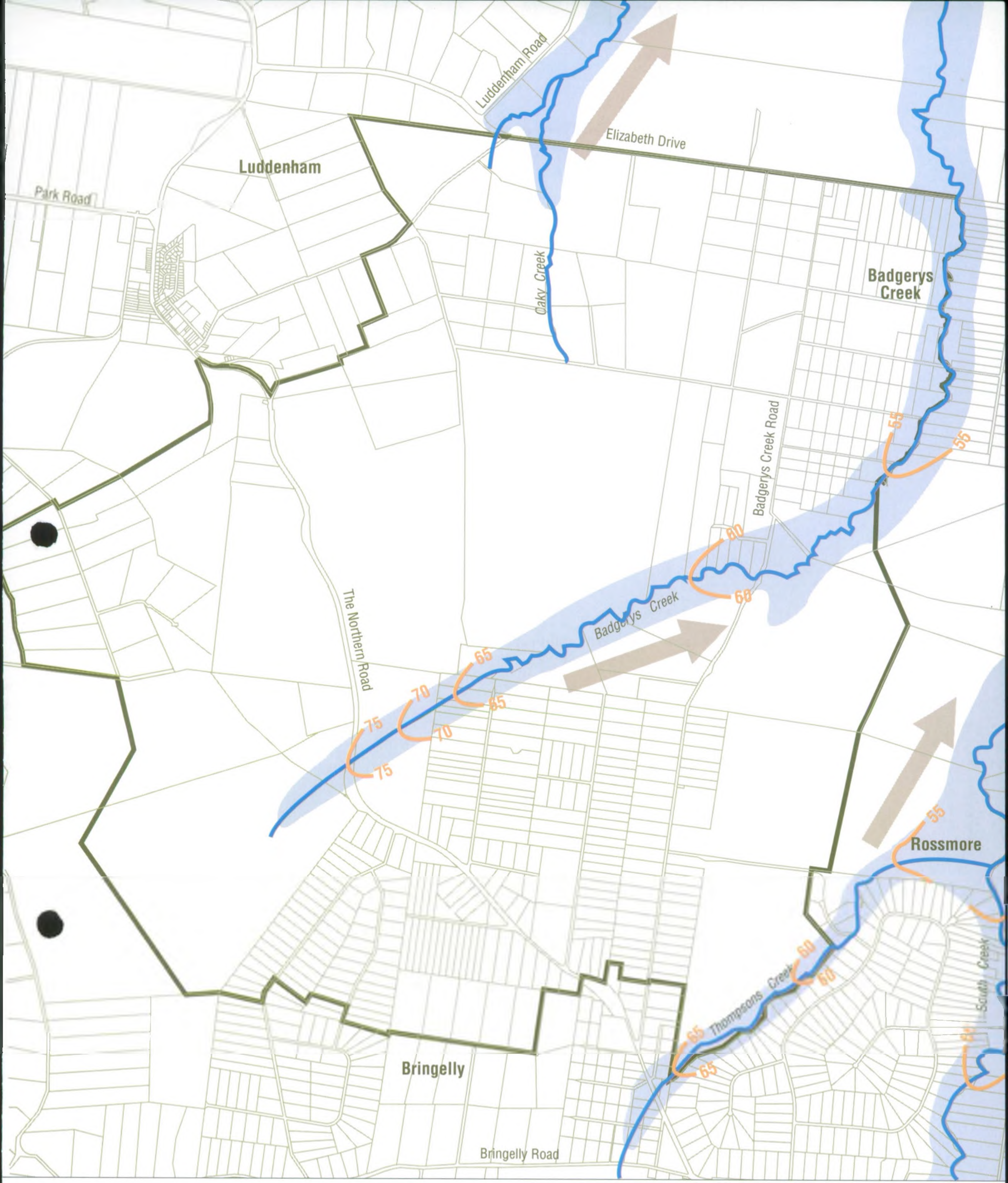
13.4.2 Impacts on Groundwater Regime Construction Impacts

During construction deep excavations might intersect isolated bodies of perched water within the weathered shale horizon and the alluvial aquifer adjacent to creek beds. Deep excavation work in the vicinity of the Luddenham Dyke is unlikely to extend into the Bringelly Shale aquifer since groundwater is typically intersected at depths below 25 metres in elevated regions of the site.

Any perched water would be small in volume and easily drained. Where present it would be too saline to discharge into the local creek system and would be drained to temporary evaporation basins. The dry sediments from the basins would be disposed of by mixing with site fill material. Drainage of perched water would have no impact on the general hydrogeology of the area.

The filling and replacement of creeks with stormwater drains would slightly increase the water table in the alluvial aquifer in the immediate vicinity of the creeks. This is because stormwater drains effectively behave as barriers reducing natural groundwater flow to the creeks. Connections would be provided between drainage and the aquifer to manage the groundwater level increase and maintain existing groundwater flows into the creek system.

The large impervious area associated with the airport would increase run-off and reduce groundwater recharge to the Bringelly Shale aquifer across the site. Groundwater recharge would also be reduced in the vicinity of the Luddenham Dyke due to the earthworks removing the upper dyke zone.



Water table surface contour within the alluvial aquifer in metres Australian Height Datum —70—

Groundwater flow direction

Aluvium

Figure 13.3
Water Table Surface of the Alluvial Aquifer

TN MN

0Km 1.5Km

Potentiometric contours within the regional shale aquifer in metres Australian Height Datum —70—

Groundwater flow direction

Figure 13.4
Potentiometric Surface of the Bringelly Shale Aquifer

0Km 1.5Km

The groundwater model (*Figure 13.5*) indicates a minor lowering in the water table within most of the alluvial aquifer, except for the slight increase occurring immediately adjacent to the filled creek system.

Groundwater modelling indicates a reduction in the potentiometric head in the Bringelly Shale aquifer by a maximum of 17 metres in the vicinity of the Luddenham Dyke, with a gradual decrease along the hydraulic gradient (*Figure 13.6*). In lower topographical areas, the lower potentiometric head caused by decreased recharge is in part balanced by local recharge from detention ponds.

The airport development would increase surface run-off and decrease groundwater recharge.

The reduction in recharge might slightly increase the salinity of the groundwater in the alluvial and Bringelly Shale aquifers since the dilution effect of rainwater would be reduced. Both aquifers are naturally saline and are not used for any beneficial purpose. The discharge of flows from the Bringelly Shale aquifer occurs on a regional basis and actual discharge locations have not been identified. The saline water which flows from the alluvial aquifer to the local creek system would not be changed to any significant extent by the airport development and would not impact on creek base flows.

13.4.3 Land Salinity and Fuel/Chemical Spill Issues

In the Badgerys Creek area, much of the native vegetation was removed over 150 years ago and, since then, a new hydraulic equilibrium has been established with a general raising of the water table. However, the depth of the water table across the sites of the airport options is sufficiently low to avoid the occurrence of dry land salinity. The reduced recharge resulting from the airport development is likely to decrease the water table depth in the shale aquifer by five to 15 metres, mostly in the vicinity of the Luddenham Dyke.

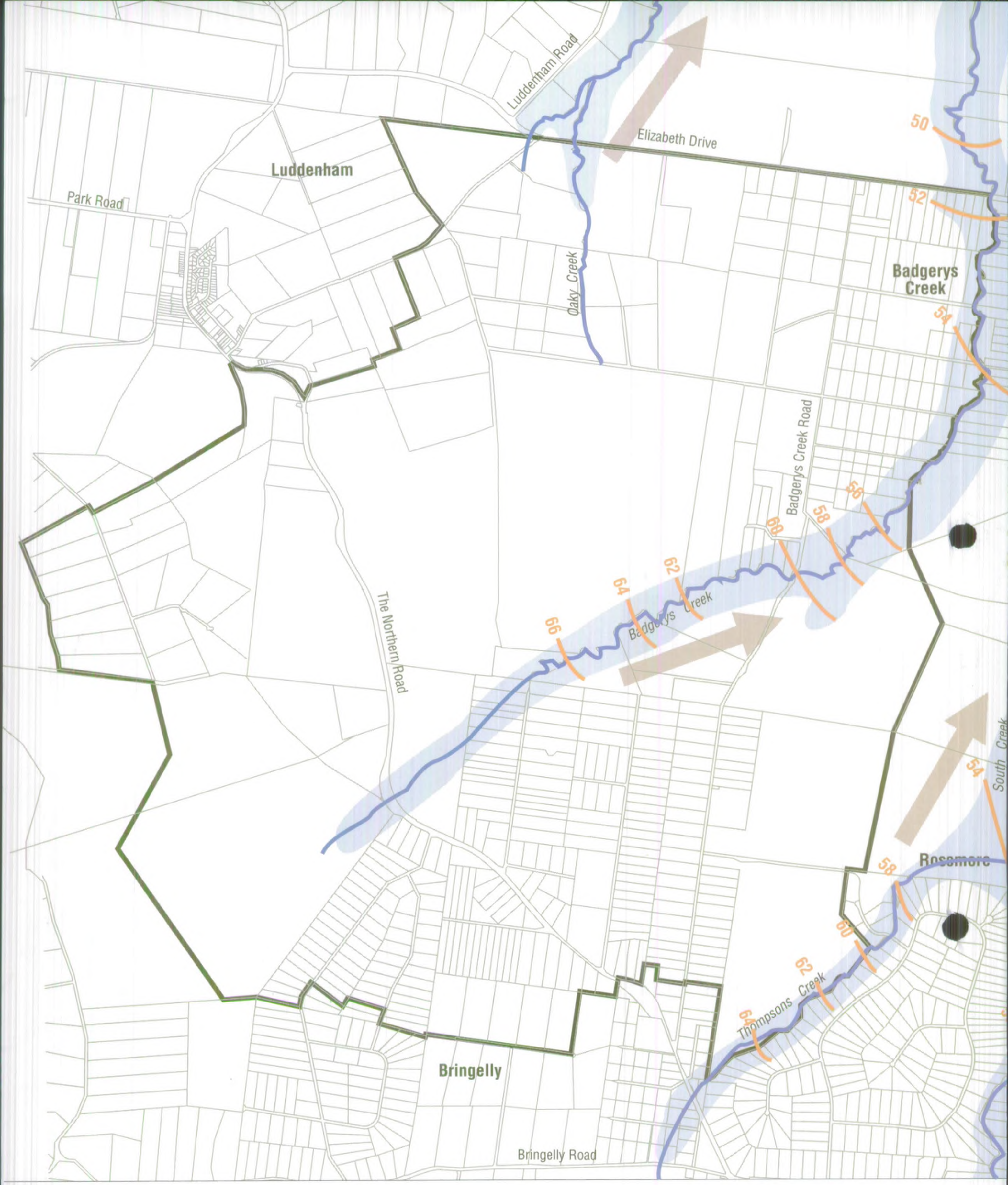
In the alluvial area, groundwater modelling indicates that the lowering of the water table would be in the order of one metre, which would not be significant and would be close to the levels existing prior to the clearance of native vegetation. The minor increase immediately adjacent to the creek system due to stormwater drains would not approach the surface and would not cause salinity problems.

Potential exists for contamination of the alluvial aquifer and, to a lesser extent, the Bringelly Shale aquifer due to the development of the airport.

Bunds constructed around storage facilities would contain any fuel and chemical spills and environmental monitoring wells would detect any subsurface migration. Minor spills in other areas, including aircraft standing and refuelling areas, would be contained in pollutant and flame traps. Any large spills would enter the drainage system and be contained at the water quality control ponds.

Of the two aquifers situated at the sites of the airport options, the alluvial aquifer is more susceptible to spills. However, with clayey soils and weathered shale, any contamination would be adsorbed into the unsaturated soil and rock profile and is unlikely to reach the Bringelly Shale and alluvial aquifers. In the unlikely event of contamination, appropriate soil and groundwater remediation techniques could be initiated. Groundwater monitoring around underground fuel facilities and similar potential contaminant sources would ensure the early detection of any contamination.

Contamination entering the Bringelly Shale aquifer is unlikely because of the lack of vertical pathways to the aquifer and the low hydraulic conductivity of the Bringelly



Modelled water table surface contour within the alluvial aquifer in metres Australian Height Datum —70—

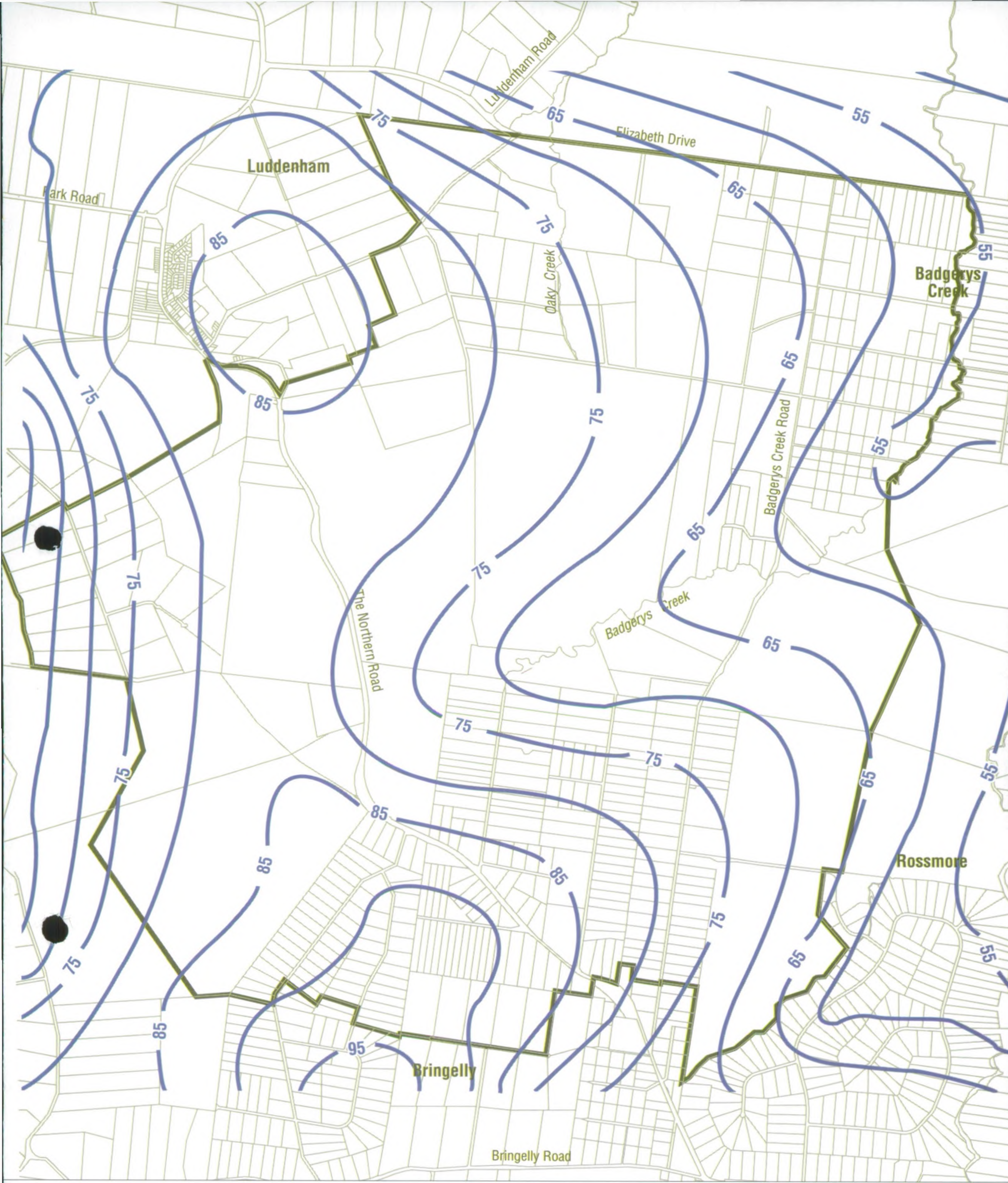
Groundwater flow direction

Aluvium

TN MN N

0Km 1.5Km

Figure 13.5
Modelled Alluvial Aquifer Levels after Airport Development



Modelled Potentiometric contour within the regional shale acquifer in metres Australian Height Datum —70—

Figure 13.6

Modelled Bringelly Shale Aquifer after Airport Development

TN MN N

0Km 1.5Km

Shale. The differential heads between the two aquifers and groundwater modelling indicate there is minimal coupling between the two aquifers and limited pathways for contaminants. This is confirmed by the model water balance which indicates groundwater interaction between the two aquifers is 0.0017 percent of the water budget.

13.5 Water Requirements and Sewage Treatment Options

13.5.1 Review of Water Supply Demands and Sewage Flows

Objectives

A review of water supply demands and sewage flows associated with airport development was made with the aim of identifying opportunities to enhance water conservation and reduce impacts of wastewater. Water demands were divided into potable (drinking quality) and non-potable usage, to assist with assessment of opportunities for wastewater re-use. In assessing water demands and resulting sewage flows it has been assumed that water conservation strategies, including demand management and sewage effluent re-use, would be adopted in design and operation of airport facilities.

Water Requirements and Sewage Flows

Details of water demand estimates are provided in *Appendix E2*. Water demands have been estimated using data from previous studies and actual water consumption data from Sydney and Melbourne Airports, forecasts of airport passengers and staffing, and a notional apportioning of potable and non-potable personal water usage. It has been assumed that non-potable water supplied from high quality sewage effluent would be used for toilet flushing, air conditioning make up, garden irrigation and fire fighting.

Sewage flows are based on the assumption that 90 percent of the potable and non-potable water used, other than water used for garden irrigation and air conditioning make up, would drain to the sewerage system.

A summary of the estimated average potable and non-potable water requirements and estimated average sewage flows for the airport is provided in *Table 13.1*.

Table 13.1 Estimated Average Daily Water Requirements and Sewage Flows

Average Day	Stage 1	Master Plan
Potable Water (megalitres per day)	1.4	4.4
Non-potable Water (megalitres per day)	1.8	4.5
Sewage (megalitres per day)	1.8	5.7

While these estimates are considered reasonable for planning and assessment purposes, it is possible that future commercial and industrial development within the airport site could include large water consuming establishments which may increase average potable water demands and sewage flows up to 10 to 15 megalitres per day. These would be subject to individual consideration at the time.

Effluent Re-use Opportunities

Use of effluent to supply water for toilet flushing, garden and lawn watering, air conditioning make up and fire fighting has been included in non-potable water supply demands for the airport.

If water demands and sewage flows during operation of the airport exceeded the estimates given in this Supplement because of the establishment of large water consuming industries or for other reasons, there would be a number of potential uses for the additional effluent within or close to the airport sites. A range of possible industrial uses including cooling water, wash down and vehicle washing, general grass irrigation within the airport site and irrigation of pastures and crops such as flowers in noise affected land adjoining the airport offer potential to greatly increase the re-use of effluent.

Opportunities to re-use effluent at locations away from the airport site are discussed in *Section 13.4.2*.

13.5.2 Sewage Treatment and Effluent Re-use and Disposal Options

Objectives and Constraints

The South Creek catchment, which drains the airport sites, already has large sewage effluent discharges representing the major proportion of stream flow during dry periods. The mass of nutrients Sydney Water can discharge to South Creek has been capped by the Environment Protection Authority under a 'bubble licence' arrangement. Sydney Water's general objectives in dealing with additional sewage flows, in order of priority, are:

- maximise local effluent re-use;
- maximise effluent re-use within the region; and
- discharge to meet environmental requirements and achieve community acceptance.

All options for sewerage services to the airport being considered aim to maximise effluent re-use opportunities in and around the airport sites.

Stage 1 Proposal

Tertiary sewage treatment would be provided on-site to cater for at least the Stage 1 airport development (nominally 10 million passengers a year). The plant would provide high quality effluent for re-use as a non-potable water supply for flushing toilets, irrigation, fire services and probably other uses. Effluent could also be used for irrigation of crops or pasture on noise affected land acquired by government under flight paths immediately outside the airport site. Storage would be provided in an open pond to balance supply and demand through wet and dry periods. The pond would be covered with netting to discourage birds.

While effluent would generally be totally re-used there may be occasions when supply might exceed demand and controlled discharge to Badgerys Creek could be necessary. This could occur during or following periods of wet weather and coincide with significant stream flows. The quantity and rate of discharge and the effluent quality would need to meet requirements to be established by the Environment Protection Authority. The Environment Protection Authority has indicated (Warren Hicks, 1998, pers. comm., 1 September) that nutrient levels in effluent discharged to Badgerys Creek could need to be as low as:

- 0.5 milligrams per litre for total nitrogen; and
- 0.05 milligrams per litre for total phosphorus.

The advanced treatment process proposed for the airport would be able to meet these requirements (details in *Appendix E2*). Final discharge license requirements would be established at the time of airport development and are likely to be based on total loads rather than concentrations and nominate a minimum flow below which discharge of effluent is not permitted.

Biosolids would be dewatered, lime stabilised and used in on-site landscaping or trucked to a regional sewage treatment plant to become part of a beneficial re-use program. Other sewage residuals (grit and screenings) would be taken to a regional landfill for disposal.

The airport sewage treatment plant would be a modular design, constructed in stages. Module size and ultimate capacity of the on-site plant would depend on the level of re-use that can be achieved on Environment Protection Authority requirements for discharge of surplus effluent to the South Creek catchment and on the rate of development of both the airport and urban development in the vicinity. A possible arrangement would be to progressively provide four modules, each capable of servicing airport development of 2.5 million passengers per year with a total capacity of 10 million passengers per year. A suitable process and suggested concept for the sewage treatment plant is described in *Appendix E2*. The plant would continue to operate and provide non-potable water supply to the airport when development exceeds its design capacity. The additional sewage or effluent generated by further development would be transported off-site.

Master Plan Options

There are three main options to cater for sewage flows generated by the ultimate master plan capacity of the airport (30 million passengers a year), as follows:

- Sewage Treatment Option 1 - discharge of surplus sewage (and surplus effluent) from the airport to the Sydney Water sewerage system. This option could also service any potential related development in the vicinity of the airport. Major new works and/or augmentation of existing systems would be required. The options for discharge would be:
  - St Marys Sewage Treatment Plant;
  - the proposed Silverdale Sewage Treatment Plant; or
  - the South West Ocean Outfall System, which extends as far west as Wetherill Park and drains to Malabar Sewage Treatment Plant.
- Sewage Treatment Option 2 - expansion of the on-site treatment plant to cater for the whole of the airport development and use effluent in one or combinations of the following:
  - use effluent totally within the airport site and on acquired noise-affected land adjacent to the airport;
  - use effluent to irrigate agricultural land identified south-west of Bringelly (Snowy Mountains Engineering Corporation, 1995) or similar land west of Camden identified by Sydney Water Corporation. This option would require long-term agreements with land owners or purchase of dedicated land;

- use effluent at Penrith Lakes development to reduce current abstraction from the Hawkesbury River. A long-term agreement with the owner/ operator would be required; or
- add advanced treatment, probably a membrane process, and deliver water to the Sydney Water Corporation's Warragamba pipeline for potable re-use after further treatment at the Prospect Water Treatment Plant;

- Sewage Treatment Option 3 - additional treatment facilities would be provided by Sydney Water outside the airport boundary to service related development as well as the airport expansion. Treated effluent would be used for irrigation of agricultural land, for recreational use at Penrith Lakes or delivered to the Warragamba pipeline for potable use as described above.

Comparison of Options

A strategy that provided some treatment capacity on-site to service the earlier stages of airport development would have a number of advantages. It would:

- provide opportunities for maximum on-site effluent re-use;
- avoid early construction of major off-site sewerage works; and
- avoid risks associated with incorrectly projecting future needs and developing unsuitable works.

The selection of the best option to service further airport development and to cater for related development (if required) is difficult to determine at this stage because of the unknown rate of development and unknown extent.

The future options identified all integrate airport and any potential related development with regional water cycle management issues, and can be considered holistic. However, proposals under Option 2 for sewerage services do not service development outside the actual airport site. Advantages and disadvantages of the identified options are discussed in more detail in *Appendix E2*.

Second Sydney Airport would be developed with an initial on-site sewage plant. Further concept design, detailed economic evaluation and environmental assessment would be required for the development of additional sewerage facilities and disposal and re-use options.

13.6 Surface Water and Hydrological Studies

13.6.1 Additional Water Quality Surveys

Survey Strategy

Additional water quality surveys were conducted at the sites covered in the Draft EIS plus three sites on South Creek, the main receiving stream of the airport area, to assist in describing the environment and potential impacts further downstream. The sites were sampled in accordance with the program in *Table 13.2*.

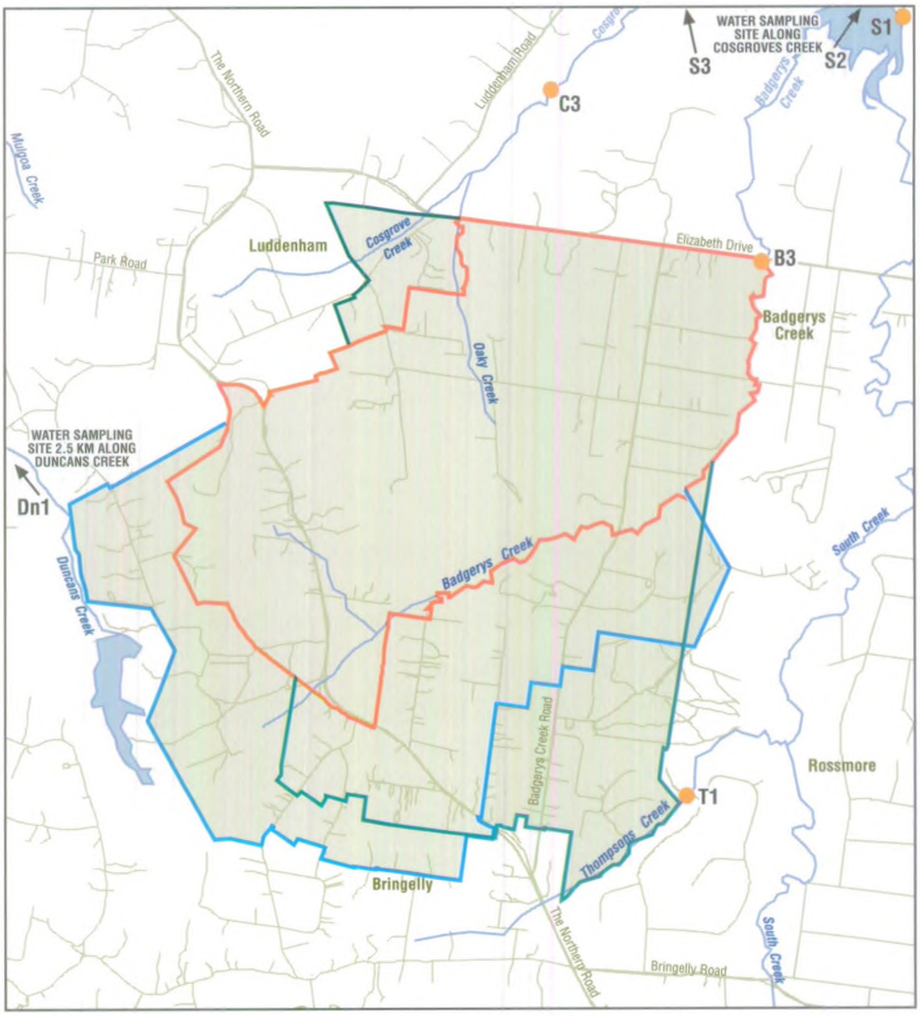
The catchment areas of streams and locations of sampling sites are shown in *Figure 13.7*.

Sampling and analytical methodologies were the same as for the Draft EIS. A complete copy of the methodologies is provided in *Appendix E3*. The complete survey results for chemical, physical and ecological constituents as well as rainfall data collected during the survey period is also provided in *Appendix E3*.

Table 13.2 Sampling Strategy

Site Name and Number	Summer 96-97 Low Rainfall	Early Spring 98 After Wet Winter	Mid Spring 98 Dry Weather	Summer 98-99 Low Rainfall
Badgerys Creek B3	✔	✔	✔	✔
Cosgroves Creek C3	✔	✔	✔	✔
Thompsons Creek T1	✔	✔	✔	✔
Duncans Creek Dn1	✔	✔	✔	✔
South Creek S1	✘	✔	✔	✔
South Creek S2	✘	✔	✔	✔
South Creek S3	✘	✔	✔	✔

Seven sites, from five streams, were sampled (*Figure 13.7*). Sites were chosen outside the proposed boundaries of the airport options. Site descriptions are provided in *Table 13.3*. A reference site at Williams Creek, a pristine site in the south-west of the Sydney basin, was used as a benchmark comparison of optimum ecosystem health. Results of surveys included in the Draft EIS have been incorporated with final stage data to provide a longer term picture of stream health.



Boundary of airport option A
Boundary of airport option B
Boundary of airport option C
Rivers and watercourses
Water sampling sites

Figure 13.7
Water Quality Sampling Sites

TN MN N 0Km 2.5Km

Table 13.3 Sampling Site Locations

Site Name	Site Description	Grid Reference	Draft EIS/ Supplement
Badgerys Creek, B3	Sample site upstream of bridge at Elizabeth Drive intersection with Badgerys Creek	489 923, Liverpool	Draft EIS
Cosgroves Creek, C3	Access via Bangalla Research Station 516 903	514 904, Warragamba	Draft EIS
Thompsons Creek, T1	Sample point is 500 metres upstream of bridge crossing via a newly constructed road called 'The Retreat'	437 914, Warragamba	Draft EIS
Duncans Creek, Dn1	300 metres upstream of Bridge along Greendale Road, Greendale	462 821, Warragamba	Draft EIS
South Creek , S1	250 metres downstream of outlet of dam at junction of Badgerys Creek and South Creek	522 937, Prospect	Supplement
South Creek, S2	400 metres downstream of the junction of South Creek and Kemps Creek	526 936, Prospect	Supplement
South Creek, S3	900 metres downstream of the junction of Cosgroves Creek and South Creek[1]	551 931, Prospect	New

Note: 1. This location was moved 100 metres upstream during the mid-spring event to avoid influence from a dead cow in the stream.

Existing Stream Environment

Field surveys revealed the catchments of the streams to be rural to semi-rural, with grazing and intensive agriculture the major land uses. Intensive agriculture took place on poultry farms, dairies and market gardens. Flows in these streams tend to be low for most of the time with occasional high to very high flows. Stream beds in all five creeks were eroded, and featured depositions of alluvial material in slow reaches. Bank damage from stock, removal of vegetation and sporadic flows have contributed to the erosion of stream channels.

In dry weather, the majority of streams are reduced to a series of pools and riffles. Some of these pools are greater than 1.5 metres deep. After a prolonged period of dry weather, many of the riffles stop flowing, reducing the streams to occasional pools. During these no-flow periods, dissolved oxygen conditions are depressed and sulphurous odours emanate from the sediments.

Aquatic Ecology

Macrophytes are found in all streams, including *Juncus* (Rushes), *Typha* (Cumbungi), *Rumex* (Dock), *Alisma* (Water Plantain), *Triglochin* (Water Ribbons) and *Phragmites* (Reed). Their growth is not necessarily restricted to sunny sections of the streams. Sampling sites at Cosgroves Creek, Badgerys Creek and Thompsons Creek are shaded by natives tress such as *Casuarina* (She Oak) and *Melaleuca* (Paperbark). South Creek and Duncans Creek have an open aspect with pasture grasses the main riparian vegetation.

Aquatic fauna include introduced organisms such as *Cyprinus carpio* (Carp) and *Gambusia* (Mosquito Fish). These fish were observed at most sites, with *Gambusia* observed in high numbers. Native fish are also present, but only after a drought has broken, and are less abundant than introduced species. The native fish were identified as: *Hypseleotris compressa* (Empirefish), *Hypseleotris galii* (Firetailed Gudgeon) and *Gobiomorphus australis* (Striped Gudgeon). These three species are common in eastern lowland streams (McDowall, 1992). Other fauna recorded included *Physignathus lesueurii* (Eastern Water Dragon) at Duncans Creek and *Crinia signifera* (Common Eastern Froglet) at Duncans Creek , Thompsons Creek and Cosgroves Creek. The frog was only heard in spring and not during dry summer weather.

Water Quality

Results of analyses show that the creeks sampled have elevated levels of nutrients (see *Appendix E3*). These levels are reflective of streams in rural/semi-rural catchments containing some intensive agricultural activities. Nitrogen concentrations at all sites, and on most occasions, were above the Australia and New Zealand Environment Conservation Council *Guidelines for the Protection of Aquatic Ecosystems* (Australia and New Zealand Environment Conservation Council, 1992). The majority of this nitrogen is in biological form, indicating potential eutrophication. Phosphorus concentrations were also above the relevant Australia and New Zealand Environment Conservation Council guidelines in South Creek and Badgerys Creek. Algal responses to these elevated nutrients are most obvious in Badgerys Creek where algae was observed growing on instream plants, logs and sediments.

The pH in all creeks is approximately neutral, with high levels of dissolved salts, reflecting the local shale geology. Thompsons Creek has particularly elevated conductivities: some four times higher than the Australia and New Zealand Environment Conservation Council guideline for ecosystem protection. Extraction of creek water from creeks in the area for horticultural purposes could therefore pose problems, especially for salt sensitive crops. It is also probable that some farming activities are contributing to the elevated dissolved salt concentrations entering the creek system.

Water clarity is typically poor, owing to the presence of eroded clays. This is particularly evident in the early spring samples, when high turbidities were recorded. The effect of high run-off from substantial winter rains would have contributed to the increase in fine particulates.

Heavy metals within the catchment, apart from iron, are restricted to low concentrations of copper, chromium, cadmium and zinc. In most instances, levels are at or below the relevant Australia and New Zealand Environment Conservation Council guidelines and can be attributed to agricultural influences such as fertilisers, pesticides and herbicides. Zinc is a ubiquitous metal and levels may be attributed to numerous sources, including run-off from buildings roofed with galvanised iron. Zinc, copper and lead have also been identified in stormwater run-off from roads, both in particulate and soluble forms (Hogan et al, 1995). It is therefore possible that airborne pollutants from roadways might be a source.

Significant levels of iron were recorded in all creeks. The transition of groundwater into surface waters could increase iron concentrations through oxidation and leaching processes. A sheen similar to that caused by iron/sulphur bacteria was apparent at most of these sites, particularly at Thompsons Creek, suggesting the presence of groundwater ingress (see *Section 13.4.1*).

Trace amounts of phenols and anionic surfactants such as detergents occur in most creeks sampled during the dry summer of 1996-97. At such low levels it is difficult to attach any significance to the results as these analyses could have detected other naturally-occurring compounds. These levels were not detected in later surveys taken following average rainfall, indicating dilution of such compounds.

Total organic carbon levels were also elevated during the dry 1996-97 summer, reflecting increased productivity as well as concentration effects due to low or no flow conditions. The results show that most of the total organic carbon was not derived directly from organic chemicals such as aromatic and halogenated hydrocarbons. However increased organic material would have been generated by eutrophication, an increase in algae and aquatic plants activity. The eutrophication results from increased nutrient concentrations, largely as a result of human activities.

Petroleum hydrocarbons, volatile aromatic and halogenated compounds and polyaromatic hydrocarbons were not detected at any site.

The recent macroinvertebrate surveys (*Appendix E3*) show similar results to the Draft EIS indicating that the streams have mild to moderate pollution. Although there is a reasonable diversity of fauna and some pollutant sensitive species, the majority of animals and other organisms are reasonably tolerant of pollution. This is confirmed by the degree of difference with the reference site. Abundances are also similar apart from two sites in mid-spring, probably due to the time of year and lack of drift from reduced flows.

Summary

Streams in the study area reflect a predominantly agricultural land use with elevated levels of nutrients and occasional pollutants from horticultural activities. Poor water clarity, high conductivities and degraded banks are partially a result of erodible soils. Creek flows are quite variable, with low to no flow for most of the time. Despite these conditions, the streams support a diverse assemblage of organisms, including both pollutant sensitive and robust macroinvertebrates, macrophytes, algae, frogs, and native and introduced fish.

13.6.2 Surface Water Flows

Objectives

A study of the hydrology and water quality behaviour in the airport catchment has been carried out to assess the stormwater impacts and mitigation measures required as part of the airport development. The methodology and results of the assessment are detailed in *Appendix E4*. The primary objective is to ensure that sufficient management measures would be put in place to mitigate any adverse impacts on downstream flooding and water quality in the South Creek catchment and ultimately the Hawkesbury Nepean River System. In view of the poor water quality in the existing waterways, particularly in Badgerys Creek, an improvement to water quality is sought.

The issue of upstream flooding has not been addressed as the airport site is at the top end of the catchment. The uppermost sections of Cosgrove Creek and Badgerys Creek and the eastern side of Badgerys Creek are upstream of the airport site. Drainage works for the airport would be designed to convey flows from these areas without increasing upstream flood potential.

It has been suggested that concerns raised over potential impacts in the Georges River have not been addressed as the airport would be entirely within the Hawkesbury Nepean River catchment. There would be no construction and no direct impact of the proposal on the Georges River catchment. Any development carried out for associated infrastructure within the Georges River catchment would be subject to separate environmental assessments.

Modelling of Stormwater Flooding and Water Quality

Mathematical hydrology and water quality models were set up and used to quantify the impact of the proposed airport development on stormwater flooding and water quality characteristics in the catchment.

Due to the scale of the proposed development, the impacts were assessed at a local level within the airport site and sub-regionally downstream of the site. Local impacts were assessed using the hydrology model RAFTS-XP and the water quality model AQUALM-XP. Sub-regional impacts downstream of the airport site and within the South Creek catchment were assessed using RAFTS-XP and the water quality model HSP-F.

All four sets of models were calibrated and verified before they were accepted for evaluation purposes. The local RAFTS-XP model was calibrated to the April 1988 and August 1990 storm events, while the AQUALM-XP model was calibrated using data from the Sydney Water (1992) *Clean Waterways Programme* and additional data from recent studies. The regional RAFTS-XP model was calibrated to the August 1986 and April 1988 storm events and was based on the results of the South Creek Floodplain Management Study (Willing & Partners and Department of Water Resources, 1991). Similarly, the regional HSP-F water quality model for South Creek, originally developed and calibrated by Sydney Water (now Australian Water Technologies) was based on extensive work carried out in recent years as part of the Clean Waterways Program.

For each local and regional model, existing or baseline storm flows and pollutant loads were simulated. The airport development options were then simulated to determine any changes to the flood and water quality regime. Detention basins were subsequently located at strategic locations within the airport and sized to control the post-development peak stormwater flow rates leaving the airport site to not more than pre-development levels. This was carried out for the full range of design storms between the 50 and one percent annual exceedence probability events. Water quality control ponds were also designed to ensure that stormwater quality discharging from the airport site complied with Australia and New Zealand Environment Conservation Council (1992) guidelines. Regional impacts downstream of the site were then assessed with the stormwater control measures in place at the airport.

While three airport development options (A, B and C) were assessed in the Draft EIS, only Options B and C have been assessed in this study. This methodology is considered to be appropriate as the boundary of Option A is wholly contained within both Option B and Option C. In addition, the development area proposed under Option A is also significantly less than that for Options B and C as shown in *Table 13.4*. Consequently, the stormwater management measures proposed for Options B and C are expected to suffice for Option A.

Table 13.4 Catchment Areas for Airport Options

	Catchment Areas (Hectares)[1,2]			
Land Use	**Existing**	**Option A**	**Option B**	**Option C**
Rural	5,793	5,159	4,929	4,776
Urban[3]	0	634	864	1017

Notes:
1. *Airport catchment at Elizabeth Drive.*
2. *Airport catchment encompasses natural catchment boundaries and extends upstream beyond the boundaries of airport options.*
3. *Refers to impervious areas.*

Assessment of On-Site Stormwater Flood Control Measures

The existing airport catchment is drained by four creek systems, Badgerys Creek, Cosgroves Creek, Thompson Creek, and Duncans Creek. Of these, the largest is Badgerys Creek, which drains approximately 2360 hectares or 41 percent of the site. Duncans Creek and Thompson Creek drain 26 percent and 17 percent of the site, respectively, while Cosgroves Creek drains only about 15 percent of the site. Oaky Creek is a tributary of Cosgroves Creek and discharges into Cosgroves Creek downstream of Elizabeth Drive.

Development of the airport is expected to re-distribute some of the sub-catchment areas draining to each of the four creeks. In general, these sub-catchment areas are estimated to differ by less than five percent after development of the airport. The only exception is Cosgroves Creek, for Option B, where the area discharging into Cosgroves Creek is estimated to increase by about 20 percent (*Table 13.5*).

Table 13.5 Catchment Areas for Airport Creeks

Drainage System	Catchment Areas (Hectares)		
	Existing	Option B	Option C
Badgerys Creek	2368	2258	2335
Cosgroves/Oaky Creek	894	1086	928
Thompson Creek	1004	1004	1004
Duncans Creek	1526	1444	1526

Design discharges computed from the local RAFTS-XP model at key locations along the creeks within the airport and under existing catchment conditions are shown in *Table 13.6*. Design discharges obtained at similar locations following development of the airport are shown in *Table 13.7* for Option B and *Table 13.8* for Option C.

Table 13.6 Design Flows for Existing Conditions

Creek	Location	Node	Design Flows (m^3/s) Annual Exceedence Probability (%)					
			50%	20%	10%	5%	2%	1%
Badgerys	Elizabeth Drive	BC30	67	90	104	123	144	162
Cosgroves	Elizabeth Drive	CC30	24	33	38	45	56	64
Oaky	Elizabeth Drive	CC21	17	23	27	31	37	42
Thompson		TC10	39	53	62	74	87	99
Duncans		DC20	57	78	91	108	126	144

Table 13.7 Post-Development Flows for Option B (No Controls)

Creek	Location	Node	Design Flows (m^3/s) Annual Exceedence Probability (%)					
			50%	20%	10%	5%	2%	1%
Badgerys	Elizabeth Drive	BC30	80	110	128	152	179	203
Cosgroves	Elizabeth Drive	CC30	24	34	39	47	58	67
Oaky	Elizabeth Drive	CC21	45	61	69	82	94	106
Thompson		TC10	39	53	62	74	87	99
Duncans		DC20	-	-	-	-	-	133

Table 13.8 Post-Development Flows for Option C (No Controls)

			Design Flows (m^3/s) Annual Exceedence Probability (%)					
Creek	**Location**	**Node**	**50%**	**20%**	**10%**	**5%**	**2%**	**1%**
Badgerys	Elizabeth Drive	BC30	133	182	210	249	287	325
Cosgroves	Elizabeth Drive	CC30	23	31	36	43	51	59
Oaky	Elizabeth Drive	CC21	58	77	88	103	116	131
Thompson		TC10	-	-	-	-	-	98
Duncans		DC20	57	78	91	108	126	144

The development of the airport would involve large paved areas and buildings and more efficient drainage resulting in an increase in the volume of stormwater and a more rapid rate of run-off. Comparison with the results for Option B in *Tables 13.6* and *13.7* indicate that, if not controlled, peak flows in Badgerys Creek and Oaky Creek at Elizabeth Drive would increase substantially after development of the airport. In Badgerys Creek the flows are estimated to increase by about 20 to 25 percent. In Oaky Creek, the increase is even larger, at between 150 to 165 percent.

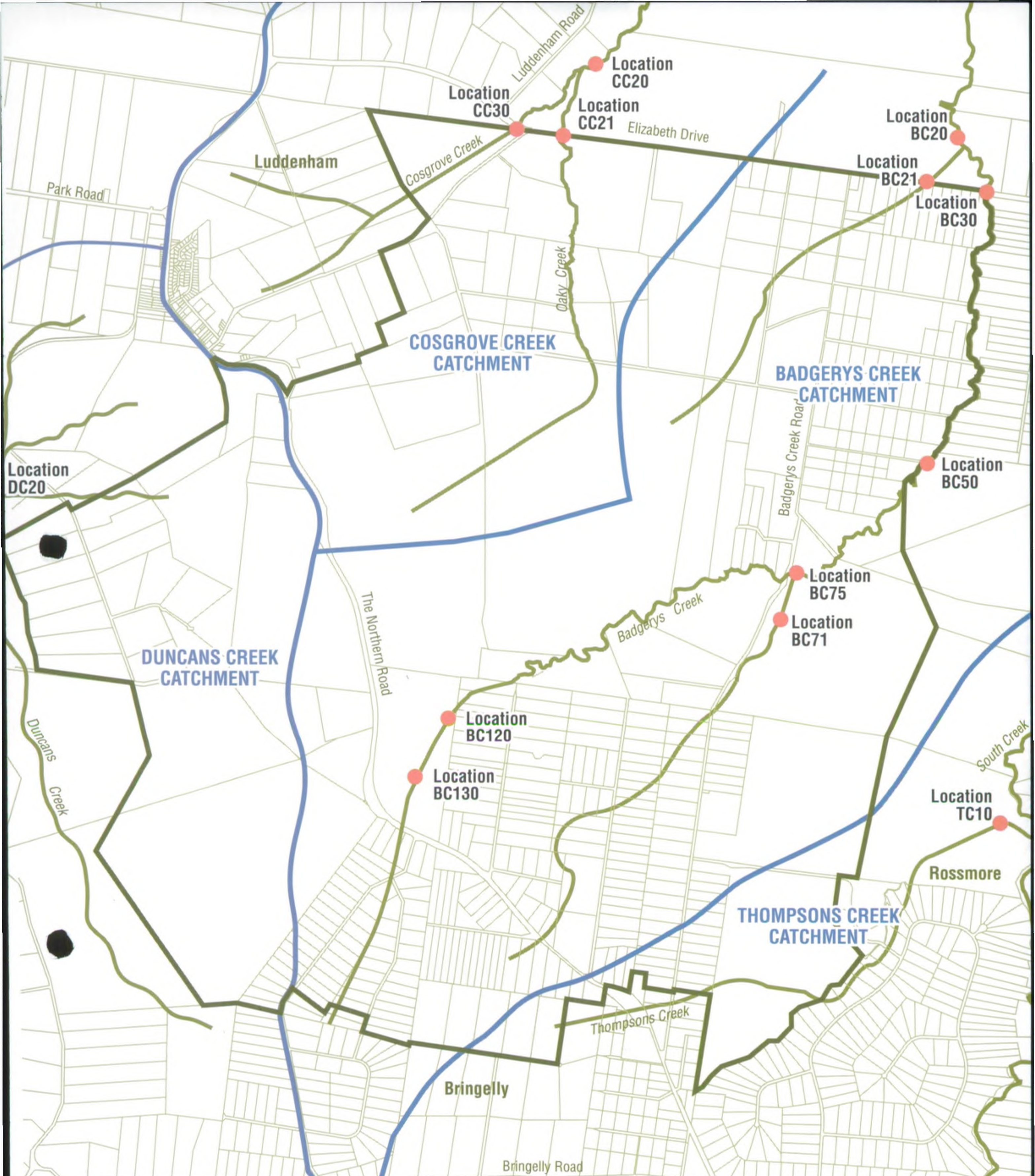
No impact is, however, expected on peak flows in Cosgrove Creek and Thompson Creek. This is because existing land use areas in these catchments remain practically unchanged under Option B. By comparison, the peak flows in Duncans Creek are expected to decrease by about eight percent after development of Option B.

Comparison of the results in *Table 13.6* and *Table 13.8* indicates that for Option C unmitigated peak flows in Badgerys Creek at Elizabeth Drive would approximately double after development of the airport. Similarly, the peak flows in Oaky Creek are estimated to increase by between 210 to 240 percent. In Cosgroves Creek, Duncans Creek and Thompsons Creek, the flows are estimated to remain the same or within five percent of the existing levels.

In order that potential stormwater flooding problems at the site and downstream may be avoided, flood control or detention basins would be constructed at strategic locations within the airport catchment to provide temporary storage and controlled release of the floodwaters. The full range of design flows between the 50 percent and one percent annual exceedence probability event would be attenuated to less than pre-development levels in order to reduce downstream environmental impacts.

The proposed locations and sizes of the basins are shown in *Figure 13.8*, *Figure 13.9*, and *Table 13.9* for Options B and C. For Option B, it is estimated that six detention basins would be required to control flooding within the airport site. This comprises four basins at Badgerys Creek and two basins at Cosgroves Creek. The combined volume of the basins would be about 1.5 million cubic metres with a surface area of about 66 hectares.

For Option C, it is estimated that four detention basins would be required, three adjacent to Badgerys Creek and one adjacent to Oaky Creek. The combined volume of the four basins is estimated at about 1.5 million cubic metres with a surface area of about 72 hectares. The detention basins shown in *Table 13.9* include a freeboard of 600 millimetres to allow passage of the Probable Maximum Flood.



Approximate catchment boundary

Locations adopted for water quality modelling (RAFTS-XP; AQUALM-XP) BC130

Figure 13.8

Existing Catchment and Impact Assessment Locations

0Km 1.5Km

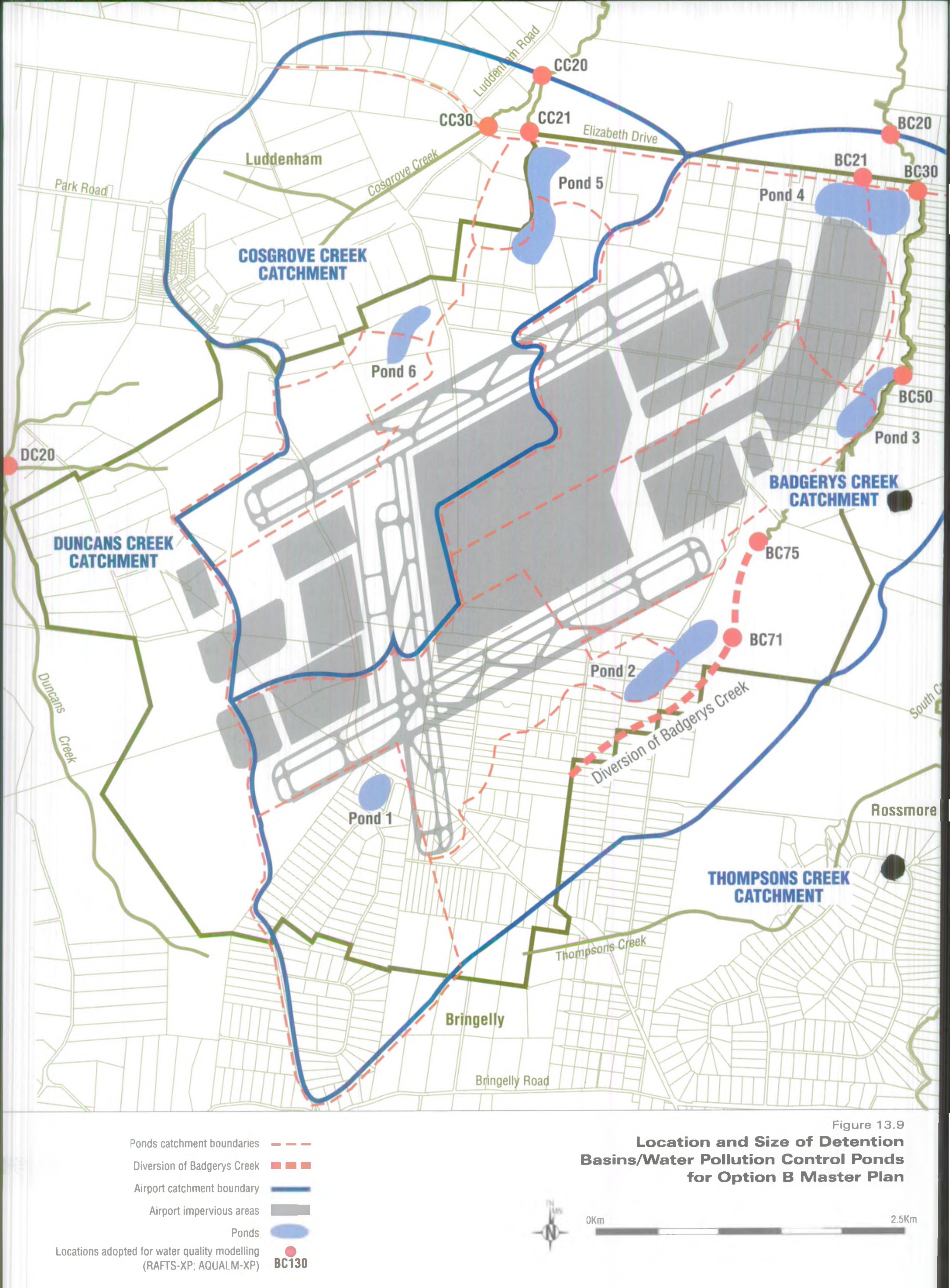


Figure 13.9

Location and Size of Detention Basins/Water Pollution Control Ponds for Option B Master Plan

Table 13.9 Detention Basins for Option B and Option C

Location	Option B Name	Option B Volume[1] (m3)	Option B Area[2] (Ha)	Option C Name	Option C Volume[1] (m3)	Option C Area[2] (Ha)
Badgerys Creek	Basin-1	129,747	6.0	Basin-1	830,190	35.7
	Basin-2	296,731	14.1	Basin-2	174,471	11.2
	Basin-3	311,980	14.1			
	Basin-4	324,817	15.3			
Oaky Creek	Basin-5	345,451	13.5	Basin-4	204,828	11.6
Cosgroves Creek	Basin-6	53,411	3.3	Basin-3	232,563	13.4
Total		**1,462,137**	**66.3**		**1,442,052**	**71.9**

Notes: 1. Includes freeboard of 600 mm.
2 Surface Area.

The effect of these basins on post-development flood behaviour at the airport site is summarised in *Tables 13.10* and *13.11*. Overall, the results show that with the detention basins in place, the flows discharging from the site would reduce to existing levels for the full range of storms between the 50 percent and one percent annual exceedence probability events.

Table 13.10 Post-Development Flows for Option B with Detention Basins

Creek	Location	Node	Design Flows (m^3/s) Annual Exceedence Probability (%)					
			50%	20%	10%	5%	2%	1%
Badgerys	Elizabeth Drive	BC30	62	85	97	115	136	154
		Pond-1	11	15	17	20	22	25
		Pond-2	17	23	27	32	37	40
		Pond-3	10	13	15	18	22	25
		Pond-4	16	22	25	30	35	41
Cosgroves	Elizabeth Drive	CC30	23	30	35	41	48	55
		Pond-6	6	8	9	11	13	15
Oaky	Elizabeth Drive	CC21	15	21	25	30	34	37
		Pond-5	12	17	20	24	26	28

Table 13.11 Post-Development Flows for Option C with Detention Basins

Creek	Location	Node	Design Flows (m^3/s) Annual Exceedence Probability (%)					
			50%	20%	10%	5%	2%	1%
Badgerys	Elizabeth Drive	BC30	58	79	93	112	134	152
		Pond-1	38	52	61	72	86	95
		Pond-2	15	20	23	27	31	34
		Pond-4	16	21	25	29	34	39
Cosgroves	Elizabeth Drive	CC30	23	31	36	43	51	59
Oaky	Elizabeth Drive	PCC21	16	22	25	29	33	38
		Pond-3	12	17	19	23	26	30

Note: Basin flows are at outlet.

Assessment of Downstream Flows and Flooding

Potential flooding within the vicinity and downstream of the airport was assessed using the regional RAFTS-XP model. The results are shown in *Table 13.12* for the one percent annual exceedence probability event in South Creek at Bringelly Road, Elizabeth Drive, the Great Western Highway, and Richmond Road. These locations are shown in *Figure 13.1*.

Table 13.12 Impact of Airport Options on One Percent Annual Exceedance Probability Event in South Creek (cubic metres per second)

South Creek Location	Existing Flows (m^3/s)	Post-Development Flows (m^3/s) Option B		Option C	
		No Basin	With Basin	No Basin	With Basin
Bringelly Rd	305	305	305	305	305
Elizabeth Dr	436	436	436	436	436
Gt Western Highway	1,137	1,117	1,123	1,113	1,117
Richmond Rd	1,358	1,382	1,356	1,375	1,350

Options B and C would not have any effect on flooding in South Creek at Bringelly Road and Elizabeth Drive, as the airport sites would not discharge to these locations. The two options are also not expected to affect the one percent annual exceedence post-development discharge at Richmond Road and the Great Western Highway by more than one to two percent, even without any flood control measures in place at the airport (*Table 13.12*). This is a reasonable expectation, considering that the entire airport catchment constitutes less than 12 percent of the South Creek catchment and that only 12 (Option A) to 21 (Option C) percent of the airport catchment (*Table 13.4*) would be developed as an impervious area.

Table 13.12 shows that the one percent annual exceedence discharge at locations downstream from the airport. The discharge at the Great Western Highway might decrease slightly without the basins, and would be slightly higher with the basins, but still less than existing levels. This is attributable to changes in the local flow times of concentrations following the airport development.

Overall, the flood basins provided at the airport would effectively maintain peak flows below the existing peak flows in South Creek. On this basis, the airport development is not expected to have any adverse impacts on flooding in the areas downstream from the airport.

Assessment of On-Site Stormwater Quality Management Measures

The major potential impacts of urban stormwater on downstream receiving waters are increases in sediment loads during the construction phase and increases in nutrients during the long-term operational phase. Pollutant loads in urban stormwater are generally dependent on land use and rainfall characteristics in the area. Pollutant export rates within the airport sites would be similar to those established by the CSIRO Division of Water Resources (1992), Sydney Water (1992) and Hammerschmidt et al (1989) for the Hawkesbury Nepean Basin (*Table 13.13*).

Table 13.13 Pollutant Export Rates for the Hawkesbury Nepean Basin (kilograms per hectare per year)

Land Use	Total Phosphorous	Total Nitrogen	Suspended Solids
Bushland	0.1	1.5	15
Rural-fertilised	0.6	7	120
Rural-unfertilised	0.25	0.9	120
Urban	1.3	5	900
Industrial	1.8	6	900

Source: CSIRO Division of Water Resources, 1993; Sydney Water Corporation, 1992; Hammerschmidt et al, 1989

The AQUALM-XP water quality model was used to provide an estimate of the pollutant loads within the airport catchment. The model was run for twelve years of daily rainfall data from 1984 to 1996 to obtain daily pollutant loads and concentration levels for total phosphorus, total nitrogen and suspended solids.

Total annual pollutant loads and average concentrations are presented in *Table 13.14* for existing catchment conditions for the locations shown in *Figure 13.10*. It is estimated that at node BC20, Badgerys Creek contributes up to about 1,500 kilograms of phosphorus, 18,000 kilograms of nitrogen and 300,000 kilograms of suspended solids each year to the South Creek river system. Similarly, the pollutant loads in Cosgroves Creek at node CC20 equate to about 670 kilograms of phosphorus, 7,900 kilograms of nitrogen and 140,000 kilograms of suspended solids annually.

Table 13.14 Existing Water Quality

Location	Node	Load (kg/year)			Average Concentrations (mg/l)		
		TP x 10^2	TN x 10^3	SS x 10^4	TP	TN	SS
Badgerys Ck d/s Elizabeth Drive	BC20	15	18	30	0.46	5.45	91
Badgerys Ck at Elizabeth Drive	BC30	10	11	19	0.40	4.40	76
Badgerys Ck at Pitt St	BC50	8.5	8.9	16	0.40	4.24	76
Cosgrove Ck d/s Elizabeth Drive	CC20	6.7	7.9	14	0.45	5.39	93
Cosgrove Ck at Elizabeth Drive	CC21	1.9	2	3.5	0.41	4.37	76
Oaky Ck at Elizabeth Drive	CC30	2.6	2.7	4.8	0.41	4.29	76
Concentration Guidelines					0.05[1]	0.50[1]	20[2]

Notes:
1. *Australia and New Zealand Environment Conservation Council (1992).*
2. *Environment Protection (1994d).*

Abbreviations:
TP Total Phosphorous.
TN Total Nitrogen.
SS Suspended Solids.

In *Table 13.14*, the existing water quality is also compared with Australia and New Zealand Environment Conservation Council and Environmental Protection Authority benchmark levels for the protection of the environmental value of freshwater waterways. The Australia and New Zealand Environment Conservation Council and Environment Protection Authority guidelines provide an indication of levels at or above which pollution problems have been known to occur. The results confirm that the existing water quality in the creeks is poor. The average pollutant concentrations for phosphorus, nitrogen and suspended solids are four to ten times

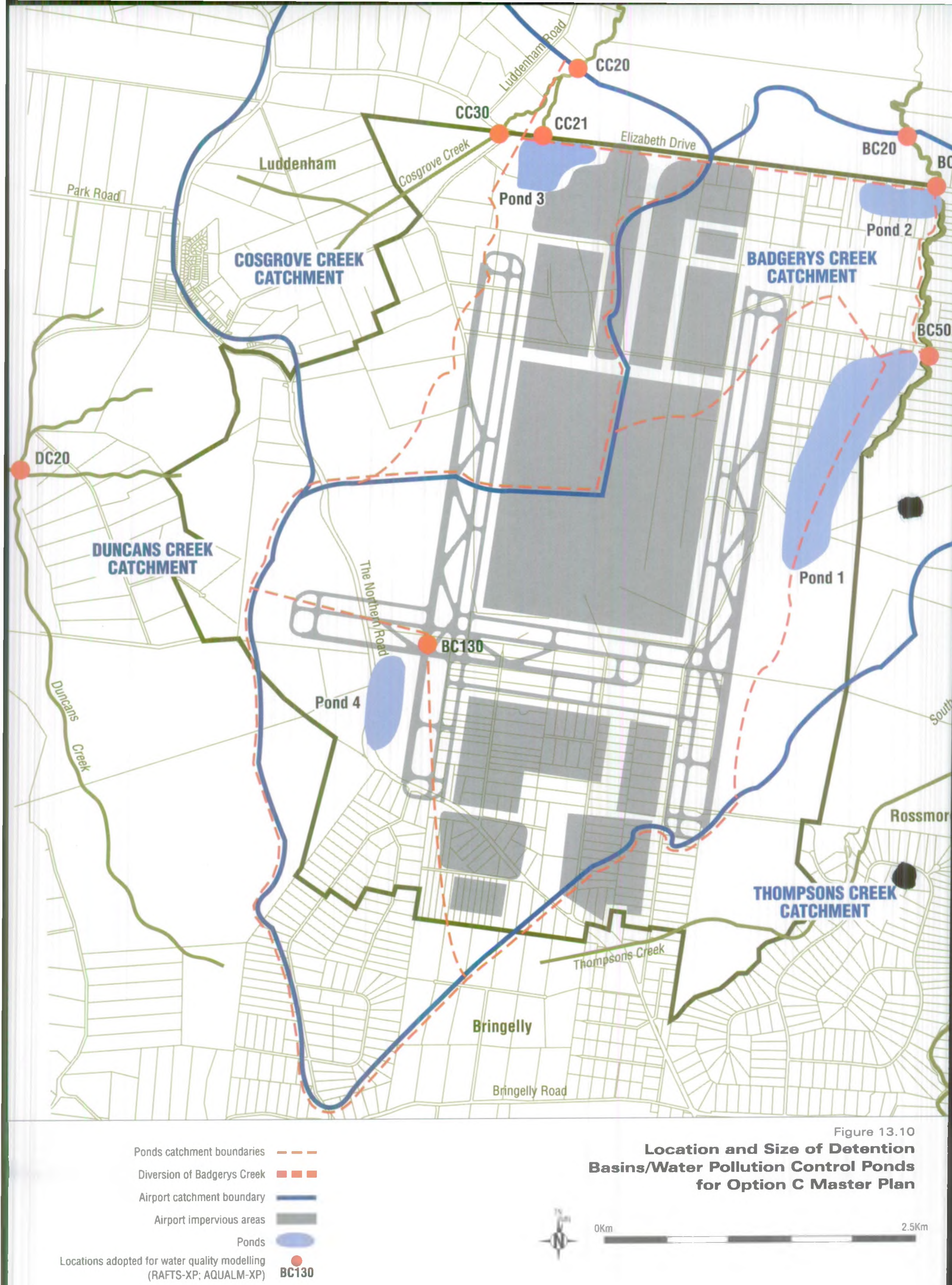


Figure 13.10

Location and Size of Detention Basins/Water Pollution Control Ponds for Option C Master Plan

above the guidelines. The impacts of such high concentrations of pollutants are discussed later in this section.

Water quality impacts on the receiving waters resulting from the proposed airport development are summarised in *Table 13.15* for Option B and *Table 13.16* for Option C. These results are for the airport options without any water quality control measures in place. Under that circumstance both Options B and C would cause a significant increase in the levels of suspended solids. For total phosphorus, however, the trends would be less distinct. In some areas the post-development total annual loads would increase, while in other areas they would decrease. For nitrogen there would be a decrease in the loads. The changes in both phosphorus and nitrogen loads are due to the change in land use, sub-catchment areas, and local run-off volumes for each of the airport options.

Table 13.15 Post-Development Water Quality for Option B (No Controls)

Location	Node	Load (kg/year)			Average Concentrations (mg/l)		
		TP x 10^2	TN x 10^3	SS x 10^4	TP	TN	SS
Badgerys Ck d/s Elizabeth Drive	BC20	13	8.5	74	0.28	1.85	161
Badgerys Ck at Elizabeth Drive	BC30	12	7.6	71	0.26	1.62	151
Badgerys Ck at Pitt St	BC50	8.5	5.2	48	0.26	1.60	148
Cosgrove Ck d/s Elizabeth Drive	CC20	7.6	5.9	30	0.34	2.65	135
Cosgrove Ck at Elizabeth Drive	CC21	3.0	1.5	19	0.25	1.24	157
Oaky Ck at Elizabeth Drive	CC30	2.5	2.5	7.7	0.34	3.36	104
Concentration Guidelines					0.05[1]	0.50[1]	20[2]

Notes: 1. *Australia and New Zealand Environment Conservation Council (1992).*
2. *Environment Protection Authority (1994d).*

Abbreviations: *TP* *Total Phosphorous.*
TN *Total Nitrogen.*
SS *Suspended Solids.*

Table 13.16 Post-Development Water Quality for Option C (No Controls)

Location	Node	Load(kg/year)			Average Concentrations (mg/l)		
		TP x 10^2	TN x 10^3	SS x 10^4	TP	TN	SS
Badgerys Ck d/s Elizabeth Drive	BC20	14	9.1	81	0.28	1.83	163
Badgerys Ck at Elizabeth Drive	BC30	13	8.1	79	0.25	1.59	155
Badgerys Ck at Pitt St	BC50	10	6.3	61	0.25	1.59	154
Cosgrove Ck d/s Elizabeth Drive	CC20	7.0	5.4	33	0.32	2.45	150
Cosgrove Ck at Elizabeth Drive	CC21	3.1	1.4	22	0.25	1.15	180
Oaky Ck at Elizabeth Drive	CC30	24	2.3	8.4	0.32	3.05	111
Concentration Guidelines					0.05[1]	0.50[1]	20[2]

Notes: 1. *Australia and New Zealand Environment Conservation Council (1992).*
2. *Environment Protection Authority (1994d).*

Abbreviations: *TP* *Total Phosphorous.*
TN *Total Nitrogen.*
SS *Suspended Solids.*

Overall, with no water quality measures in place, the levels of suspended solids for both Options B and C would increase to five to nine times that of the Australia and New Zealand Environment Conservation Council guidelines. In addition, the post-development nutrient loads would be two to seven times higher than the Australia and New Zealand Environment Conservation Council guidelines even with the reductions brought about by the change in land use.

Water quality control ponds would be provided to assist in the treatment of stormwater to improve downstream water quality. It would be necessary to design the ponds as sedimentation systems, without macrophyte zones, and with steep batters to discourage bird life at the airport. Provision of a fore bay zone at the upstream portion of the pond would facilitate the trapping concentration of coarse material. Chemical or organic flocculants would also be required to assist in the settling of colloidal particles.

Generally, the water quality control ponds would be combined with the flood detention basins. The lower portion of the combined pond would provide a permanent pond for water quality control and the upper portion for the temporary storage of flood water.

The size and locations of the proposed detention basins and water quality ponds are shown in *Table 13.17*, and *Figures 13.8* and *13.9* for Options B and C, respectively. The ponds would be generally located at the downstream boundaries of the airport site and set back from the main flow channels.

Table 13.17 Proposed Water Quality Ponds for Option B and Option C

Location	Option B			Option C		
	Name	Volume (cubic metre)	Area (hectares)	Name	Volume (cubic metre)	Area (hectares)
Badgerys Creek	Pond 1	67,998	5.0	Pond 1	1,278,059	33.0
	Pond 2	470,498	12.4	Pond 2	384,910	10.2
	Pond 3	474,384	12.5			
	Pond 4	521,159	13.7			
Oaky Creek	Pond 5	443,234	11.7	Pond 3	462,700	12.2
Cosgroves Creek	Pond 6	96,369	2.7	Pond 4	250,816	10.4
Total		**2,073,642**	**58.0**		**2,376,485**	**65.8**

For Option B, six water quality ponds are proposed for the treatment of stormwater at various locations within the site. The combined volume of the ponds is estimated to be 2.1 million cubic metres spread over a total surface area of 58 hectares. The latter equates to about one percent of the area of the airport catchment.

For Option C, four water quality ponds are proposed. The combined volume is estimated at 2.4 million cubic metres, and the total surface area at 66 hectares or 1.1 percent of the airport catchment area. This includes one large pond of about 1.3 million cubic metres with a surface area of 33 hectares.

The water quality ponds for both Options B and C are generally sized to ensure that the pond outflows meet with the Australia and New Zealand Environment Conservation Council guidelines. The guidelines were not applied to Pond 1 for Option B which drains into Pond 2 and Pond 4 for Option C which drains into Pond 1. Water quality results obtained at various locations along the creek system using the AQUALM-XP model and with the water quality ponds in place are summarised in *Table 13.18* and *Table 13.19*.

Table 13.18 Post-Development Water Quality for Option B (With Controls)

Location	Node	Load (kg/year)			Average Concentrations (mg/l)		
		TP x 10^2	TN x 10^3	SS x 10^4	TP	TN	SS
Badgerys Ck d/s Elizabeth Drive	BC20	5.0	4.7	12	0.15	1.37	35
Badgerys Ck at Elizabeth Drive	BC30	4.4	3.9	9.9	0.11	0.95	24
	Pond 4	**0.41**	**0.29**	**0.31**	**0.05**	**0.36**	**4**
Badgerys Ck at Pitt St	BC50	3.2	2.7	8.1	0.11	0.95	29
	Pond 3	**0.36**	**0.24**	**0.21**	**0.05**	**0.34**	**3**
	Pond 2	**0.42**	**0.29**	**0.45**	**0.05**	**0.38**	**6**
	Pond 1	**0.57**	**0.57**	**1.5**	**0.22**	**2.17**	**57**
Cosgrove Ck d/s Elizabeth Drive	CC20	4.3	4.5	9.4	0.23	2.46	51
Cosgrove Ck at Elizabeth Drive	CC21	0.7	0.5	1.5	0.06	0.45	14
	Pond 5	**0.37**	**0.26**	**0.42**	**0.05**	**0.37**	**6**
Oaky Ck at Elizabeth Drive	CC30	2.0	2.3	4.8	0.30	3.26	68
	Pond 6	**0.08**	**0.04**	**0.13**	**0.05**	**0.26**	**8**
Concentration Guidelines					0.05[1]	0.50[1]	20[2]

Notes:
1. Australia and New Zealand Environment Conservation Council (1992)
2. Environment Protection Authority Guidelines (1994d)
3. Pond 1 for Option B drains into Pond 2

Abbreviations: TP Total Phosphorous
TN Total Nitrogen
SS Suspended Solids

Table 13.19 Post-Development Water Quality for Option C (With Controls)

Location	Node	Load (kg/year)			Average Concentrations (mg/l)		
		TP x 10^2	TN x 10^3	SS x 10^4	TP	TN	SS
Badgerys Ck d/s Elizabeth Drive	BC20	4.1	3.8	8.5	0.12	1.12	25
Badgerys Ck at Elizabeth Drive	BC30	3.6	3.1	6.9	0.08	0.72	16
	Pond 2	**0.32**	**0.2**	**0.39**	**0.05**	**0.33**	**6**
Badgerys Ck at Pitt St	BC50	2.6	2.1	5.2	0.08	0.64	16
	Pond 1	**1.2**	**0.84**	**1.3**	**0.06**	**0.40**	**6**
	Pond 4[3]	**0.43**	**0.46**	**6.9**	**0.19**	**2.03**	**30**
Cosgrove Ck d/s Elizabeth Drive	CC20	4.4	4.3	13	0.24	2.31	70
Cosgrove Ck at Elizabeth Drive	CC21	0.56	0.34	1.1	0.05	0.31	10
	Pond 3	**0.34**	**0.23**	**0.17**	**0.05**	**0.34**	**2.5**
Oaky Ck at Elizabeth Drive	CC30	2.4	2.3	4.8	0.32	3.05	64
Concentration Guidelines					0.05[1]	0.50[1]	20[2]

Notes:
1. Australia and New Zealand Environment Conservation Council (1992)
2. Environment Protection Authority (1994d)
3. Pond 4 for Option C drains into Pond 1

Abbreviations: TP Total Phosphorous
TN Total Nitrogen
SS Suspended Solids

It is evident from the results in *Tables 13.18*, *13.19* and *13.14*, that the water quality ponds would be effective in reducing the existing level of pollution in the downstream waters. At each pond outlet, the concentration levels of total phosphorus and total nitrogen would meet the Australia and New Zealand Environment Conservation Council guidelines.

For Option B, the annual pollutant loads and concentrations at Badgerys Creek downstream of Elizabeth Drive (node BC20) would be generally reduced to about 25 to 40 percent of the existing levels. Similarly, at Cosgroves Creek, downstream of Elizabeth Drive (node CC20), they would be reduced to about 45 to 65 percent of the existing levels. For Option C, at Badgerys Creek (node BC20), the annual pollutant loads and concentrations are reduced to 21 to 28 percent of the existing levels, while at Cosgroves Creek (node CC20), they are reduced to 43 to 75 percent of the existing levels.

The improvements are considerable, taking into account the fact that a large proportion of the stormwater discharging into these locations comes from areas outside the control of the airport. Consequently, it has been assumed that stormwater from these areas would not be treated prior to discharge into the creek system. These untreated flows would have the effect of lowering the water quality in some of the downstream areas.

Overall, it is concluded that provision of the water quality ponds as part of the airport development for both Options B and C would have a beneficial impact in improving the quality of water flowing from the sites.

Assessment of Downstream Water Quality

The potential impacts of the airport on downstream water quality in South Creek were assessed using the regional HSP-F model. The HSP-F model was used to simulate the hourly discharge of run-off and pollutants for the rainfall period between 1985 to 1994, including the advection and dispersion of pollutants, the transport and deposition of suspended solids, the death of faecal coliforms, and the growth and death of algae.

Sewage effluent discharge from the airport has not been included in the model as it would be almost totally re-used within the airport. Under prolonged wet weather conditions discharge of some effluent may be necessary. As this effluent would be of very high quality and would occur at times of high stream flows with high levels of dilution no adverse impacts would result.

The locations at which water quality assessments have been made using the HSP-F model are shown in *Figure 13.1*. The results obtained are summarised in *Table 13.20* for existing conditions, *Table 13.21* for Option B, and *Table 13.22* for Option C. In these tables, the water quality levels are represented by the frequency of compliance with Australia and New Zealand Environment Conservation Council guidelines for the protection of environmental values in freshwater systems. This includes total phosphorus, total nitrogen, suspended solids, chlorophyll-a, and faecal coliforms for primary and secondary contact recreation.

Table 13.20 Existing Water Quality Compliance in South Creek

Location Criteria	Compliance with Australia and New Zealand Environment Conservation Council Guidelines (%)					
	TP 0.05[1] mg/l	TN 0.5[1] mg/l	SS 20[2] mg/l	Chl-a 20[1] ug/l	Prim 100[1] cfu/100ml	Sec 1000[1] cfu/100ml
M4 Motorway	26%	76%	69%	56%	26%	91%
D/s Badgerys Ck	-[3]	83%	97%	84%	81%	94%
Elizabeth Dr	46%	64%	23%	54%	32%	87%

Notes:
1. *Australia and New Zealand Environment Conservation Council (1992)*
2. *Environment Protection Authority (1994d)*
3. *Not validated in model but trend similar to that for total nitrogen*

Abbreviations:
TP Total Phosphorus
TN Total Nitrogen
SS Suspended Solids
Chl-a Chlorophyll-a
Prm Coliform levels for primary contact recreation
Sec Coliform levels for secondary contact recreation

Table 13.21 Water Quality Compliance in South Creek for Option B

Location Criteria	Compliance with Australia and New Zealand Environment Conservation Council Guidelines (%)					
	TP 0.05[1] mg/l	TN 0.5[1] mg/l	SS 20[2] mg/l	Chl-a 20[1] ug/l	Prim 100[1] cfu/100ml	Sec 1000[1] cfu/100ml
M4 Motorway	34%	78%	64%	55%	25%	91%
D/s Badgerys Ck	-[3]	86%	97%	85%	81%	94%
Elizabeth Dr	52%	68%	20%	57%	32%	87%

Notes:
1. *Australia and New Zealand Environment Conservation Council (1992)*
2. *Environment Protection Authority (1994d)*
3. *Not validated in model but trend similar to that for total nitrogen*

Abbreviations:
TP Total Phosphorus
TN Total Nitrogen
SS Suspended Solids
Chl-a Chlorophyll-a
Prm Coliform levels for primary contact recreation
Sec Coliform levels for secondary contact recreation

Table 13.22 Water Quality Compliance in South Creek for Option C

Location Criteria	Compliance with Australia and New Zealand Environment Conservation Council Guidelines (%)					
	TP 0.05[1] mg/l	TN 0.5[1] mg/l	SS 20[2] mg/l	Chl-a 20[1] ug/l	Prim 100[1] cfu/100ml	Sec 1000[1] cfu/100ml
M4 Motorway	36%	77%	63%	55%	25%	91%
D/s Badgerys Ck	-[3]	86%	97%	85%	81%	94%
Elizabeth Dr	52%	68%	20%	57%	32%	87%

Notes:
1. *Australia and New Zealand Environment Conservation Council (1992)*
2. *Environment Protection Authority (1994d)*
3. *Not validated in model but trend similar to that for total nitrogen*

Abbreviations:
TP Total Phosphorus
TN Total Nitrogen
SS Suspended Solids
Chl-a Chlorophyll-a
Prm Coliform levels for primary contact recreation
Sec Coliform levels for secondary contact recreation

The results relate to South Creek locations at Elizabeth Drive, at its confluence with Badgerys Creek, and at the M4 Motorway with the airport water quality control measures in place. Areas downstream of the M4 Motorway are not assessed as the water quality there is heavily affected by poor quality urban stormwater from St Marys and discharges from the St Marys sewage treatment plant. A large pondage at the confluence of South Creek with Badgerys Creek influences water quality.

Under existing conditions, it is estimated that the nutrients and chlorophyll-a levels at Elizabeth Drive generally comply with Australia and New Zealand Environment Conservation Council guidelines for about 50 percent of the time or more. However, the guideline for suspended solids is satisfied only 23 percent of the time. In comparison, the coliform levels satisfy the guidelines for secondary contact recreation 87 percent of the time.

At the pondage in Badgerys Creek the existing level of compliance is high, being 80 percent above most guidelines. It is clear that the large pondage removes a lot of the pollution, particularly total nitrogen, suspended solids and faecal coliforms. At the M4 Motorway, the existing water quality is generally poorer than that at the Badgerys Creek pondage, except for total phosphorus.

For both Options B and C, the water quality results show that the level of compliance would be generally equivalent to or better than the existing condition for all the indicators at all the three locations (*Table 13.21* and *Table 13.22*). The exception is for suspended solids, where the HSP-F model results indicate a slight reduction in the level of compliance of between three and five percent for both Options B and C. It is likely that this would be due to a slight increase in river bed and bank erosion brought about by changes in the flow regime. These aspects are discussed in the following section covering stream morphology and would be investigated further during the detail design phase. If necessary, additional river erosion control measures would be provided to mitigate any adverse impacts.

Serious concerns regarding the impacts on the water quality of the Hawkesbury Nepean River System were raised in submissions on the Draft EIS. Reference is made in submissions to the policy of Hawkesbury Nepean Catchment Management Trust, which states that no development can lead to a deterioration of the ecosystem or compromise its environmental values. The proposed water quality measures to be implemented at the airport sites would ensure that downstream water quality would be improved over existing conditions. This improvement would be most noticeable within South Creek. In addition, the airport would contribute to downstream regional water quality within the Hawkesbury Nepean River System by reducing, with the exception of suspended solids, the levels of pollutants entering the system.

Impacts on Stream Morphology and Ecology

Hydrological Impacts

The assessment of the impact of changed hydrological conditions on stream morphology and ecology was based on a comparison between the existing hydrology in Badgerys Creek and Cosgrove Creek and the predicted flow characteristics as a result of operation of the airport. Two major changes to run-off quantity characteristics would result from airport operation:

- an increase in total volume of run-off from the impervious areas of the development as described earlier in this section; and
- attenuation of storm flows by detention basins.

Hydrographs of flows in Badgerys Creek and Cosgrove Creek for pre-airport conditions and for the airport with detention ponds were compared. The hydrographs represent flows downstream of the discharge from the detention basins and therefore reflect the changes in the vicinity of the airport. Although the catchment areas for before and after scenarios are slightly different within the airport sites, the stream impacts remain comparable.

The hydrological changes evident in streams after run-off from a storm has passed through the detention basins are:

- a change in the time when the peak flow occurs (generally a delay);
- an increase in the duration of high stream flow; and
- an increase in the total volume of water transported.

There would be virtually no change to peak flow rates as the detention system is designed to limit peak flow rates so that they do not exceed flow rates under existing conditions. The change in the time when the peak flow occurs is considered insignificant to erosion and aquatic ecological impacts.

The total average flow in streams at the airport site after development would increase by approximately four percent for Option B and seven percent for Option C. The duration of flows above the base flow can be expected to be prolonged by an increase of similar magnitude.

The flow volume for Cosgrove Creek would increase by approximately 25 percent under average flow conditions (node CC20). A lesser effect would result in Badgerys Creek where flow volumes would increase by approximately five percent (node BC20). The points of reference used are immediately downstream of the airport site but, in the case of Badgerys Creek, a significant proportion of the contributing catchment is land outside the airport sites.

In addition, the impact of an extended wet period was addressed. Under prolonged wet weather conditions there would be less of a sharp peak in stream flow rates. Once the detention basins are full there would be little impact on the streams except at the end of the rainfall event, when discharge would be prolonged. The increase in duration of high flow would be less in proportional terms to a shorter but high intensity rainfall event.

As parts of Badgerys Creek are currently showing signs of erosion, increased periods of high flow may exacerbate bank erosion in the area immediately downstream of the creek. Further downstream flow changes would be dampened by wider catchment influences.

Cosgrove Creek would have longer periods under high flow and a greater proportional increase in flow volume. However, the potential for erosion would be lower as this stream has banks that are largely stable and vegetated.

The potential for adverse impacts on aquatic fauna and flora from the changed stream hydrology would depend on the degree of habitat disturbance and extent of dislocation of species (for example, invertebrate drift). Increase in the transport of species downstream is likely to occur but, given the current highly variable flow regime, it would be expected that fauna would have adapted to drift and recolonisation. Any scouring of in-stream and riparian vegetation, if substantial, could be of greater importance to both invertebrate and vertebrate species such as fish, as this would remove habitat and shelter.

During design and construction of the airport a fluvial geomorphologist would examine the potential for erosion and macrophyte scour in detail and, if necessary, recommend mitigation measures to reduce bank erosion and aquatic plant dislocation.

Water Quality Impacts

The water quality control ponds would be designed to achieve Australia and New Zealand Environment Conservation Council (1992) water quality guideline concentrations for nutrients discharged in treated stormwater of 0.05 milligrams per litre total phosphorus and 0.5 milligrams per litre total nitrogen. Suspended solids would be reduced to less than Environmental Protection Authority (1994d) criteria of 20 milligrams per litre. Pollutant export after development would be lower than under the current land management.

The proposed wastewater management scheme for the airport would result in virtually no stream discharge of treated effluent, with effluent being re-used for a number of purposes, including irrigation, industrial uses, cooling system water and toilet flushing. Storage ponds would be provided for wet weather retention. Under prolonged wet weather conditions when storage pond capacity is exceeded, treated effluent with low nutrient concentrations (total phosphorus of 0.05 milligrams per litre) might be discharged.

Given that pollutant load in stormwater run-off would be reduced and any sewage effluent discharge would be infrequent and of high quality and would occur at a time when there is a high level of dilution, there are not likely to be any adverse aquatic impacts on the immediate stream or any cumulative impacts further downstream

13.7 Impact of Aircraft Emissions on Water Supply

Further studies were undertaken to establish the validity of the assessment made in the Draft EIS and to further investigate the impact of aircraft emissions on water quality. A report on the additional work is provided in *Appendix E5*.

The study focused on the pollutants polycyclic aromatic hydrocarbons, benzene, butadiene, formaldehyde, phenol and xylene. Consideration was given to expected emission levels, what happens to these pollutants in the atmosphere and potential transport routes that might lead to deposition in areas of potential concern, particularly Lake Burragorang, Prospect Reservoir and rainwater tanks. The study also provides information relevant to potential contamination of agricultural dams

13.7.1 Aircraft Exhaust

The impact on water reservoirs of aerial pollutants from aircraft operation was further investigated and the predicted concentrations compared to human health guidelines and ecological guidelines for aquatic biota (Australia and New Zealand Environment Conservation Council, 1992).

Major reservoirs near the airport sites include the potable water supplies of Lake Burragorang (Warragamba), Prospect Reservoir and the more distant Upper Nepean reservoirs. Numerous small agricultural dams have been constructed in the area. The assessment of risk of water supply contamination from aircraft emissions involved estimating the rate of transfer and degree of solubility for key contaminants into water near off-takes for given ground level concentrations of air pollutants. Information for this exercise was located in the published literature and also derived from *Technical Paper No. 6*.

Aircraft exhaust consists of organic compounds, which can be broadly classified into particulate and volatile components. Polycyclic aromatic hydrocarbons are representative of the particulate compounds. Volatile emissions include benzene, butadiene, formaldehyde, phenol and xylene.

The presence of polycyclic aromatic hydrocarbons in aircraft exhaust has been well documented. The United States Environmental Protection Agency lists sixteen polycyclic aromatic hydrocarbons that are especially relevant to environmental and human health. Of these ten have been attributed to aircraft turbines, including benzo(a)pyrene. It was confirmed that using benzo(a)pyrene as an indicator of the presence of polycyclic aromatic hydrocarbons was appropriate.

The Australia and New Zealand Environment Conservation Council (1992) guideline for total polycyclic aromatic hydrocarbons is three micrograms per litre for ecosystem protection, and in drinking water, the health related guideline value is 0.01 micrograms per litre. The specific interim Australia and New Zealand Environment Conservation Council guideline proposed for benzo (a) pyrene in water for ecosystem protection is 0.3 micrograms per litre.

While there have been no studies dealing with polycyclic aromatic hydrocarbon levels produced for an airport in Australia, a study has been made of benzo (a) pyrene releases from aircraft engines at a Moscow Airport (Shabad and Smirnov, 1972; 1976). The Moscow study occurred in 1969 before improvements to engines decreased levels of pollutants including polycyclic aromatic hydrocarbons. These can provide a basis for estimating inputs to a reservoir like Lake Burragorang. Fall-out rates of benzo (a) pyrene into snow samples adjacent to taxiways accumulated 2.2 micrograms per square metre in 24 hours, compared to 0.3 micrograms per square metre 1.5 kilometres from the end of the runway. At 10 to 15 kilometres from the airport, the snow contained 0.03 micrograms per square metre to 0.1 micrograms per square metre.

Using these fall-out rates, coupled with the dispersion of the type noted in the Draft EIS, the annual fallout at Lake Burragorang might be expected to be below 10 micrograms per square metre. The estimated concentration from this fall-out in the water of Lake Burragorang is not more than 0.01 micrograms per litre.

Polycyclic aromatic hydrocarbons have very low water solubility, preferring to bind with particulates such as organic carbon. The polycyclic aromatic hydrocarbons entering water systems from dry atmospheric deposition would rapidly partition into solid phases, with its ultimate fate being accumulation in bottom sediments. When polycyclic aromatic hydrocarbons settle with soot or contact soils, their mobility is limited to the particulate to which they adhere. Once in water, they are likely to settle to the bottom. The particulate fraction is generally considered as being not biologically available. The particle size is expected to be in the range of 10 to 100 micrometres. Prospect Water Filtration Plant is designed to remove 99 percent of particulates between 2 and 350 micrometres (Murray, 1995).

The additional studies confirm the Draft EIS findings that in dry weather benzene and other volatile compounds would be lower than the relevant guideline values. In wet weather some benzene would combine with rainfall and enter waterways. Even with this additional conduit, levels of benzene would be less than the drinking water guideline.

In submissions on the Draft EIS, concern was raised that benzene is not the only volatile component of aircraft exhaust and that other constituents should be modelled. It has been confirmed that benzene was the appropriate choice of compound for volatile modelling other pollutants including formaldehyde, 1,3 – butadiene and xylene. Phenol, having a low vapour pressure, would not be well modelled by benzene. The relative low level of phenol in aircraft exhaust and the higher levels allowed for phenol in drinking water guidelines show that it is less of a risk to human health than benzene and 1,3 – butadiene. For the same atmospheric concentration, 13.5 times more benzene will combine with rainfall than 1,3 – butadiene, thus justifying the choice of benzene as a model compound. Photochemical degradation pathways exist for 1,3 – butadiene and formaldehyde that would further reduce concentrations.

The additional studies confirm the predicted absence of threats to human and aquatic health as a consequence of deposition of emissions from aircraft engines in water supply reservoirs should an airport be built at Badgerys Creek.

13.7.2 Rainwater Tanks

Since polycyclic aromatic hydrocarbons are found in the atmosphere and in rain, it is likely that they would also be found in rainwater tanks. This would occur both by direct run-off of contaminated rainwater to tanks, as well as through wash-off of any particulate-associated dry deposition on roofs.

Using data quoted for polycyclic aromatic hydrocarbons in urban rainfall from a Swiss study (Leuenberger *et al.*, 1988), the concentrations of dissolved polycyclic aromatic hydrocarbons in rainwater tanks in an urban area could exceed the drinking water guidelines. The high levels of polycyclic aromatic hydrocarbons in urban areas is attributed to emissions from automobile engines with only a small fraction attributed to aircraft emissions. In areas away from major traffic sources, the concentrations would be considerably lower.

The first flush concentration would be the major carrier of these contaminants. First flush diversion options are probably a desirable means of overcoming the problem, otherwise the use of a suitable filter would effectively trap particulate-associated polycyclic aromatic hydrocarbons. Natural settling of particulates in the tanks would also effectively remove most of the contaminants from the bulk water. As stated in the Draft EIS, there are other contaminants that need to be avoided in roof run-off with health impacts that may be more serious.

As with polycyclic aromatic hydrocarbons, volatile compounds would be expected to be present in rainwater tanks. Since predicted concentrations of benzene are below drinking water guidelines, it can be reasonably assumed that there would be no threat to human health from benzene or other volatiles.

The additional studies confirm the predicted absence of increased threats to human health as a consequence of deposition of emissions from aircraft engines in rainwater tanks should an airport be built at Badgerys Creek.

13.7.3 Fuel Venting

Fuel venting is the accidental release of small amounts of fuel resulting from a malfunction in the fuel valve system. Fuel venting should not be confused with fuel dumping, which is the controlled release of fuel at high altitudes over the Tasman Sea during emergency situations.

There is only a remote possibly of accidental fuel spillage from aircraft using an airport at Badgerys Creek, as outlined in *Section 20.4.4* of this Supplement. The fate of any fuel which might be vented would be the same as other volatile emissions described in *Section 13.6.1* and would not be a threat to human or aquatic health.

13.7.4 Other Water Issues

The claim was made in one submission that Sydney's water supply currently fails to meet National Health and Medical Research Council guidelines. This is not an issue related to the airport development and would be a matter for action by the State Government if appropriate.

The risks to water quality and water supply from an aircraft crash at Warragamba Dam are addressed in *Chapter 16* of this Supplement.

13.8 Environmental Management

13.8.1 Impacts During Construction

Potential impacts during construction of the airport are:

- filling and replacement with stormwater drains of approximately five kilometres of stream for option A, 10 kilometres for option B and 10 kilometres for option C;
- soil erosion of disturbed areas and subsequent sedimentation of downstream creeks;
- discharges of saline water from perched aquifers;
- spillage or discharge into a watercourse of oil, fuel and other polluting substances associated with construction activities; and
- increased rates of stormwater run-off with subsequent increases in downstream flood potential.

The major adverse impact was assessed as resulting from the infilling of streams on the site. The sites of the airport options are at the very top end of the catchment, where it is difficult to define exactly what constitutes a stream. A conservative approach was taken in defining a stream and consequently the lengths quoted can be considered a maximum.

The key strategies in mitigating construction impacts are summarised as:

- careful design of the airport to minimise the lengths of stream to be filled;
- the establishment of base environmental conditions and monitoring of impacts against these for the duration of construction work;
- careful advanced planning and ongoing management of works and mitigating procedures to reduce erosion and pollutant loads;
- construction and commissioning of all or part of the permanent storm detention basins and water quality control ponds before any other major earthworks and if possible make use of the existing detention pond at the site; and
- locate in advance any perched groundwater zones affected by construction and that drain to evaporation basins.

Management measures to mitigate potential construction impacts are described in detail in *Chapter 25*.

13.8.2 Water Cycle Management During Operation

Water Cycle Management Objectives

A Water Cycle Management Plan would form part of an environmental strategy required for the operational airport under the *Airports Act 1996*.

The major water cycle management objectives are:

- stormwater discharge from airport would be controlled so that peak stream flow rates did not exceed existing levels, to avoid increasing downstream flood risk;
- existing stream water quality conditions would be improved; and
- water conservation and wastewater re-use would be maximised.

Water Cycle Components

A schematic presentation of the water cycle at the airport is shown in *Figure 13.11*.

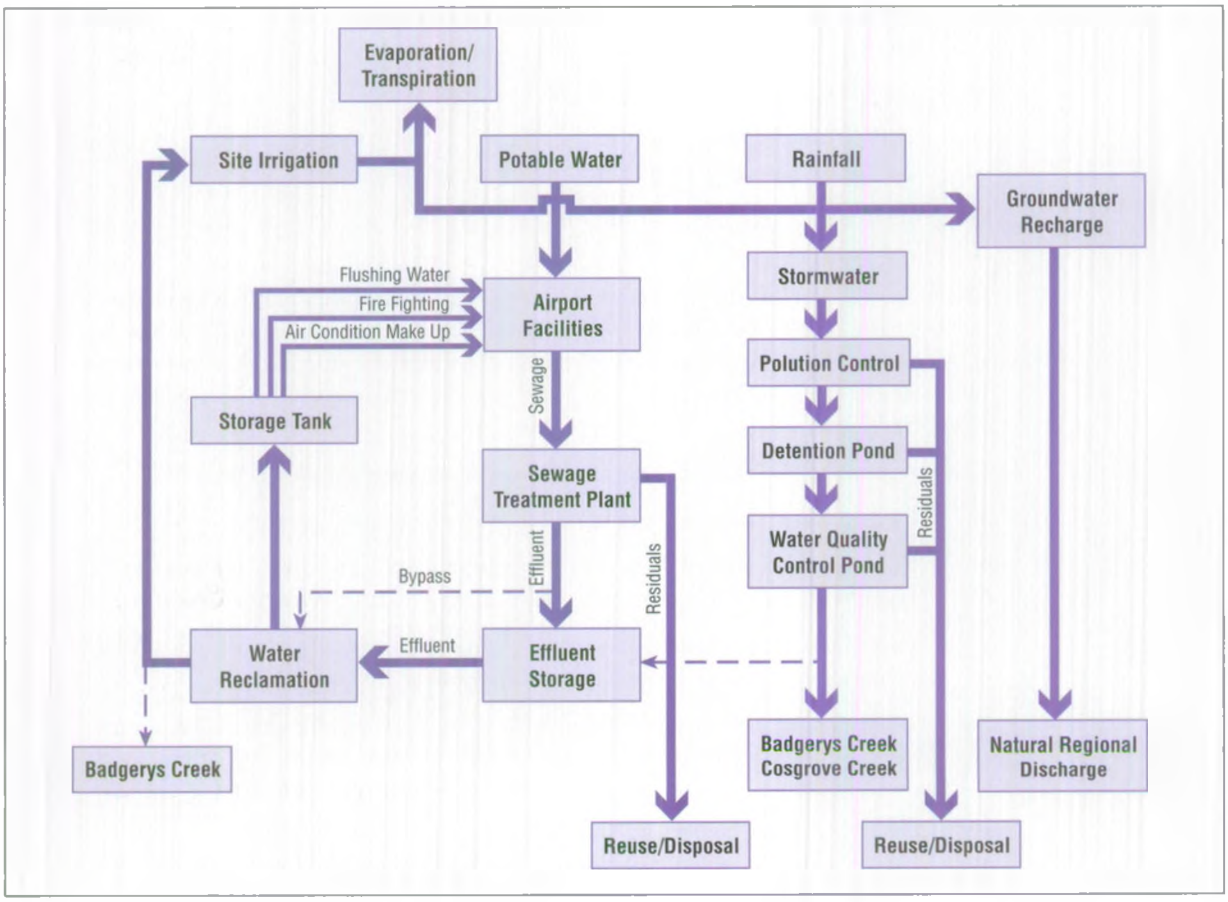


Figure 13.11
Water Cycle Schematic

Groundwater plays a minor role in the water cycle at the airport. The construction of impervious areas would reduce groundwater recharge, resulting in a slight lowering of the groundwater table. Changes to groundwater flows would be insignificant and natural regional discharge would continue.

Rainfall would be collected in the stormwater drainage system and directed to storm flow detention basins and water quality control ponds for controlled release to the local creek system. Some stormwater may be transferred to the reclaimed water system for re-use on the airport site.

Fresh water would be delivered to the airport from the Sydney water supply system. Sewage from at least the Stage 1 development would be collected and treated in an on-site sewage treatment plant and then in a reclaimed water treatment plant for re-use for toilet flushing, air conditioning make up, garden watering and other non-potable uses. Storage will be provided to balance differences between the supply and demand of reclaimed water. Under prolonged wet weather conditions, when reclaimed water storage capacity is exceeded, treated effluent with low nutrient concentrations would be discharged to Badgerys Creek. Additional sewage flows from development beyond Stage 1 will probably be transferred off-site.

Groundwater Protection

There are no identified uses for the shallow saline groundwater at the site. Nevertheless protective measures, such as bunding, would be provided around fuel facilities and any other similar potential sources of contamination and groundwater monitoring would be undertaken as part of the water cycle management program.

Water Conservation and Sewer Inflow Management

The water and sewerage systems at the airport would be designed, constructed and maintained to a high standard to reduce leakage and inflows.

Strict water-demand management measures would be applied, including the use of efficient plumbing appliances, restrictions on potable water usage where replacement by reclaimed water is feasible and metering of supplies to leased sites with a charging structure that encourages conservation. Periodic water consumption audits would be carried out, a waste and leakage detection and control program would be implemented and continuous communication with and education of consumers (employees and passengers) would be maintained.

The quality and quantity of sewage inflow to the sewage treatment plant would be monitored to detect any unusual flows or unacceptable substances. Sewage from any large single contributors or potential producers of unacceptable wastes would also be monitored. Inflow of stormwater would be managed by regular inspections of the sewerage collection system and flow monitoring in wet weather. Sewage flow management measures would include application of a charging structure for leased sites, encouraging reductions in both volume and strength of sewage. Rules based on regulations used by water authorities would be established and enforced limiting the quantity and strength of contaminants that could be discharged and prohibiting the discharge of unacceptable substances. Pre-treatment to meet these rules prior to discharge to the sewer system would be required where contaminant levels are high.

Effluent and Stormwater Re-use

Treated sewage effluent would be re-used as much as possible at the airport site for non-potable water requirements to conserve fresh water supplies and to avoid the discharge of effluent into local creeks. Treated effluent would be used to supply water for toilet flushing, garden and lawn watering, air conditioning make up and fire fighting.

Based on the estimates of average daily water requirements and sewage flows provided in *Table 13.1* (*Section 13.4.1*) it is expected that all sewage effluent for the first stage of airport development could be beneficially used within the airport site.

The extent to which sewage effluent could be re-used at the airport for development beyond Stage 1 would depend partly on whether or not a future connection is provided to a regional sewerage scheme. However, the Stage 1 sewerage treatment plant would be retained and could be expanded to continue to provide additional non-potable water requirements.

Other opportunities to use sewage effluent at and adjoining the airport are discussed in *Section 13.4.1* and at locations away from the airport in *Section 13.4.2*.

Non-potable water demands would be highest in hot, dry weather and lowest in cold, wet weather. Storage built to balance supply and demand would also provide an opportunity to use stormwater for non-potable use. Transfer facilities would be provided to deliver stormwater when available and, if required, from the water quality control and detention ponds to the effluent storage pond.

Stormwater Quality and Catchment Management

An essential component of water cycle management at the airport would be the ongoing prevention of contaminants entering the water cycle in stormwater.

The use of herbicides, pesticides and fertilisers in garden and grassed areas would be controlled as part of the environmental strategy. The disposal of any unacceptable substances such as paint and oils into the drainage system would be prohibited.

Pollutant traps would be provided at strategic locations to prevent debris and silt entering the drainage system. Inspections and monitoring activities of pollutant traps would be undertaken at regular intervals and after large storms, to check accumulation of material and look for evidence of overflows and blockages. Accumulated sediment and debris would be regularly removed from the traps. Access to all structures would be provided for maintenance vehicles.

Flame traps would be provided on all airport aprons and outside hangars to prevent the spread of flames from the immediate area and to contain small quantities of oil and fuel. Large spills would enter the drainage system and be contained at the water quality control ponds.

Fuel storage facilities and any other similar storage or handling facilities with the potential to contaminate stormwater would be provided with perimeter bunds.

Flame traps and bunded areas would be regularly inspected and any spillage immediately removed.

Detention Pond and Water Quality Control Pond Operation and Maintenance

An Operation and Maintenance Plan would be prepared for the detention basins and water pollution control ponds to ensure performance meets requirements. Operation and management activities would involve bank maintenance to prevent erosion, periodic trash and sediment removal, flocculant dosing and monitoring of water quality indicators.

The ponds would be inspected at regular intervals and after high flow events. The inspections are required to ensure that all components within the ponds are functioning correctly and to determine the need for embankment erosion control or sediment removal measures.

A flocculant, probably aluminium sulphate, subject to approval of Environment Protection Authority, would be dosed into stormwater just upstream of the detention ponds to enhance the settlement of sediments and precipitate phosphorus. Dosing would be automatic and controlled by inflow rates. Inspection and maintenance of dosing equipment and adjustment of dosing rates would be carried out as part of the regular inspection of the water quality control ponds and detention basins.

Sediment would be removed as required to restore pond operational depth using earth moving equipment. Sediments would be used in landscaping works around the site or transported to a suitable landfill.

Any large spills of fuel which bypass the flame traps would be conveyed through the drainage system and intercepted by floating oil/fuel booms which would be provided in the fore bay and around the spillway of each water pollution control pond. Specialised oil skimming equipment would be used to remove any spills.

Regular monitoring of inflow and outflow water quality parameters would provide information to assess the performance of the ponds in meeting water quality objectives and to adjust flocculant dosage levels. Monitoring of peak inflow and outflow rates and total discharge volumes will provide information on the performance of detention ponds in mitigating downstream flood impacts.

Water Balance

The quantities of water involved in each component of the water cycle would vary with the rate and nature of airport development as well as with seasonal changes.

Quantities have been estimated for surface water flows for the existing site and for the completed master plan (*Section 13.5.2*) and can be expected to be within this range for the various stages of airport development.

Quantities for potable and non-potable water supply and for wastewater flows have been provided for the Stage 1 development and for the master plan (*Table 13.1*). These estimates could vary significantly with the nature and scale of commercial and industrial development that actually occurs on the airport site. However, irrespective of the quantities of water involved, the water balance would remain essentially the same throughout the airport life.

The water cycle at sites of the airport options is shown in schematic form in *Figure 13.11*. The essential equations involved are as follows:

- increased stormwater run-off volume would equal significantly decreased evapotranspiration along with insignificant groundwater recharge. There would also be an opportunity to transfer storm run-off to the reclaimed water supply for non-potable water use, depending on supply and demand; and
- potable water supply inflow would equal losses by evaporation (mainly air conditioning make up), evapotranspiration from irrigated landscape areas and wastewater discharges off-site. Wastewater discharges in Stage 1 would be minor and would involve occasional discharge of high quality sewage effluent to Badgerys Creek during periods of extended wet weather. For further stages of development it would be likely that the potential quantity of reclaimed wastewater would exceed the re-use opportunities and a proportion of the wastewater transferred to an off-site facility.

Monitoring

Groundwater monitoring would be a routine procedure involving periodic measuring of water table levels and analysis of groundwater samples from the network of monitoring wells around the site and at fuel storage facilities.

Total flow volumes, peak flow rates and water quality of stormwater flows, would be monitored at the inlet and discharge points of detention basins and water quality control ponds.

The total fresh water and reclaimed water usage would be metered as well as the water supplied to major airport facilities and individual large consumers.

The quality and quantity of sewage inflow to the sewage treatment plant would be monitored to detect any unusual flows or unacceptable substances. Sewage from any large single contributors or potential producers of unacceptable wastes would also be monitored.

The quality and quantity flows from the sewage treatment plant, the quality and volume of water in the effluent storage pond, and the quality and quantity of water flowing to and from the water reclamation plant will all be monitored.

The quantity, quality and time of discharge of any sewage effluent to Badgerys Creek would be monitored as well as the flow rate in the creek.

13.9 Overview of Water

13.9.1 Construction Impacts

Potential impacts during construction of the airport are:

- filling and replacement with stormwater drains of approximately five kilometres of stream for option A, 10 kilometres for option B and 10 kilometres for option C;
- soil erosion of disturbed areas and subsequent sedimentation of downstream creeks;
- discharges of saline water from perched aquifers;
- spillage or discharge into water ways of oil, fuel and other polluting substances associated with construction activities; and
- increased rates of stormwater run-off with subsequent increases in downstream flood potential.

The key strategies to mitigating construction impacts are summarised as:

- careful design of the airport to minimise the lengths of stream to be filled;
- establishment of base environmental conditions and monitor impacts against these for the duration of construction work;
- careful advanced planning and ongoing management of works and mitigating procedures to minimise erosion and pollutant loads;
- construction and commissioning of all or part of the permanent storm detention basins and water quality control ponds before any other major earthworks and if possible make use of the existing detention pond at the site; and
- location in advance of any probable perched groundwater zones affected by construction and drain to evaporation basins.

13.9.2 Operational Impacts

Groundwater

There would be a reduction in groundwater recharge at the airport sites with a minor lowering in the water table within most of the local alluvial aquifer, except for a slight increase immediately adjacent to the filled creek system, and a moderate lowering of the water table in the shale aquifer. This would have no significant impact as changes in groundwater flow and salinity changes would be negligible.

Wastewater

Sewage from at least the Stage 1 development would be treated at an on-site plant to produce a high quality effluent which would be re-used as a non-potable water supply for the airport. Following extended periods of wet weather it may be necessary to discharge some effluent to Badgerys Creek. This would have no significant impact as the effluent would be of high quality with low levels of nutrients, discharges would be infrequent and high levels of dilution would be achieved.

Surface Water Quality

Surface water quality discharged from the airport site would be of better quality than existing run-off. This would be achieved by implementing safeguards and procedures to prevent contaminants entering the drainage system and by treating all surface water in water quality control ponds prior to discharge. The improvement in surface water quality would generally have a positive impact on downstream water quality in South Creek for all water quality indicators examined, with the exception of suspended solids. A slight increase in suspended solids is expected due to increased creek bed and bank erosion brought about by changes in the flow regime.

Stormwater Flows and Flooding

Development of an airport at Badgerys Creek would increase the volume of and rate of storm run-off. Storm detention basins would be provided to control peak flows such that they do not exceed pre development levels. This would ensure that the proposal would not exacerbate flooding.

Stream Flow Modifications

The total volume of storm run-off would be increased by the airport development causing an increase in the period flows in streams above base flow. This has potential to increase stream scouring and could impact on aquatic flora and fauna. Further hydrological modelling carried out as part of the airport design would assist with identifying potential stream scouring. During design and construction a fluvial geomorphologist would examine the potential for erosion and macrophyte scour in creeks downstream of the airport and if necessary, recommend mitigative measures to minimise bank erosion and aquatic plant dislocation.

Water Supplies

Emissions from aircraft would result in low concentrations of benzene and other volatile compounds and particulates in water supply storages. Further studies have confirmed the absence of threats to human and aquatic health as a consequence of the aircraft emissions.

Chapter 14

Flora and Fauna

Chapter 14
Flora and Fauna

14.1 Summary of the Draft Environmental Impact Statement

14.1.1 Methodology

The aims of the flora and fauna assessment in the Draft EIS were to assess the conservation significance of the sites of the airport options, to determine the likely impacts of the airport options on flora and fauna, including threatened species, populations and ecological communities, and to propose measures to avoid or reduce those impacts.

14.1.2 Existing Environment

Flora

Native vegetation communities on the sites of the airport options were found to comprise scattered remnants of Grey Box Woodland (Cumberland Plain Woodland) and River-flat Forest. Examples of these communities at the airport sites are small and degraded by grazing and weed invasion, and thus considered in the Draft EIS to have only local conservation significance.

A total of 49 plant species of conservation significance were recorded on the sites of the airport options, including the nationally endangered shrub *Pultenaea parviflora*. The full list of flora recorded during field surveys was provided in Appendix F of the Draft EIS.

Fauna

The condition of fauna habitats within the sites of the airport options was assessed as generally poor, with a high proportion of weed species, limited nesting and roosting resources for native fauna and significant disturbance to soils and vegetation from grazing, burning and construction. Duncans Creek and South Creek were considered to have local significance as aquatic (or stream) habitats and Badgerys Creek was considered to have high local conservation significance as a wildlife corridor.

A total of 18 terrestrial fauna species of conservation significance were recorded within the sites, including two species of State significance and 16 species of regional significance. In addition, a further 39 significant fauna species were recorded in the vicinity of Badgerys Creek and may occur within the sites. It is concluded that habitat for two species of national significance, 10 species of State significance and 20 species of regional significance could be affected by construction of the airport options; habitat for five bird species listed under Australian international agreements, such as CAMBA and JAMBA; and habitat for two significant aquatic species, could also be affected. Fauna species were listed in Appendix F of the Draft EIS.

Conservation Significance

The sites of the airport options were considered in the Draft EIS to have regional significance for nature conservation owing to the presence of:

- threatened and regionally significant species;

- aquatic habitats of local significance; and
- a wildlife corridor of high local significance.

14.1.3 Flora and Fauna Impacts

Flora

The Draft EIS found that vegetation clearance associated with construction of the Second Sydney Airport would affect up to 38 plant species of conservation significance, including one species of national significance and 37 species of regional significance. Up to 198 hectares of remnant Cumberland Plain Woodland would be removed during construction. However, due to the fragmented distribution and poor condition of the woodland, the impact on this community was not considered to be significant. Impacts on native flora would be similar under all options, although the number of regionally significant plant species potentially affected would be greater under Options B and C. The overall impact of the proposal on native vegetation was considered to be significant at a regional level.

Fauna

The Draft EIS concluded that construction of the proposal would affect the habitat of up to 52 significant terrestrial fauna species, five bird species listed under international agreements and two significant aquatic species. Development of the proposal would result in the loss of terrestrial and stream habitats. Up to 212 hectares of terrestrial habitat of poor to moderate quality would be removed and up to 10 kilometres of stream habitat would be in-filled. Aquatic impacts were likely to be high for local amphibian, fish and crayfish populations. The proposal would create a barrier across Badgerys Creek, which was considered to be a wildlife corridor of high local significance.

The significance of impacts on native fauna would be similar under all options, although fewer species, communities and habitats would be affected by Option A. Overall, impact of the airport development on terrestrial and aquatic fauna was assessed in the Draft EIS as being of high local significance.

14.2 Summary of Flora and Fauna Issues

14.2.1 Issues Raised in Submissions

Methodology and Scope

The Draft EIS was criticised in submissions from the Western Sydney Alliance and others for relying on results from the *Second Sydney Airport Site Selection Programme Draft Environmental Impact Statement* (Kinhill Stearns, 1985a) which only covered the land within the current airport Option A. It was suggested that surveys conducted for the Draft EIS concentrated on land within Options B and C, at the expense of land within Option A. Furthermore, submissions suggested that it was inappropriate to rely on the results of the *Second Sydney Airport Site Selection Programme Draft Environmental Impact Statement* (Kinhill Stearns, 1985a) as the *Threatened Species Conservation Act, 1995* was not gazetted at the time of the *Site Selection Programme* surveys. Hence, there was concern that threatened species within Option A had been overlooked during surveys for the Draft EIS.

The methodology adopted for fauna surveys was a common issue raised in submissions. In particular, the survey methodology was viewed in submissions as being qualitative, rather than quantitative; that is, the surveys aimed to determine the level of fauna diversity, rather than describe comprehensively the abundance of fauna types within the airport sites. The approach was therefore considered to be flawed. There was also some uncertainty expressed about whether all habitats within the sites were included in the assessment.

The methodology was criticised in submissions because the survey area was limited by access restrictions to a number of private properties, and did not include off-site areas adjacent to the proposed airport sites.

Concerns were also raised in submissions from Liverpool and other western Sydney Councils about the timing of surveys. The length of time spent surveying was viewed in some submissions as insufficient, with the possibility that some species, particularly threatened fauna, might have been overlooked. There was also concern that some species might not have been recorded because surveys were conducted during summer and not at other times of the year.

The criteria used for the assessment of terrestrial and aquatic impacts in the Draft EIS were considered in submissions to be inconsistent. Specifically, the assessment of impacts on aquatic fauna and habitat was carried out according to specific categories relating to the scale and nature of impacts, whereas terrestrial impacts were assessed using less specific criteria.

Concerns were raised in relation to the potential effects of clearing for obstacle limitation surfaces, which would be located beyond the ends of the runways. These areas were not considered to be adequately addressed in the Draft EIS.

Flora and Fauna Survey

The survey methodology adopted for bats and owls was viewed in submissions from the general public and local government as inadequate, with the main criticism being the short time frame within which the surveys were conducted. Some submissions considered that further survey work was required for a range of threatened species. Other submissions expressed unspecified concerns about, or objections to, the assessment of impacts on flora and fauna (or wildlife), in the Draft EIS. Some submissions considered impact assessment to be inadequate.

Submissions from Western Sydney Alliance and some western Sydney local Councils also called for additional survey work in order to accurately map the distribution of *Pultenaea parviflora* within the sites, and hence provide the basis for a more detailed assessment of potential impacts under different airport options. Submissions also noted the need for further assessment of patches of the Sydney Coastal River-flat Forest community occurring at the sites.

Legislation and National Strategies

Submissions from the general public suggested that key environmental legislation relating to flora and fauna was not properly incorporated into the flora and fauna assessment.

There were also submissions from the general public which suggested that the flora and fauna assessment should have taken into account the principles of ecologically sustainable development. Although the Draft EIS made reference to the *National Strategy for Ecologically Sustainable Development* (Commonwealth of Australia, 1992a) it was felt that the flora and fauna assessment did not sufficiently consider the objectives of the strategy. Other strategies considered to require further discussion in the flora and fauna assessment included the *National Greenhouse Response Strategy*

(Commonwealth of Australia, 1992b) and the *National Strategy for Conservation of Biological Diversity* (Commonwealth of Australia, 1996).

Ecological Significance

It was suggested in submissions from local government that the assessment should have discussed the ecological and conservation significance of the sites of the airport options as a whole.

Submissions pointed out that Cumberland Plain Woodland was listed as an endangered ecological community under the *Threatened Species Conservation Act, 1995*. It was suggested that the significance of this community was not properly addressed in local, regional or State contexts and that the condition and significance of Cumberland Plain Woodland remnants should be compared with other stands of this community in western Sydney. Similarly, submissions stated that more information regarding the regionally significant vegetation community, Sydney Coastal River-flat Forest, should have been provided.

Badgerys Creek was identified in the Draft EIS as a wildlife corridor of high local significance. However, submissions, including Liverpool Council's, express concern that the significance of the creek was not discussed in sufficient detail to allow decision makers to determine the full extent of potential impacts on this fauna habitat. Other submissions suggested that important vegetation corridors exist along roadsides which qualify for discussion.

Impacts on Threatened Species

Submissions expressed concerns that potential impacts on threatened species were not adequately addressed and that targeted surveys conducted for the Draft EIS were inadequate to determine the distributions of threatened species within the airport sites. The preparation of a species impact statement was called for in some submissions from the general public. A species impact statement was considered necessary to adequately address potential impacts on threatened species.

Submissions from the Western Sydney Alliance and others suggested that the impact assessment and proposed management measures for *Pultenaea parviflora*, a plant of national conservation significance, needed to be more detailed.

Other issues raised in submissions which related to impacts on flora were the need to address the potential for weed invasion and increased risk of bush fire. Submissions also expressed uncertainty regarding the State significance of plants.

It was suggested in other submissions from the general public that development of the airport would eliminate birds and their habitats, which would cause insect populations to rise, and therefore the assessment should have included the potential impacts of increased insect populations.

The treatment of cumulative impacts resulting from construction of the airport and associated infrastructure was considered in some submissions as cursory and qualitative. Submissions called for an overview of the potential impacts of the proposal on the ecosystems at the airport sites, as opposed to impacts on individual species forming part of an ecosystem.

Blue Mountains National Park

An issue raised in submissions from local government and the Western Sydney Alliance was the treatment of potential impacts on flora and fauna in natural areas (including wilderness areas) in the region, particularly in the Blue Mountains

National Park. The Draft EIS was criticised in submissions for not taking into account the potential impacts on the biodiversity values of the Blue Mountains. This issue is considered to be particularly important, due to the nomination of the Blue Mountains for World Heritage listing.

The Draft EIS was criticised in submissions from the general public for not including the potential impacts on wildlife of low-flying aircraft that would be following flight paths outside the airport sites. This concern was largely directed at fauna inhabiting the Blue Mountains National Park and other natural areas in the region. Submissions suggested that wildlife might be affected adversely by the noise of aircraft flying over natural areas

14.2.2 Issues Raised by the Auditor

Methodology and Scope

The methodology adopted for fauna surveys for the Draft EIS was viewed by the Auditor as being qualitative, rather than quantitative; that is the surveys aimed to determine the level of fauna diversity, rather than describe the abundance of fauna types within the airport sites. The approach was therefore considered to be flawed. There was also some uncertainty expressed by the Auditor about whether all habitats within the sites were included in the assessment.

The criteria used for the assessment of terrestrial and aquatic impacts in the Draft EIS were considered by the Auditor to be inconsistent. The Auditor also considered that the assessment of flora and fauna impacts on the Draft EIS did not allow an easy comparison of the airport options to be made.

The Auditor also indicated that the qualifications of survey team members were unclear.

Additional Flora and Fauna Survey

The Auditor stated that targeted surveys of species of conservation significance might have been insufficient to determine the distributions of species within the airport sites. Additional survey work was suggested as a means to remedy this omission.

Impacts on Endangered Ecological Communities

The Draft EIS was criticised by the Auditor for inadequately addressing potential impacts on Cumberland Plain Woodland, the main vegetation community recorded on the airport sites. The Auditor suggested that the Draft EIS lacked a clear assessment of the airport's potential impact on this community.

Impacts on Threatened Species

The Auditor questioned the basis for establishing the State significance of plants.

Cumulative Impacts

The Auditor concluded that the treatment of cumulative impacts resulting from construction of the airport and associated infrastructure was cursory and qualitative.

Environmental Management

The Auditor considered the section on environmental management and monitoring to lack clear direction.

14.3 Response to Methodology and Scope Issues

14.3.1 Review of Flora and Fauna Surveys Undertaken for Draft EIS

Field Survey Methodology

During preparation of the Draft EIS field surveys for terrestrial and aquatic flora and fauna were conducted over a total of seven days in December 1996 and January 1997. Surveys targeted remnants of native vegetation and areas not previously studied. They were designed to complement previous work undertaken within the site of airport Option A. This methodology was considered appropriate to ensure that the entire existing environment of the sites of the airport options was addressed.

Database records of flora and fauna for the Badgerys Creek area, including those of the National Parks and Wildlife Service (*Atlas of NSW Wildlife*), Australia Museum (Fauna Database) and NSW Fisheries, were obtained during studies for the Draft EIS. These records indicate the location of all previous recordings of threatened species in the area. Combined with assessments of fauna habitat undertaken during field surveys for the Draft EIS, the records allowed an assessment of the likely presence of threatened species within the airport sites. Hence, the methodology adopted for the Draft EIS took into account all threatened species potentially inhabiting the airport sites that would not have been listed on the *Threatened Species Conservation Act* at the time of the *Second Sydney Airport Site Selection Programme Draft Environmental Impact Statement* (Kinhill Stearns, 1985a).

Fauna Survey Methodology

The methodology adopted for fauna surveys undertaken and presented in the Draft EIS was qualitative in nature, as suggested in submissions and by the Auditor. The methodology focused on determining the biodiversity of fauna, rather than quantitatively measuring the abundance of fauna at a site. Quantitative surveys are primarily concerned with ascertaining the presence or absence of flora and fauna species, particularly threatened species. The qualitative approach adopted for the Draft EIS was considered the most appropriate to determine the level of biodiversity at the airport sites and assess the potential impacts of the airport options on all fauna considered likely to be present.

Access Restrictions

The sites of the airport options include a large number of properties which are currently in private ownership. Access restrictions were enforced by some property owners, and therefore, detailed flora and fauna survey was not undertaken on the these properties. The total area not surveyed is 6.2 hectares which represents only a small proportion (0.2 percent) of the total area assessed for the Draft EIS. The areas not surveyed contained small, isolated remnants of Cumberland Plain Woodland and represented approximately 1.8 percent of the total area of vegetation that was present within the sites of the airport options.

Survey Timing

The flora and fauna surveys were undertaken during the summer months when a greater number of plants are flowering and fauna are generally more active. Hence, the timing of surveys was conducive to observing and identifying a greater number of species than would be expected during colder months of the year. The aim of the surveys was not to compile a comprehensive inventory of species, rather to assess the presence or likely presence of threatened species by opportunistically recording species and assessing fauna habitats. The assessment considers impacts on all threatened species recorded, or likely to be present, in the area, not just those observed during surveys. Thus the timing of surveys would not affect the overall consideration of threatened species.

Criteria for Assessing Terrestrial and Aquatic Impact

Table 14.1 describes the criteria used to assess impacts on aquatic and terrestrial ecosystems in response to concerns over a lack of consistency. Impacts on aquatic ecosystems were assessed using a scale of severity related to effects on aquatic fauna and a time scale over which impacts occurred, as shown in Table 17.1 of the Draft EIS. The severity of impacts on terrestrial biota were assessed to a similar level of detail; the assessment criteria were described in Section 6.3 of *Technical Paper No. 8*.

Consideration of Obstacle Limitation Surfaces

The scope of the flora and fauna assessment undertaken in the Draft EIS included assessment of the areas affected by the obstacle limitation surfaces. Obstacle limitation surfaces are a series of surfaces that set the height limits for objects around an airport. Objects that project through obstacle limitation surfaces become obstacles to aircraft operations and may need to be removed. Areas which would require clearing and/or earthworks to comply with obstacle limitation surfaces generally lie within the boundaries of the airport sites, as shown on Figures 9.6, 9.10 and 9.16 of the Draft EIS.

The assessment of impacts on flora and fauna in the Draft EIS assumed that all vegetation within the airport sites would be cleared as part of development of the airport and that there would be some habitat removal and disturbance associated with obstacle limitation areas off-site. Small areas that may need some clearing to comply with the obstacle limitation surfaces extend outside the boundaries of Option A (refer Figure 9.6 of the Draft EIS) and Option B (refer Figure 9.10 of the Draft EIS). These areas have been largely cleared for agricultural activities and therefore no stands of remnant vegetation off-site would require clearing for construction of the proposal.

Qualifications of Survey Team

Curricula vitae of the survey team were provided to the Auditor during preparation of the Draft EIS and the qualifications of the team were summarised in Appendix B of the Draft EIS.

14.3.2 Flora and Fauna Surveys for the EIS Supplement

Additional flora and fauna studies were undertaken to address concerns raised by submissions regarding survey coverage and methodology. The perceived shortfalls in the Draft EIS have been addressed through additional surveys targeting threatened species and endangered ecological communities.

Endangered Ecological Communities

Supplementary surveys of remnant vegetation communities present within the sites of the airport options were undertaken from 22 to 25 September, 28 September, 1998, and 11 January, 1999. Vegetation remnants mapped in the Draft EIS were numbered and surveyed. The location of numbered remnants (or survey sites) are shown in *Figure 14.1*.

Table 14.1 Criteria for Aquatic and Terrestrial Ecosystem Impact Assessment

Timescale of Impacts[1]	Years
Short Term	About one month
Medium Term	Up to one to two years
Long Term	Beyond three to four years
Scale of Potential Effects on Aquatic Flora and Fauna Impacts	
Minor	Small reductions in the abundance of sensitive native fish and crayfish species
	Small community composition changes favouring pollution tolerant taxa
	Slight reductions in reproductive success
Major to Very Major	Substantial reduction in the majority of native fish taxa down affected tributaries and possibly affecting trunk streams
	Moderate community composition changes favouring pollution tolerant taxa
	Moderate reductions in reproductive success
Severe to Very Severe	Virtual elimination of the majority of native fish taxa down affected tributaries and well into trunk streams
	Elimination of all crayfish taxa
	Cessation of reproductive activities
Scale of Potential Effects on Terrestrial Flora and Fauna Impacts	
Low	Results in alterations to behaviour or activities of individuals in the local area
	May be associated with a low probability event (eg. a plane crash) under normal circumstances
High	Results in the elimination of local or regional populations of flora and fauna
	Results in the elimination of restricted habitat resources or types in the local or regional area
	Results in a long-term decrease in reproductive success of populations or species
Significant	Results in a significant effect on threatened species, populations or ecological communities, or their habitats as specified in Section 5A of the Environmental Planning and Assessment Act, 1979
Unknown	Impacts which can not be defined on the basis of existing knowledge (for example, there is a lack of research into the effects of noise and lighting on fauna)

Note: 1. Used in the Draft EIS for both aquatic and terrestrial flora and fauna.

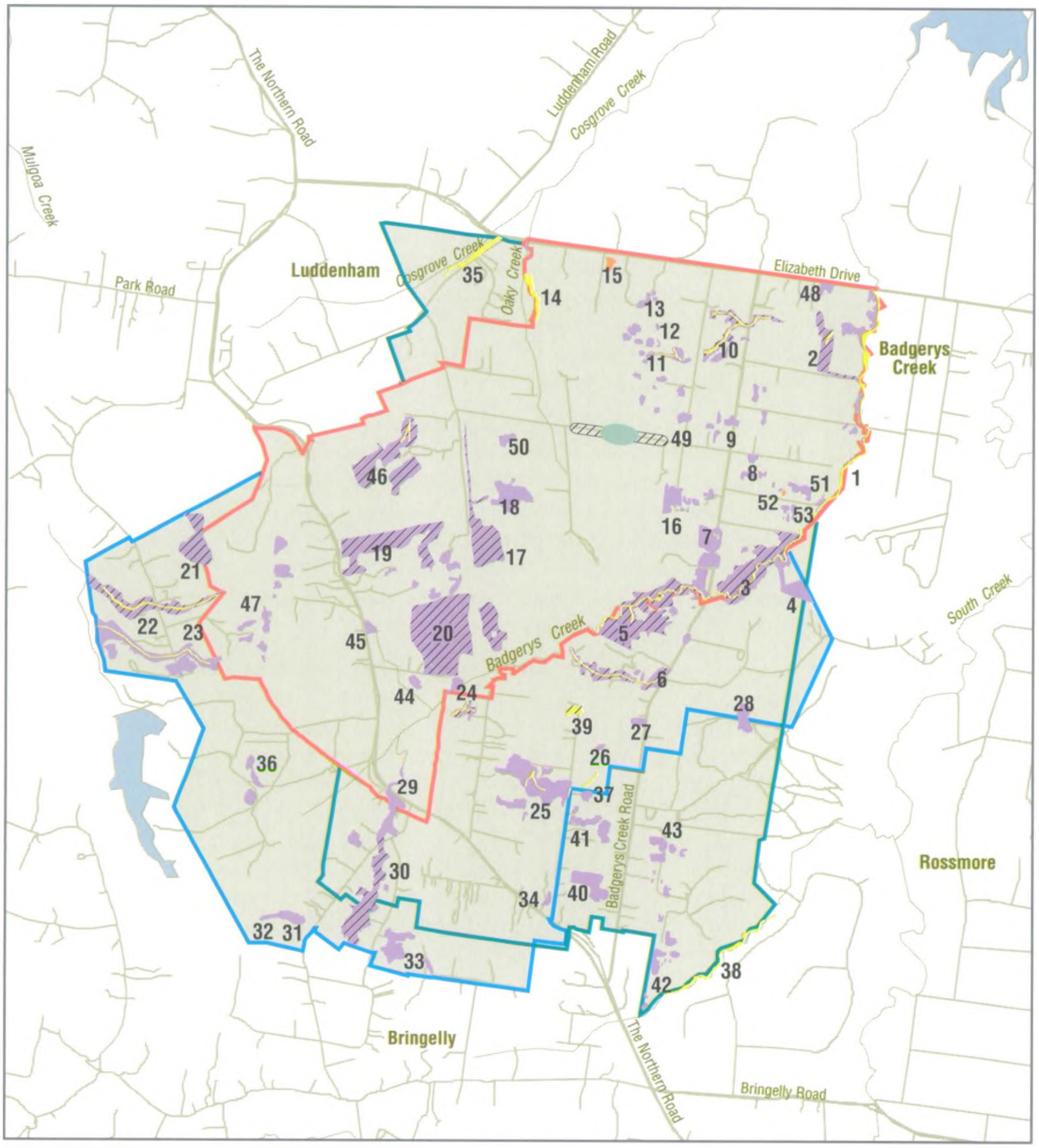


Figure 14.1
Areas of Ecological Significance

All remnant vegetation described in the Draft EIS were surveyed and reassessed to determine conservation significance in light of amendments to the Schedules of the *Threatened Species Conservation Act* and of the *Western Sydney Urban Bushland Biodiversity Survey* (National Parks and Wildlife Service, 1997a). This survey was not available at the time of preparation of the Draft EIS and a review of the survey is contained in *Appendix F1* of this Supplement.

The conservation significance of remnants of Cumberland Plain Woodland was determined according to criteria of the National Parks and Wildlife Service (1997b) and the 'Final Determination' on Cumberland Plain Woodland of the NSW Scientific Committee (1997). These criteria include vegetation structure, condition, potential to regenerate to a near-natural state, size and connectivity. Descriptions of structure and species composition of Cumberland Plain Woodland were based on those of Benson (1992), and Benson and Howell (1994).

National Parks and Wildlife Service guidelines for the assessment of River-flat Forest were not available at the time of the surveys. Assessment criteria for this community were based on descriptions contained in the *Western Sydney Urban Bushland Biodiversity Survey* (National Parks and Wildlife Service, 1997a) and Benson (1992). The assessment also encompassed the broad criteria used for Cumberland Plain Woodland such as vegetation structure, condition, potential to regenerate to a near-natural state, size and connectivity. These are criteria which can be utilised when assessing all terrestrial vegetation communities.

A total of 53 vegetation remnants were identified and assessed within the airport sites (*Figure 14.1*). Of these 34 comprise Cumberland Plain Woodland, five comprise River-flat Forest, and 12 contain both remnant vegetation communities. Two survey sites (numbers 15 and 52) do not support a native vegetation community. The condition and size of each vegetation remnant is summarised in *Table 14.2* and detailed in *Appendix F2* of this Supplement. The condition of remnants ranged from 'very poor', represented by a high degree of degradation, including ongoing disturbance, a high proportion of weed species, lack of natural community structure and low potential to regenerate; to 'moderate', indicating only moderate levels of disturbance and weed invasion and the presence of a community structure. Remnants assessed as 'poor' were considered to have characteristics that fell between very poor and moderate.

The remnant Cumberland Plain Woodland and River-flat Forest communities within the airport sites are highly fragmented, occurring mostly as small, scattered remnants ranging from 0.1 to 41 hectares in size. These remnants are generally in poor condition, having been degraded by clearing, weed invasion, and grazing. There is evidence that while some remnants are subject to ongoing pressure from these disturbance factors others are regenerating, with juvenile trees and shrubs observed in some remnants.

The location of remnants of Cumberland Plain Woodland are shown in *Figure 14.1*. The majority of these Cumberland Plain Woodland remnants are considered to be in poor condition with only three remnants in moderate condition.

River-flat Forest is distributed along most creeks and tributaries within the airport sites, often in association with Cumberland Plain Woodland as shown in *Figure 14.1*.

All remnants of River-flat Forest are highly disturbed with no remnants considered to be in moderate condition.

Table 14.2 Condition and Area of Endangered Ecological Communities

Condition	Survey Sites[1]	Total Area (hectares)
Cumberland Plain Woodland		
Moderate	17, 19, 20	72.9
Poor	2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 18, 21, 22, 23, 24, 25, 28, 34, 40, 41, 42, 43, 44, 46, 47, 49, 50, 51, 53	200.4
Very Poor	1, 26, 27, 29, 30, 31, 32, 33, 45, 48	36.0
Unknown	4, 36	6.2
	Total	**315.5**
River-flat Forest		
Moderate	-	-
Poor	2, 3, 5, 6, 10, 11, 22, 23, 24, 25, 35, 38, 46	14.6
Very Poor	1, 14, 37, 39	4.2
	Total	**18.8**

Note: 1. Survey sites 15 and 52 are not representative of any native ecological communities.

Threatened Flora

In response to submissions, targeted surveys for the threatened native shrub *Pultenaea parviflora* were undertaken to more accurately quantify and map the distribution of this species within the boundaries of the airport options. The exact location of this species was determined using a global positioning system, which is accurate to within 10 metres. Clumps of *Pultenaea parviflora* were registered, and the number of plants and size of each plant within these clumps was recorded during the survey.

The targeted flora survey for *Pultenaea parviflora* resulted in the identification and mapping of a population comprising 68 plants recorded within a small area adjacent to Longleys Road between Taylors Road and Ferndale Road, as illustrated in *Figure 14.1*. The plants were flowering at the time of the survey and the population, although small in size, appeared to be in good condition. The location and density of individual plant clumps are detailed and mapped in *Appendix F3*. No other threatened plant species were detected during the targeted flora survey.

Threatened Fauna

Methodology

Additional fauna surveys were undertaken in response to criticisms regarding the bat and owl survey methodology, and to target the threatened species *Litoria aurea* (Green and Golden Bell Frog) and *Meridolum corneovirens* (Cumberland Plain Large Land Snail). The fauna surveys were designed to target threatened species likely to occur within the airport sites and those that were considered in the submissions to require further analysis.

The surveys aimed to identify the presence of threatened species utilising specific habitats or sites within the airport sites rather than accurately map fauna distributions. Fauna species may be highly mobile or occupy large home ranges and therefore, fauna distributions are usually mapped over large spatial scales, such as regions, or States. It is not normally practical or feasible to map fauna distributions at small scales, such as the sites of the airport options. Regional distributions of species are typically determined from a number of sources, including National Parks and Wildlife Service records and specialist research expertise.

Supplementary fauna surveys were undertaken from 21 September to 25 September, 1998 with additional Cumberland Plain Large Land Snail surveys occurring from 2 December to 3 December, 1998 and on 11 January, 1999.

Bats were surveyed using ultrasonic bat detectors and harp traps. Ultrasonic detectors were set up on logs or in trees on a 45 degree angle near potential fly-ways for bats or where bats were observed flying. Detectors were left out to continuously record for 30 minute periods following dusk, on four nights at seven different sites. A total of 3.5 hours of stationary bat detecting was undertaken over eight sites. An ultra-sonic bat detector was also used on a walking transect, continuously for 20 minutes following dusk, at one site.

Harp traps were used to provide an alternative method for surveying bats to ensure a wide range of species was targeted. Both riparian and woodland habitats were sampled, with screening provided around the traps wherever possible to funnel bats into the traps. Traps were erected at seven sites over four nights.

Bird surveys were undertaken during daytime (diurnal) and evening (nocturnal) hours. Diurnal bird surveys involved recording species along walking transects during dawn and dusk in various habitats, with particular attention to water bodies. Opportunistic sightings were also recorded during other field activities. A total of 11 person hours were spent undertaking bird surveys.

Nocturnal bird surveys were conducted using playback of pre-recorded calls of the Powerful Owl, Sooty Owl, Masked Owl, Barking Owl and Bush Stone Curlew. Calls were played through a megaphone in areas of potential habitat or feeding grounds for a total of 7.5 person hours. Calls were played for approximately five minutes followed by a ten minute listening period to enable detection and identification of responses.

A specialist consultant conducted a targeted survey for the threatened Cumberland Plain Large Land Snail within remnants of Cumberland Plain Woodland located on the sites of the airport options. The survey methodology consisted of identifying and searching suitable habitat, active searching under logs and other ground cover and raking accumulations of bark and leaf litter around the base of trees.

A specialist consultant conducted targeted surveys for the Green and Golden Bell Frog throughout suitable habitat. Potential sites of habitat, particularly dams, shallow wetlands and creeklines, were identified on maps and aerial photos. These sites were visited to ground-truth habitat value to threatened frog species and the most suitable habitat targeted during nocturnal surveys. Survey methodology included listening for frog calls, playback of taped frog calls, and active searching of frog habitat. Sites of potential habitat for the Green and Golden Bell Frog were surveyed by listening for and identifying characteristic frog calls. This technique enabled a large number of potential habitat sites to be surveyed from one location; hence, a large number of dams and pools were assessed during the survey. The survey effort totalled 16 person hours and included 155 dams and pools, and seven streams.

Indirect evidence of the presence of fauna species was recorded opportunistically throughout the survey period. Scats, tracks, scratches and other marks on trees were recorded wherever possible. Spotlighting for nocturnal fauna was undertaken at one site, involving a total of four person hours. Koala call playback was undertaken concurrently with nocturnal bird call playback. The survey effort applied to each targeted survey is shown in *Table 14.3*.

Table 14.3 Extent of Fauna Survey

Survey Type	Draft EIS (Person Hours)	Draft EIS Supplement (Person Hours)
Ultrasonic Bat Detecting	2	4
Harp Trapping	0	6 trap nights
Nocturnal Call Playback (Koala, Owls and Bush Stone Curlew)	0	7.5
Diurnal Bird Watching	14	11
General Snail Searches	0	1.0
Targeted Cumberland Plain Large Land Snail Survey	0	40.5
Scat Collection	0	2 scats collected
General Frog Surveys	4	0.5
Targeted Green and Golden Bell Frog Survey	0	16
Spotlighting	4.5	4

Results of Threatened Fauna Survey

No threatened bats, birds, or frogs were identified during fauna surveys undertaken for this Supplement. A detailed assessment of survey results for birds and bats, and a list of the additional fauna species recorded during surveys, is provided in *Appendix F4* of this Supplement. A full discussion of the findings of the Green and Golden Bell Frog survey is provided in *Appendix F5*.

A bat roost comprising populations of *Chalinolobus gouldi* (Goulds Wattled Bat) and *Mormopterus sp. 1* was found in the Badgerys Creek Community Hall (Hoye, 1998, *pers. comm.*). The roost contains over 100 individuals and is known to be utilised as a breeding site during summer. Roosts for these species are generally in the order of 30 individuals (Hoye, 1998, *pers. comm.*) and as such, this roost is considered larger than usual.

The Cumberland Plain Large Land Snail, shown in *Photograph 2*, was the only threatened species recorded at the sites of the airport options during supplementary fauna surveys. Over 90 individual Cumberland Plain Large Land Snails were observed within 14 Cumberland Plain Woodland remnants within the airport sites as well as additional records from Longleys Road. The survey results are summarised in *Table 14.4*.

Table 14.4 Suitability of Habitat and Presence of Cumberland Plain Large Land Snail (*Meridolum corneovirens*)

Suitability of Habitat	Survey Sites (refer Figure 14.1)
High - snails present	19
Moderate - snails present	3, 5, 17, 20, 39, 46
Moderate - snails not found	40, 43
Low - snails present	2, 6, 10, 21, 22, 24, 30, Longleys Road between Ferndale Road and Taylors Road
Low - snails not found	7, 8, 9, 12, 13, 14, 16, 23, 25, 27, 31, 33, 34, 37
No suitable habitat	1, 11, 15, 18, 26, 29, 32
Unknown[1]	4, 28, 35, 36, 38, 41, 42, 44, 45, 47-53

Note: 1. These surveys sites were not surveyed due to access restrictions.

Photograph 2
Cumberland Plain Large Land Snail
Source: Invertebrate Identification Australasia

Remnants have been classified in *Table 14.4*, based on the quality of snail habitat present, from 'high' to 'no suitable habitat'. High suitability of habitat refers to remnants that have relatively low levels of disturbance (such as grazing, fire and mechanical), a low level of weed invasion and the presence of groundcover, such as leaf litter, logs and vegetation. Low suitability indicates a remnant that is subject to significant ongoing disturbance, and lacks any suitable groundcover. The snail was recorded in highest numbers within survey site 19 despite the groundcover being sparse and subject to weed invasion and grazing (refer *Figure 14.1* for location). The detailed findings of the survey for the Cumberland Plain Large Land Snail and an assessment of the habitat suitability of each vegetation remnant are provided in *Appendix F6* of this Supplement.

14.4 Response to Issues Regarding Legislation and National Strategies

14.4.1 Legislative Context

The Commonwealth government, as the proponent for the development of an airport at Badgerys Creek, is not legally bound to comply with State legislation. However, in response to issues raised in submissions to the Draft EIS, this section considers the requirements of both national and NSW legislation and policies relevant to flora and fauna. This approach reflects the objectives of the *Intergovernmental Agreement on the Environment* (Council of Australian Governments, 1992).

Endangered Species Protection Act

The *Endangered Species Protection Act 1992* is a Commonwealth Act that provides for the protection of nationally endangered species and ecological communities on land that is affected by Commonwealth decisions or finance, owned by the Commonwealth, or proposed for development by the Commonwealth.

One flora species of national significance, *Pultenaea parviflora*, was recorded on the sites of the airport options. *Pultenaea parviflora* is listed as 'vulnerable' under Schedule 1 of the Act. Cumberland Plain Woodland is listed as an 'endangered ecological community' under Schedule 1 of the Act. No fauna species recorded within the airport sites are listed under the Act.

Part 6 of the Act imposes obligations on consent authorities to protect species and ecological communities listed under the Act. In accordance with *Sections 87* and *88* of the Act, a licence is required to 'take' (kill, destroy, damage or collect) native species. For the Second Sydney Airport, a licence issued by Environment Australia would be required to clear areas supporting Pultenaea parviflora and Cumberland Plain Woodland.

The potential impacts of the proposal on *Pultenaea parviflora* and Cumberland Plain Woodland are addressed in *Section 14.6* of this Supplement.

Threatened Species Conservation Act

The *Threatened Species Conservation Act 1995* provides protection of threatened flora and fauna species, populations and endangered ecological communities within NSW. Species, populations and communities considered to be 'endangered' are listed under Schedule 1 of the Act; 'vulnerable' species are listed under Schedule 2 of the Act. These schedules are subject to periodic amendment.

Threatened flora and fauna listed under the Act were considered in the Draft EIS and in *Technical Paper No. 8*. Since the preparation of the Draft EIS a number of amendments to the Schedules within the Act are applicable to sites of the airport options. The Cumberland Plain Large Land Snail has been listed as an endangered species under Schedule 1 of the Act. Cumberland Plain Woodland is listed in Schedule 1 of the Act as an endangered ecological community and criteria for assessment of conservation significance have been prepared by National Parks and Wildlife Service. River-flat Forest is a vegetation community occurring on the airport sites that has also been listed as an endangered ecological community under the Act.

The potential impacts of the proposal on threatened species and ecological communities listed under the *Threatened Species Conservation Act* are addressed in *Section 14.6* of this Supplement.

Native Vegetation Conservation Act

The *Native Vegetation Conservation Act 1997* replaced *State Environmental Planning Policy No. 46* and incorporates provisions relating to vegetation management in the *Soil Conservation Act 1938*, the *Western Lands Act 1901*, the *Crown Lands (Continued Tenures) Act 1989* and the *Forestry Act 1916* (the non-State Forest Crown timber land provisions). The Act aims to conserve native vegetation in New South Wales and manage it in an ecologically sustainable manner.

Under the Act, an approval for clearing of vegetation on land to which the Act applies is required from the Department of Land and Water Conservation. Approvals are required for development applications on land not subject to a 'regional vegetation management plan' and 'protected land', which includes land with slopes greater than 18 degrees, land within 20 metres of a 'prescribed stream' (as defined under the *Soil Conservation Act*) and environmentally sensitive land. Schedule 1 of the Act lists local government areas that are exempt from the Act.

The sites of the proposed Second Sydney Airport are within the Liverpool local government area which is listed under Schedule 1 of the Act and hence all land except 'protected land' is exempt from the Act. Although land would be cleared within 20 metres of drainage lines, the creeks at the sites are not listed as 'prescribed streams' under the *Soil Conservation Act*. Therefore, the *Native Vegetation Conservation Act* would not apply to these sites under any development application. Measures to mitigate the impacts of the proposal on native vegetation are addressed in *Section 14.8* of this Supplement.

State Environmental Planning Policy No. 44 Koala Habitat Protection

State Environmental Planning Policies are made by the relevant Minister pursuant to the *Environmental Planning and Assessment Act 1979*. The purpose of this Policy is to conserve and manage areas of native vegetation that provide habitat for *Phascolarctos cinereous* (koala). The Policy applies to 107 local government areas (listed on Schedule 1 of the Policy) throughout the known distribution of koalas in NSW. The Policy requires an investigation of "core koala habitat" to accompany development applications in relevant local government areas to determine the need for a koala plan of management.

The sites of the airport options are within Liverpool local government area, which is listed on Schedule 1 of the Policy. One tree species recorded within the airport sites, *Eucalyptus tereticornis* (Forest Red Gum), is listed as a primary koala food tree under Schedule 2 of the Policy. Eleven of the remnant stands of Cumberland Plain Woodland within the sites contain more than 15 percent of *Eucalyptus tereticornis* in the canopy. Hence the sites of the airport options contain 'potential koala habitat', as defined by the Policy. However, these remnants comprise small isolated areas of vegetation surrounded by grazed paddocks. Eight remnants are degraded, have a sparse understorey and contain a high proportion of weed species in the ground layer. The remaining three remnants are in poor to moderate condition.

Although potential koala habitat occurs within the sites of the airport options, there are no koala records within 10 kilometres of the airport sites on the National Parks and Wildlife Service (1998) *Atlas of NSW Wildlife*, and the Australian Museum Wildlife Database contains only one historic record of a koala within 10 kilometres of the airport sites from 1926. The closest existing populations of koalas are located at Voyager Point, Kentlyn and Holsworthy Military Area, all more than 10 kilometres from the study area. No individuals or populations of koalas were recorded at the airport sites during supplementary studies or during fauna studies undertaken for the Draft EIS. Furthermore, no local residents have observed koalas in the area. Due to the disturbed condition of vegetation communities, the likely presence of feral predators, and the absence of local recordings, it is considered unlikely that the site would support a resident population of koalas. The site therefore, would not qualify as core koala habitat, as defined in the Policy and a Koala Plan of Management would not be required.

State Environmental Planning Policy No. 19 Bushland in Urban Areas

This Policy aims to protect bushland within urban areas because of its value to the community, natural heritage, recreation, education and science. It is designed to protect bushland in open space and reserves and to ensure that it is adequately considered when planning for urban development.

Schedule 1 of the Policy lists local government areas to which the policy applies. Liverpool local government area, incorporating the sites of the airport options, is included on Schedule 1. The Policy defines bushland as "*land on which there is vegetation which is either a remainder of natural vegetation of the land or, if altered, is still representative of the structure and floristics of the natural vegetation*". With the exception of three areas, this definition applies to all stands of remnant vegetation within the airport sites.

Assuming the Policy applied to the airport sites, the following factors would be considered in an application to disturb or destroy vegetation present on the sites of the airport options:

- the need to protect and preserve the bushland having regard to the aims of this policy;
- whether disturbance of the bushland is essential for a purpose in the public interest and no reasonable alternative is available to the disturbance of that bushland; and
- whether the amount of bushland proposed to be disturbed is as little as possible and, where bushland is disturbed to allow construction work to be

  carried out, the bushland will be reinstated upon completion of that work as far as it is possible.

The conservation significance of threatened vegetation communities are assessed in *Appendix F2* and potential impacts associated with the proposal are addressed in *Section 14.6.3* of this Supplement.

14.4.2 National Strategies

The principles of ecologically sustainable development, as they relate to the proposal, were discussed in Chapter 26 of the Draft EIS. Consideration of national strategies, such as the *National Strategy for Ecologically Sustainable Development*, the *National Greenhouse Response Strategy*, and the *National Strategy for Conservation of Biological Diversity*, and their relevance to the flora and fauna assessment is discussed in relation to the cumulative impacts of the proposal, in *Section 14.6* of this Chapter.

14.5 Reassessment of Ecological Significance

The original ecological assessment of the impacts of the Second Sydney Airport was revised taking account of the results of supplementary studies. Since the preparation of the Draft EIS, the National Parks and Wildlife Service has undertaken an extensive review of the flora and fauna of the western Sydney region. The conservation significance of the flora and fauna at the airport sites detailed in the Draft EIS was compared with the findings of the *Western Sydney Urban Bushland Biodiversity Survey* (National Parks and Wildlife Service, 1997a). Based on this regional assessment, the presence of the endangered ecological communities, and the finding of the threatened Cumberland Plain Large Land Snail at the airport sites, the overall ecological significance of the site has been reassessed.

14.5.1 Regional Context

The sites of the airport options lie within the western Sydney region, also known as the Cumberland Plain bioregion (Thackway and Cresswell, 1995). The region covers an area of approximately 245,120 hectares and includes the local government areas of Auburn, Bankstown, Blacktown, Baulkham Hills, Camden, Campbelltown, Fairfield, Hawkesbury, Holroyd, Liverpool, Parramatta and Penrith.

The western Sydney region is characterised by relatively fertile shale soils and gently undulating topography. These characteristics were favoured for agricultural use since the early days of European settlement of Sydney. Consequently, large areas of the region have been cleared for agriculture, residential and commercial development (Benson and Howell, 1990). The region supports a unique range of flora of national, State and regional significance and provides habitat for many threatened plant species.

The *Western Sydney Urban Bushland Biodiversity Survey* (National Parks and Wildlife Service, 1997a) represents the most recent assessment of the conservation status of native flora and fauna species in the region. The key findings of the regional survey indicate:

- a high level of flora diversity, despite past and present threatening processes;
- a high proportion of plant species which are considered regionally threatened;
- that the survival of some vegetation (or ecological) communities is seriously threatened;
- low levels of mammal diversity;
- a diverse assemblage of bird species; and
- riparian corridors of importance for biodiversity conservation in western Sydney.

The Survey identifies 'core biodiversity areas' that contain significant remnants of threatened vegetation communities that are not protected in conservation reserves. The remnants within the sites of the airport options are not listed as a core biodiversity area for flora or fauna conservation. However, Badgerys Creek (from The Northern Road to Elizabeth Drive) is considered by the Survey to be a riparian corridor of regional significance. It is recommended that the corridor be protected from the current pressures on biodiversity of the region, including vegetation clearance and development.

A number of core biodiversity areas were identified in areas adjacent to the airport sites, including Kemps Creek and South Creek. These creeks are also recognised for their riparian corridor values. Up to 75 native flora species have been recorded in Kemps Creek. South Creek is considered by the survey to form an important corridor, providing connections between conservation areas. Duncans Creek, immediately south-west of the airport sites, is identified as a 'complementary biodiversity area'. These areas are considered important for biodiversity conservation, but have less ecological value than core biodiversity areas.

A summary of the results of the *Western Sydney Urban Bushland Biodiversity Survey* and a comparison with the findings of the Draft EIS are presented in *Appendix F1*. The assessment of conservation significance of the Survey are generally consistent with those of the Draft EIS. However, the following differences in the results of the Survey are incorporated in a reassessment of conservation significance of the sites of the airport options:

- the presence of additional significant flora and fauna species recorded within the Liverpool area, some of which may utilise the sites of the airport options;
- the identification of an additional two vegetation communities of River-flat Forest along Badgerys Creek;
- the conservation ranking of the Badgerys Creek riparian zone as a corridor of regional significance, rather than of high local value; and
- the ranking of River-flat Forest as a community of regional, rather than local, significance (National Parks and Wildlife Service, 1997a).

The overall findings of the *Western Sydney Urban Bushland Biodiversity Survey* are consistent with the ecological significance rating of the airport sites as 'regionally significant'. However, the assessments of significance in both the Survey and the

Draft EIS were made prior to finding one of the largest recorded populations of the threatened Cumberland Plain Large Land Snail at the site. The findings elevate the significance of the airport sites for native conservation from regional to State significance.

14.5.2 Assessment of Significance

The overall assessment of conservation significance of the sites of the airport options is based on the qualitative and quantitative criteria listed in *Table 14.5*. Significance is assessed on a hierarchy of national, State and regional levels according to the methodology used in the Draft EIS (see also *Technical Paper No. 8*). This considers a range of factors including the *Endangered Species Protection Act* and the *Threatened Species Conservation Act* in considering at what level a site makes a contribution to nature conservation. The Auditor and some submissions question the basis for establishing the State significance of plants. State significance is determined according to listings under the *Threatened Species Conservation Act*, as described in Section 17.2 of the Draft EIS.

Table 14.5 Reassessment of Conservation Significance of the Sites of the Airport Options

Assessment Criteria	Reassessment of Conservation Significance
Ecological integrity	Fragmented; high proportion of weed species; poor condition of understorey
Habitat quality	Generally low to moderate; high at site 19 for Cumberland Plain Large Land Snail
Introduced flora species[1]	84 species
Significant flora species[1]	One national, 48 regional
Significant fauna species (recorded)[1, 2]	Three State, 19 regional
Significant fauna species (potential)[1, 3]	Two national, 13 State, 48 regional, five bird species listed on international agreements, two aquatic species
Endangered ecological communities	Remnant Cumberland Plain Woodland and River-flat Forest of regional significance
Size	2,795 hectares
Connectivity	Generally poor; Badgerys Creek a riparian corridor of regional significance
Viability	Small bushland remnants subject to ongoing pressure from agriculture, weed invasion, and development
Representativeness	Regional examples of Cumberland Plain Woodland and River-flat Forest. One of the largest recorded populations of Cumberland Plain Large Land Snail and therefore of State significance. Population of the endangered plant *Pultenaea parviflora* which has regional significance
Richness and diversity	176 native plant species; three vegetation communities; 211 native fauna species
Social value	None[4]

Notes:
1. *Species recorded during the Draft EIS are listed in Appendix F of the Draft EIS; species recorded during studies for this Supplement are listed in Appendix F4 of this Supplement.*
2. *Recorded within the sites of the airport options during field surveys for the Draft EIS and this Supplement.*
3. *Species recorded in the area and considered to be potential visitors to the airport sites owing to the presence of suitable habitats.*
4. *Assessment of social value of airport sites contained in Technical Paper No. 8.*

The conservation significance has been reassessed to incorporate the findings of the additional survey work and changes to legislation.

Cumberland Plain Woodland

Cumberland Plain Woodland is a vegetation community of national significance. It is listed nationally as an 'endangered ecological community' under the *Endangered Species Protection Act* and in New South Wales under the *Threatened Species Conservation Act*. Of the original area of Cumberland Plain Woodland in western Sydney, 93 percent has been cleared since European colonisation of Sydney (National Parks and Wildlife Service, 1997a). The current distribution of Cumberland Plain Woodland in western Sydney is illustrated on *Figure 14.2*.

The sites of the airport options support 314 hectares of the remaining 8,550 hectares of this vegetation community. Three remnants of Cumberland Plain Woodland (survey sites 17, 19 and 20 as shown on *Figure 14.1*) within the airport sites are considered to have regional conservation significance. Their significance is based on their larger size, moderate condition, greater diversity and abundance of native plant species, and ability to regenerate to a near natural structure (refer *Appendix F2*). These remnants have a greater level of connectivity, and could, with appropriate management, be regenerated into a single remnant. The other remnants of the site are considered to have local value, owing to the degree of modification that has occurred, and the widespread removal of the community in the local area.

Overall, the sites of the airport options contain remnants of Cumberland Plain Woodland that are considered regionally significant.

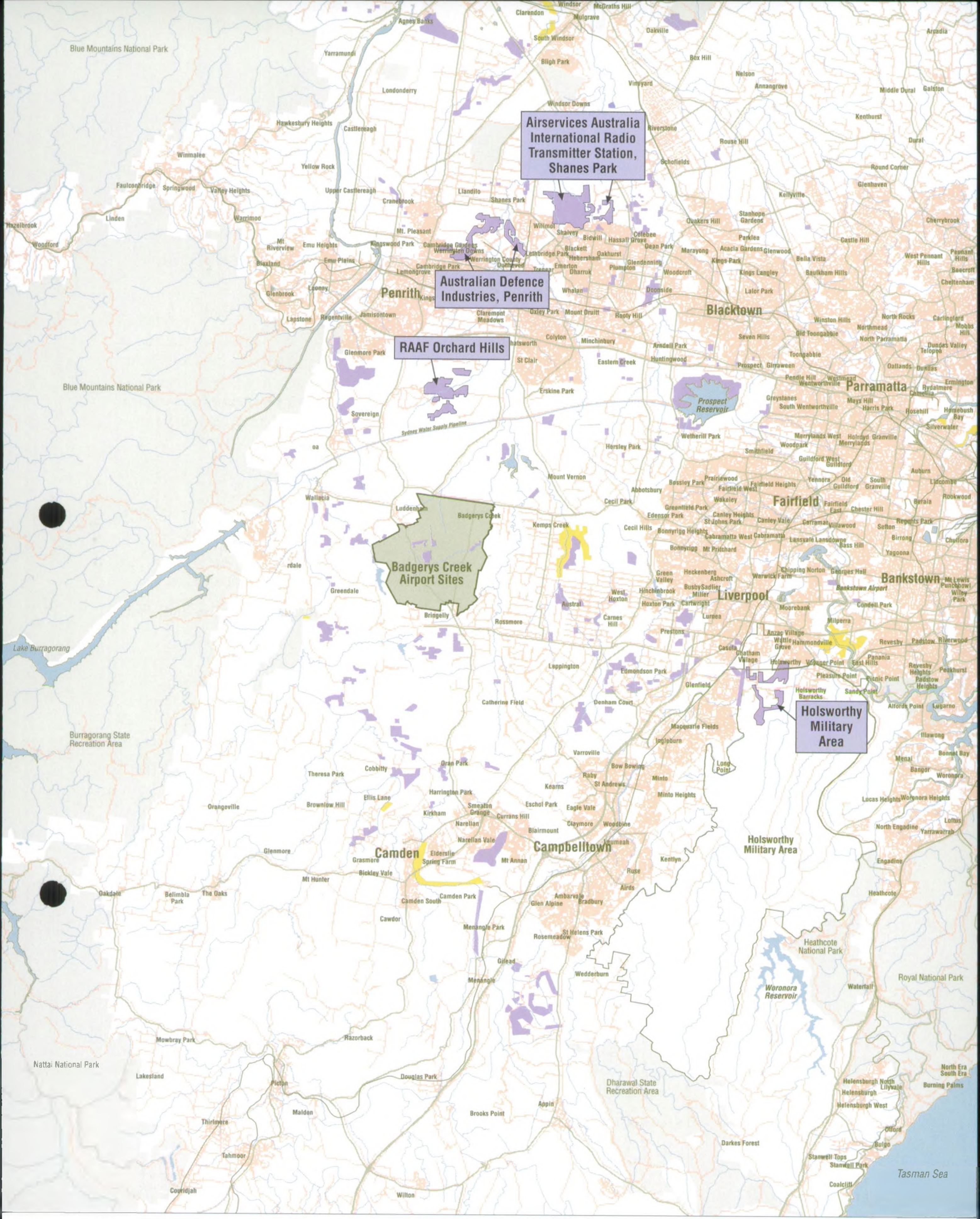
River-flat Forest

River-flat Forest is listed as an endangered ecological community under the *Threatened Species Conservation Act* by the National Parks and Wildlife Service (1997a) and has been preliminarily determined. Prior to European occupation of Sydney, River-flat Forest occupied some of the most fertile agricultural land in the Sydney area. Consequently, this land has been cleared extensively and farmed since European settlement. It is estimated that 91 percent of the pre-European distribution of this community has been removed (National Parks and Wildlife Service, 1997a). Small remnants occur sporadically along the Hawkesbury Nepean River System and its tributaries and provide habitat for local populations of native fauna, as well as movement corridors for wildlife. The current distribution of River-flat Forest in the western Sydney region is shown in *Figure 14.2*.

Collectively, the 19 hectares of remnant River-flat Forest on the sites of the airport options are considered to have regional conservation significance (refer *Appendix F2*). The assessment takes into consideration the regional conservation status of this community and its likely future listing as a community of State conservation significance (National Parks and Wildlife Service, 1997a). Examples of River-flat Forest distributed along Badgerys Creek within the airport sites form a riparian corridor considered to be of regional conservation value (National Parks and Wildlife Service, 1997a).

Badgerys Creek Corridor

The sites of the airport options contain a significant proportion of Badgerys Creek, extending from The Northern Road, Luddenham to Elizabeth Drive, Badgerys Creek. The creek is lined with stands of River-flat Forest, an endangered ecological community. This section of the creek is considered to be of conservation significance in western Sydney as a flora and fauna corridor by the National Parks and Wildlife



Potential off-site conservation areas in Commonwealth ownership

Water

River-flat forest

Cumberland Plain Woodland

tional Parks and Wildlife Service reserves

Figure 14.2

Distribution of Cumberland Plain Woodland and River-flat Forest in the Western Sydney Region[1]

Source: National Parks and Wildlife Service (1997a)

Note: 1. Vegetation boundaries are indicative only.

Service (1997a). Although the existing vegetation is degraded by past and current disturbance, the corridor provides an important habitat for native flora and fauna in an area that has been largely cleared for agriculture and forms an important tributary of South Creek, a major corridor within the Liverpool local government area.

Badgerys Creek is assessed as a wildlife corridor of regional conservation significance.

Pultenaea parviflora

Pultenaea parviflora is a species of national conservation significance. It is listed as endangered (Schedule 1) under the NSW *Threatened Species Conservation Act* and as vulnerable (Schedule 1, Part 2) under the Commonwealth *Endangered Species Protection Act*. According to Briggs and Leigh's (1995) database of *Rare or Threatened Australian Plants*, the species is endangered nationally, occupying a distribution of less than 200 kilometres, and is currently not adequately represented in conservation reserves.

The population of *Pultenaea parviflora* recorded within the sites of the airport options is relatively small in size and occurs at a location degraded by weeds and grazing (see *Figure 14.1*). Owing to its proximity to a road, the population is susceptible to ongoing disturbance. However, results from the additional survey work indicate that the population is in good condition and may be increasing in size (refer *Appendix F3*).

The population recorded within the airport sites is near the southerly limit of the known distribution of the species and is considered to have regional conservation significance.

Cumberland Plain Large Land Snail

The Cumberland Plain Large Land Snail was listed as endangered under Schedule 1 of the *Threatened Species Conservation Act* in June 1997. The species has within the last 15 months been identified at over 50 locations within western Sydney, with well over 500 individuals observed (Clark, 1998, *pers. comm.*). The species is restricted to dry eucalypt woodlands of the Cumberland Plain and is under threat from habitat loss and fragmentation. The Cumberland Plain Large Land Snail is currently not considered to be adequately protected in conservation reserves.

The populations of Cumberland Plain Large Land Snail present within the sites of the airport options though fragmented, are considered to represent a 'cluster' of State significance (refer *Appendix F6*). Approximately 90 Cumberland Plain Large Land Snails were recorded within the sites of the airport options representing one of the largest known clusters of populations (Clark, 1998, *pers. comm.*).

Almost all the populations found within the boundary of the proposed airport are viable. The populations are at the western edge of the known distribution of the species and are only a few kilometres south of the type location Mulgoa, where the original material used to describe the species was derived.

The sites of the airport options are considered to be of State significance for the conservation of the Cumberland Plain Large Land Snail. This rating is based on current knowledge and it should be noted that no extensive survey has to date been conducted throughout the western Sydney region for this species.

Overall Significance

The sites of the airport options are considered to have State significance for nature conservation. This reassessment of ecological significance is detailed for each of the assessment criteria in *Table 14.5* and is based primarily on the significance of the population of Cumberland Plain Large Land Snail discovered at the sites. In assessing the significance of a site, the highest significance rating for a species, population or ecological community is the rating (or the cumulation of these) that is applied to the site. The presence of the Cumberland Plain Woodland, River-flat Forest, *Pultenaea parviflora*, and the Badgerys Creek corridor (which are all of regional conservation significance) reinforce the State conservation significance rating of the site as a whole.

14.6 Response to Impact Assessment Issues

14.6.1 Introduction

In response to issues raised in relation to the impact assessment undertaken for the Draft EIS, impacts on flora and fauna have been reassessed to take account of the revised conservation significance of the site and the proposed environmental management measures. The environmental management measures described in *Section 14.8* have been developed to mitigate the impacts of the proposal as identified in the Draft EIS. These measures include rehabilitation of degraded vegetation remnants, revegetation of areas to link fragmented habitat and programs to conserve threatened species at the site. These environmental management measures are based on the current master plan and would require further investigation during the detailed design phase. The revised impact assessment takes into account these management measures in a broad sense, as exact locations and areas may vary.

14.6.2 Impacts on Natural Areas in the Blue Mountains

An issue raised in submissions relates to a concern over the lack of assessment of impacts on 'wilderness areas', such as the Blue Mountains National Park. It should be noted that not all natural areas of the Blue Mountains are classified as wilderness, as defined under the *Wilderness Act 1987*.

An area termed the 'Greater Blue Mountains' has been nominated for World Heritage listing by a joint team of the NSW Government and Environment Australia. The area comprises the Blue Mountains, Wollemi, Yengo, Nattai, Kanangra Boyd, Gardens of Stone and Thirlmere Lakes National Parks and the Jenolan Caves Karst Conservation Reserve (Environment Australia, 1998). The nominated area extends over one million hectares and lies, at its closest point, approximately seven kilometres west of the airport sites. The nomination is based on the native flora values of the region, in particular, the existing diversity of eucalypt species.

Potential impacts on native fauna inhabiting nature reserves close to the airport sites associated with aircraft overflights are discussed in Chapters 11 and 12 of the Draft EIS and in *Technical Paper No. 8*. Specific reference was made to wildlife of the Blue Mountains National Park in Section 12.7 of the Draft EIS and in Sections 6.1 and 6.2 of *Technical Paper No. 8*. Impacts on noise levels, Aboriginal heritage values and scenic quality of the area are addressed in *Chapters 8, 17* and *21* of this Supplement, respectively.

The impacts of noise on wildlife are not well understood. Research into the effects of aircraft overflights on wildlife conducted for the Draft EIS did not provide any clear relationship between noise and animal behaviour. Information presented in Section 11.5 of the Draft EIS suggests that animals can adapt to artificial noise regimes. However, a diversity of responses may occur given that different species have different tolerances, psychology and adaptability and that there are a wide range of noise regimes created by humans.

A literature review by the United States Department of Agriculture Forest Service (1992) on the effect of aircraft overflights on wildlife indicates that while a variety of responses may occur, most animals often adapt to noise regimes well under most circumstances. A more recent review by the United States Department of the Interior and National Parks Service (1995) concludes that aircraft overflights can have a negative effect on wildlife populations. However, the significance of such impacts is not clear. Much of the literature comprises studies in the United States of the impacts of low-flying military aircraft and light aircraft on large ground-dwelling mammals and large birds.

Current literature indicates that overflights can induce psychological responses in animals, such as increased heart rate, but whether these responses adversely effect health is unknown (United States Department of the Interior and National Parks Service, 1995). Researchers have documented a variety of behavioural responses in wildlife, such as birds being flushed from their perches. Variations in response are likely to be due to differences between species, study methodology, spatial and temporal parameters and ecosystem characteristics. Such variation does not allow general conclusions to be drawn that apply to all wildlife types. Overflights can induce indirect effects, for example, accidental injury, energy losses and changes to offspring survival. However, there is little evidence of reproductive losses or impacts on population size. In any case, the long-term effects of overflights on wildlife have not been determined and results of studies in the United States cannot be readily compared to fauna inhabiting the Greater Blue Mountains.

Aircraft flights are likely to occur over parts of the Blue Mountains National Park, Lake Burragorang State Recreation Area and Bents Basin State Recreation Area, as shown in Figures 9.7 to 9.20 of the Draft EIS. As discussed in Section 12.7 of the Draft EIS, Options A and B may generate up to 25 aircraft overflights a day exceeding 70 dBA in some areas of the Blue Mountains National Park, with up to about 15 exceeding 70 dBA south of Lake Burragorang. It is unlikely that this number of flights at the noise levels indicated would have a significant effect on wildlife in these areas.

Option C would have a lower effect than the first two options. It is expected that no overflights would exceed 80 dBA in the Blue Mountains National Park, while up to seven or eight movements daily would exceed 70 dBA.

14.6.3 Impacts on Endangered Ecological Communities

Potential impacts on Cumberland Plain Woodland and River-flat Forest communities were assessed in *Technical Paper No. 8* and Chapter 17 of the Draft EIS. Further analysis of the impacts on these endangered ecological communities was undertaken in response to concerns raised in submissions, and their recent listing under the *Threatened Species Conservation Act*.

The areas of endangered ecological communities proposed to be cleared and areas proposed to be retained under each airport option are listed in *Table 14.6*. During preparation of the Draft EIS, it was conservatively assumed that all existing vegetation would be removed during construction of the airport options. Remnant vegetation likely to be able to be preserved during construction and operation of each airport option has now been identified as illustrated in *Figures 14.3, 14.4, and 14.5*. Although 36 to 53 percent of Cumberland Plain Woodland would be retained, the remnants of regional conservation significance within the airport sites would be partly or completely removed under each of the airport options. Under Option A, sites 17, 19 and part of 20 would be removed. Under Option B, sites 17, 19 and 20 would be completely removed. Option C would involve the removal of remnants 17 and 20, with remnant 19 almost completely retained.

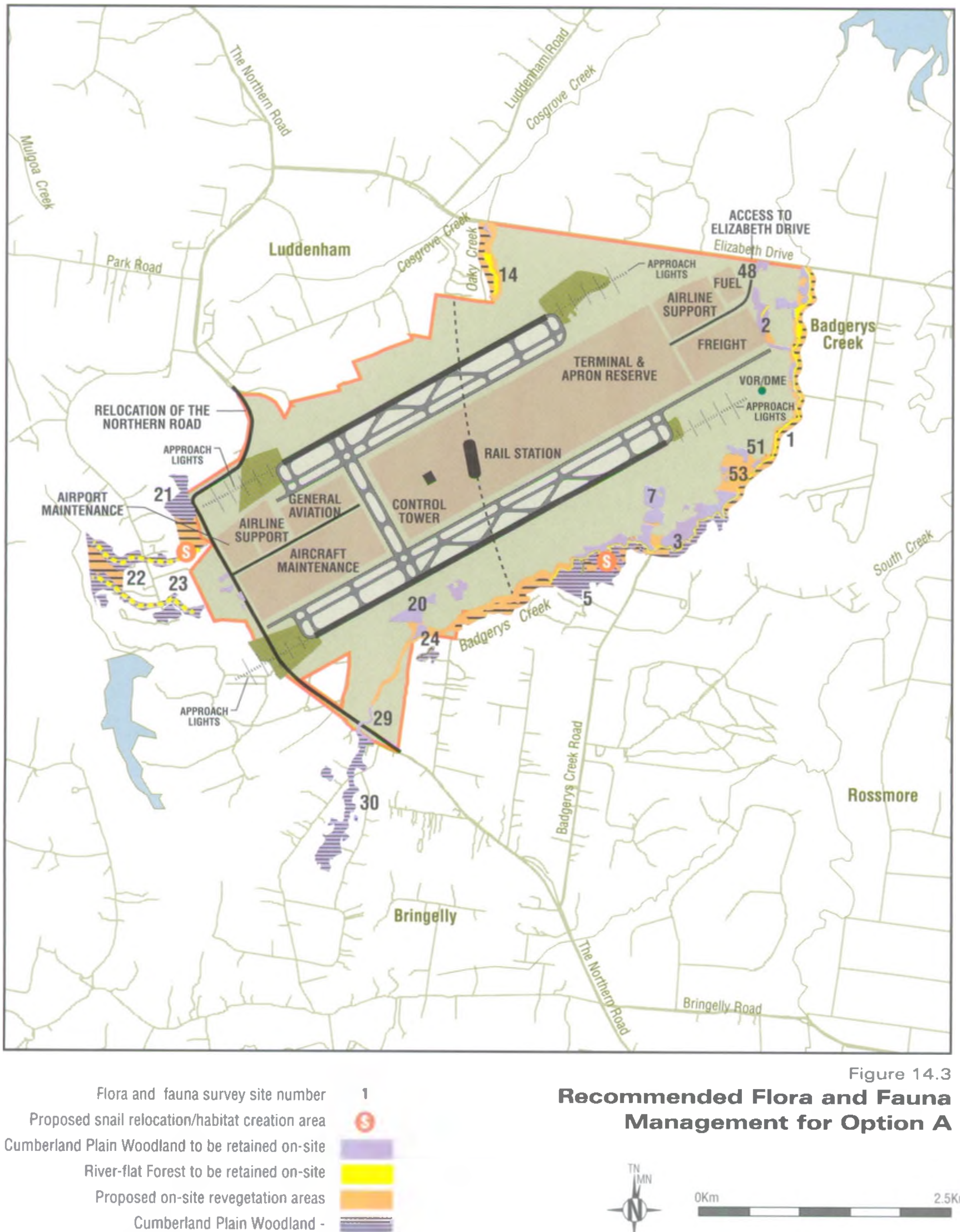


Figure 14.3
Recommended Flora and Fauna Management for Option A

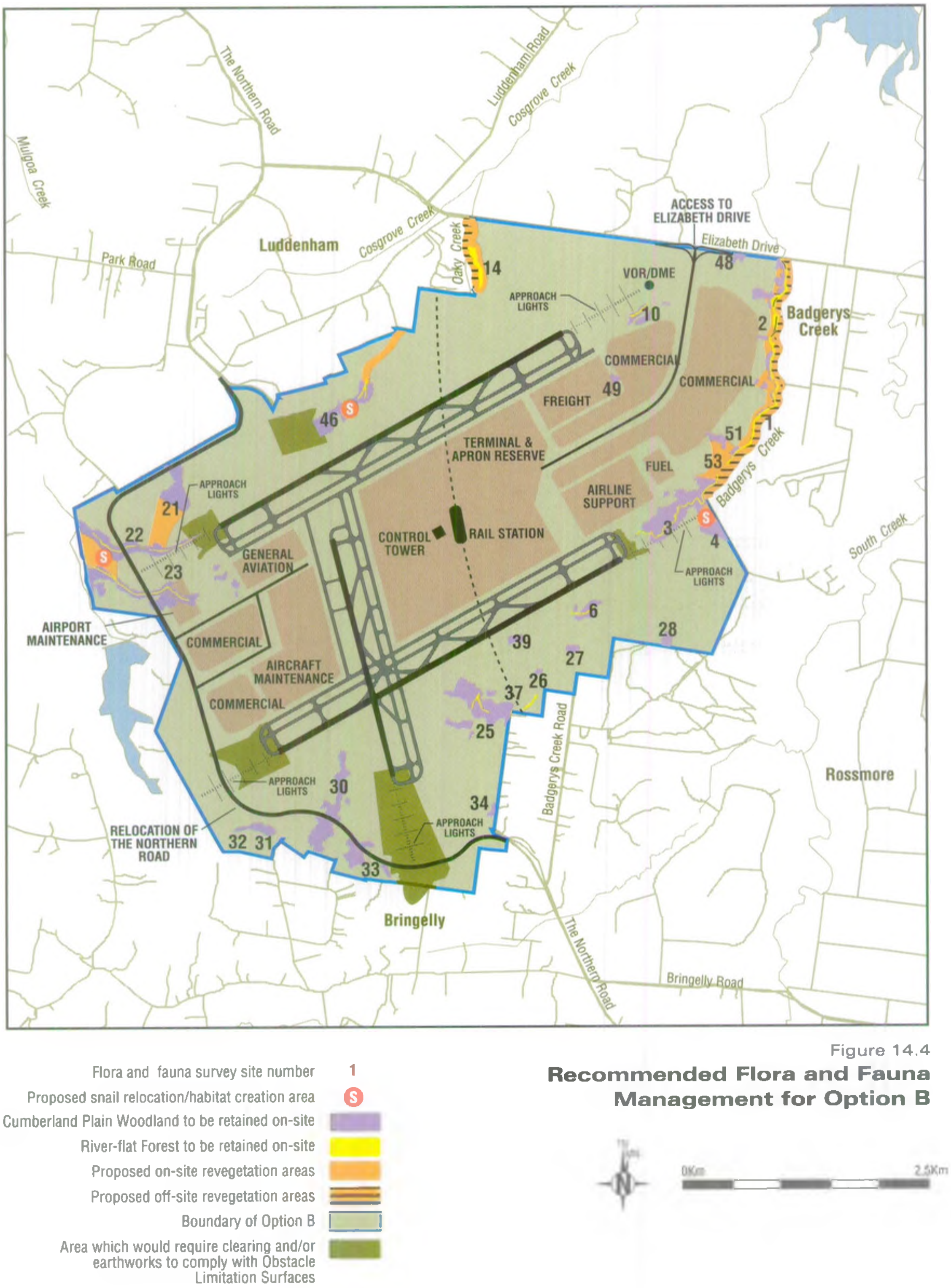
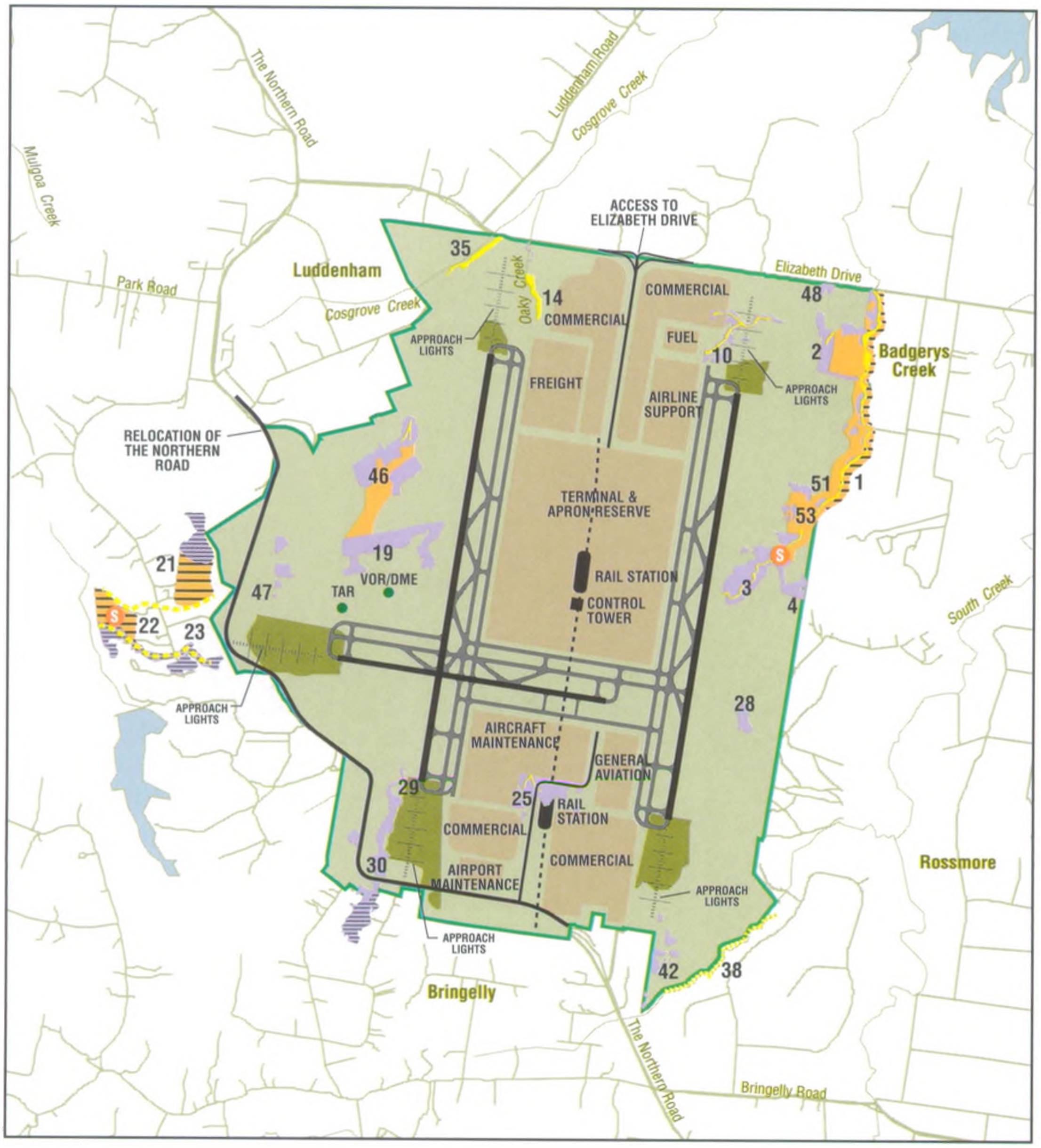


Figure 14.4
Recommended Flora and Fauna Management for Option B



- Flora and fauna survey site number: 1
- Proposed snail relocation/habitat creation area: S
- Cumberland Plain Woodland to be retained on-site
- River-flat Forest to be retained on-site
- Proposed on-site revegetation areas
- Cumberland Plain Woodland - proposed off-site conservation area
- River-flat Forest - proposed off-site conservation area
- Proposed off-site revegetation areas
- Boundary of Option C
- Area which would require clearing and/or earthworks to comply with Obstacle Limitation Surfaces

Figure 14.5
Recommended Flora and Fauna Management for Option C

TN MN N

0Km 2.5Km

Development of the Second Sydney Airport would involve the removal of less than 25 percent of the River-flat Forest on the sites of the airport options (refer *Table 14.6*). The regionally significant riparian corridor of River-flat Forest along Badgerys Creek would be completely retained under Option A, and partly retained under Options B and C (refer *Figures 14.3* to *14.5*).

Table 14.6 Potential Areas of Vegetation Removal and Retention

Vegetation Community	Area (Hectares)[1] Option A	Option B	Option C
Cumberland Plain Woodland			
Area Retained	70	152	107
Area Removed	121	140	149
Total Area of Existing Vegetation	191	292	255
River-flat Forest			
Area Retained	7.4	11.4	16.4
Area Removed	2.5	3.1	0.6
Total Area of Existing Vegetation	9.9	14.5	17.0
Total Area of Existing Vegetation	**201**	**307**	**272**

Source: *Technical Paper No. 8*
Note: *1. Areas have been rounded off so may not match total.*

The impact of removing the areas of remnant vegetation during development of the Second Sydney Airport would be partially mitigated by the provision of compensatory habitat through revegetation. The areas to be revegetated with Cumberland Plain Woodland and River-flat Forest species would link existing remnants at the site (*Figures 14.3, 14.4* and *14.5*). In addition, consideration would be given to conserving areas of compensatory habitat outside the boundary of the airport options as described in *Section 14.8* of this Chapter.

The remnants of endangered ecological communities to be removed are primarily in poor condition and subject to ongoing pressure from existing land uses and continuing weed invasion. It is proposed to enhance the ecological value and conservation significance of vegetation remnants retained at the sites of the airport options through rehabilitation works. As detailed in *Section 14.8*, rehabilitation would involve weed control, bush regeneration techniques and revegetation programs. These rehabilitated remnants would be managed primarily as conservation areas and protected in the long-term.

Overall, the potential impacts of the airport options on regionally significant endangered ecological communities are considered to be high in the short and medium-term as a result of vegetation clearance. However, in the long-term the conservation significance of the remaining remnants would be enhanced using bush regeneration techniques and revegetation works (refer *Section 14.8.1* of this Chapter). The proposed rehabilitation, management and protection of retained vegetation remnants would contribute to the long-term viability of the endangered ecological communities at the site.

14.6.4 Impacts on Threatened Species

A species impact statement is a document that provides a detailed assessment of impacts on species listed under the *Threatened Species Conservation Act*. The need for a species impact statement is determined under *Section 5a* of the *Environmental*

Planning and Assessment Act 1979. The Second Sydney Airport proposal is not bound by State Government legislation and thus the requirements of the Act have not been formally considered in this assessment. While a species impact statement has not been prepared, the potential impacts of the proposal on species and communities listed under the *Threatened Species Conservation Act* have been assessed.

The potential impacts of the proposal on the nationally endangered plant *Pultenaea parviflora* were addressed in *Technical Paper No. 8* and briefly in Chapter 17 of the Draft EIS. Additional detailed mapping undertaken in response to suggestions made in submissions has quantified the population of this species as 68 plants occurring within a small area adjacent to Longleys Road, Badgerys Creek (refer *Appendix F3* of this Supplement).

The impact on the endangered species *Pultenaea parviflora* would be the complete removal of the population under all airport options. Loss of the population would have an adverse affect on local biodiversity and distribution of the species. The population of *Pultenaea parviflora* at the airport site is at the southern limit of the species' known distribution. The impact of the proposal on the regionally significant *Pultenaea parviflora* population is therefore considered to be high in the short-term. This assessment remains unchanged from that stated in *Technical Paper No. 8*.

In the long-term, a replanting and management program would re-establish an increased area of *Pultenaea parviflora* at the sites of the airport options (refer *Section 14.8.2* of this Chapter). In 1989, the then Department of Transport and Communications, began a conservation program for this threatened species to ensure the viability of re-establishing the population of *Pultenaea parviflora* at the airport site. The results of the program to date indicate that seeds collected and plants propagated from the sites of the airport options can successfully be replanted (Offord, 1998, *pers. comm.*) and would contribute to the long-term conservation of this threatened species.

Cumberland Plain Large Land Snail

The populations of Cumberland Plain Large Land Snail at the sites of the airport options when considered as a whole, are considered to be of State significance. All three airport options involve removal of up to 94 hectares of Cumberland Plain Woodland remnants which support these populations.

A number of revegetation/regeneration areas have been proposed to mitigate the flora and fauna impacts of each airport option, along with proposed relocation areas for the Snail, as illustrated in *Figures 14.3* to *14.5*. The potential impacts for each of the three airport options with regard to the conservation of the Snail has been assessed as follows:

- Option A would force the relocation of the populations from survey sites 2, 10, 17, 19, part of 20, 46, and the site on Longleys Road, to survey sites 3, 5, 21, 22, 24 and 30 (refer *Figure 14.3*);
- Option B would force the relocation of the populations from surveys sites part of 2, 5, part of 6, part of 10, 19, 20, 24, part of 46, and the site on Longleys Road, to survey sites 3, 21, 22, 30 and 46 (refer *Figure 14.4*); and
- Option C would force the relocation of populations from survey sites part of 3, 5, 6, 17, part of 19, 20, 24, 39, and the site on Longleys Road, to survey sites 2, 3, 10, 19, 21, 22, 30 and 46 (refer *Figure 14.5*).

Of the three airport options under consideration, Option B has the greatest potential impact on the Cumberland Plain Large Land Snail, while Option C appears to represent the least impact, by virtue of the potential for preservation of some of the better remnants of Cumberland Plain Woodland (refer *Section 14.8.3* of this Chapter). However, Options B and C have a significant effect on Badgerys Creek, while Option A would retain the creekline as intact and would be enhanced overall by the proposed regeneration/revegetation measures. It is considered that Option A has the best overall potential for the long-term protection of the species and the diversity of habitats present within the airport sites.

It remains to be tested whether relocation of the Snail to either on-site or off-site conservation areas would be successful, as this has never been attempted for this species. As detailed in *Section 14.8* of this Chapter, it is considered that the likelihood of the species surviving the relocation process are reasonably good, especially if relocated to areas of a similar nature and close proximity. Therefore, successful implementation of the management measures would ensure the continued viability of the local populations at the sites of the airport options.

Accordingly, provided the proposed management measures are successful, the potential impact of the proposal on the threatened Cumberland Plain Large Land Snail is not expected to be significant in the long-term.

Threatened Fauna

The potential impacts of the Second Sydney Airport on threatened fauna relate to habitat loss and fragmentation associated with vegetation clearance during construction. The quality of terrestrial and aquatic habitats at the sites of the airport options is generally poor due to small size, degradation, and existing fragmentation. The removal of these poor quality habitat remnants is considered to represent a low impact to threatened fauna species, with the exception of the Cumberland Plain Large Land Snail discussed above. The development of the Second Sydney Airport would represent a barrier to fauna movement locally.

Badgerys Creek is considered to be a wildlife corridor of regional significance by the National Parks and Wildlife Service (1997a). Under Option A, Badgerys Creek would be completely retained and its value as a wildlife corridor enhanced in the long-term through regeneration, additional plantings, and protection (*Figure 14.3*). The planned revegetation would increase the length of the fauna corridor, linking existing remnants and reducing the impacts of edge effects. The regeneration and protection of this regionally significant corridor represents a positive impact in both the short and long-term for all native fauna.

Sections of Badgerys Creek would be removed under airport options B and C (refer *Figures 14.4* and *14.5*). Option B would involve removal of a slightly larger section of the Creek and option C would require the additional removal of a section of Oaky Creek. The impact on threatened fauna as a result of Options B and C is considered to be high in the short-term and low in the long-term, depending on the success of proposed mitigative measures. As detailed in *Section 14.8* of this Chapter, long-term environmental management of the airport sites would include linking existing habitat remnants and enhancing the remaining riparian corridors with native plantings and regeneration works. In the long-term, the remaining fauna habitats at the airport site would be conserved and managed for fauna protection under all options.

Weed and Fire Management

The potential for weed invasion was assessed as a potential impact on flora in the Draft EIS (refer Section 17.4) and in *Technical Paper No. 8* (refer Section 6.1 and Chapter 7). As discussed in *Section 14.8* of this Chapter, long-term management of remaining vegetation communities would include weed control through bush regeneration techniques.

The ecological impacts of altered fire regimes are discussed in Section 6.1 of *Technical Paper No. 8*. The hazards and risks of bush fire are addressed in detail in *Technical Paper No. 10*.

Insect Population

A discussion of impacts on insect populations is provided in response to concerns raised in submissions that the elimination of birds and their habitats would cause insect populations to rise.

Development of the proposal would result in the reduction of available woodland bird habitat in the local area. However, environmental management measures (*Section 14.8*), would ensure that remnant woodland and riparian bird habitats are conserved within the airport sites. Hence it is unlikely that birds and their habitats would be completely eliminated from the airport sites.

The abundance of insect populations is influenced by a complex range of factors, such as seasonal weather patterns and the availability of food resources. Furthermore, only some bird species are insectivorous (that is, feed on insects), others rely on fruits and seeds for food. As such, it is unlikely that the abundance of insects is related directly to the abundance of birds in the Badgerys Creek area. Development of the airport would therefore not have a significant impact on local insect populations.

14.6.5 Summary of Impacts

The potential impacts on flora and fauna resulting from development of the Second Sydney Airport have been revised based on additional studies undertaken for this supplement and in light of the proposed mitigation measures. Changes to the impact assessment summary provided in Chapter 10 of *Technical Paper No. 8* and the Draft EIS are listed in *Table 14.7*.

Of the three airport options, Option A is considered to represent the least impact on flora and fauna. This is primarily due to the retention and proposed enhancement of the regionally significant Badgerys Creek wildlife corridor. Option C is preferred to Option B, as the remnants retained are of higher conservation value and provide higher quality habitat for the Cumberland Plain Large Land Snail.

14.7 Further Analysis of Cumulative Impacts

14.7.1 Surrounding Land Use

The cumulative impacts resulting from construction of infrastructure associated with the airport on adjacent sites have been addressed in response to comments by the Auditor.

Assumptions about future land use for the airport options were discussed in *Technical Paper No. 2*. The current flora and fauna assessment does not address impacts of future land use changes associated with local government rezonings in areas adjacent to the airport. The impacts of future land uses and development on flora and fauna would be addressed under the State environmental impact assessment processes.

The potential impacts of infrastructure development associated with the proposal on flora and fauna were discussed in *Technical Paper No. 8*. Activities such as road and rail construction, creation of utility corridors, road realignment and widening are known to contribute to vegetation clearance, habitat loss and fragmentation and creation of barriers to fauna movement, as discussed in Chapters 6 and 7 of *Technical Paper No. 8*. Alternatives for the provision of infrastructure and services to the airport

Table 14.7 Summary of Flora and Fauna Impacts for Airport Option[1]

Impacts	A	B	C
Construction (or Short-term) Impacts:			
Loss of significant remnant vegetation communities	124 hectares of endangered ecological communities removed	143 hectares of endangered ecological communities removed	150 hectares of endangered ecological communities removed
Loss of habitat for significant fauna species	89 hectares of low to high quality habitat for Cumberland Plain Large Land Snail removed	93 hectares of low to high quality habitat for Cumberland Plain Large Land Snail removed	94 hectares of low to moderate quality habitat for Cumberland Plain Large Land Snail removed. One of three remnants of highest habitat quality is retained under this option.
Loss of habitat for significant flora species	Permanent removal of regionally significant population of *Pultenaea parviflora* (68 individual plants)	Permanent removal of regionally significant population of *Pultenaea parviflora* (68 individual plants)	Permanent removal of regionally significant population of *Pultenaea parviflora* (68 individual plants)
	33 regionally significant species removed	34 regionally significant species removed	37 regionally significant species removed
Fragmentation and Barriers	None as Badgerys Creek corridor is retained in this option	Creates a barrier across a wildlife corridor of regional significance.	Creates a barrier across a wildlife corridor of regional significance.
Loss of stream habitat	2.2 kilometres of Oaky Creek	4.3 kilometres of Badgerys Creek; 2.2 kilometres of Oaky Creek	4.7 kilometres of Badgerys Creek; 3.2 kilometres of Oaky Creek
Operation (or Long-term) Impacts[2]:			
Endangered ecological communities	Long-term conservation of two endangered ecological species	Long-term conservation of two endangered ecological species	Long-term conservation of two endangered ecological species
	Area to be protected in the long-term (222 hectares) comparable with existing area (201 hectares)	Area to be protected in the long-term (303 hectares) comparable with existing area (306 hectares)	Area to be protected in the long-term (273 hectares) comparable with existing area (272 hectares)
Significant flora species	Increased area of *Pultenaea parviflora* at airport site through ex-situ conservation program	Increased area of *Pultenaea parviflora* at airport site through ex-situ conservation program	Increased area of *Pultenaea parviflora* at airport site through ex-situ conservation program
	Habitat for regionally significant flora species conserved and enhanced	Habitat for regionally significant flora species conserved and enhanced	Habitat for regionally significant flora species conserved and enhanced
Significant fauna species	Cumberland Plain Large Land Snail Populations conserved and maintained in the long-term	Cumberland Plain Large Land Snail Populations conserved and maintained in the long-term	Cumberland Plain Large Land Snail Populations conserved and maintained in the long-term
	Potential habitat for threatened fauna conserved and enhanced	Potential habitat for threatened fauna conserved and enhanced	Potential habitat for threatened fauna conserved and enhanced
Blue Mountains Natural Areas	Low	Low	Low
Bird and Bat Strike	Low	Low	Low
Weeds and Fire	Low	Low	Low

Note: 1. Other potential impacts on flora and fauna which remain unchanged from those assessed in the Draft EIS are provided in Table 10. 1 in Chapter 10 of Technical Paper No. 8
2. Assumes that proposed mitigation measures are successful.

sites were considered in Chapter 10 of the Draft EIS. Figure 10.13 in the Draft EIS indicated potential transport corridors to the sites of the airport options. Electricity, gas, aviation fuel and telecommunications are likely to utilise existing infrastructure and would largely follow existing road and rail corridors. Environmental impacts from this infrastructure, including impacts on flora and fauna, are not expected to be significant and would be the subject of a separate assessment process.

Cumulative impacts on flora and fauna were addressed in Chapters 6 and 7 of *Technical Paper No. 8* and summarised in Chapter 17 of the Draft EIS. General cumulative impacts associated with the proposal were addressed in Chapter 27 of the Draft EIS.

14.7.2 Biodiversity

Cumulative impacts may be defined as those that arise from the additive effects of processes or activities that have a negative long-term impact on the environment. An assessment of cumulative impacts takes into consideration the regional context of the proposal within long-term time scales. This section addresses the long-term cumulative impacts of the Second Sydney Airport on the biodiversity of the western Sydney region. The assessment addresses the contribution the proposal would make, in combination with current or proposed developments, to impacts on flora and fauna in the region.

Cumulative impact assessment forms an important part of applying the principles of ecologically sustainable development and biodiversity conservation in the evaluation process. This is recognised in the *National Strategy for Ecologically Sustainable Development* (Commonwealth of Australia, 1992a) and the *National Strategy for the Conservation of Biological Diversity* (Commonwealth of Australia, 1996).

Loss of habitat for native flora and fauna represents the most significant influence on species survival and extinction rates in western Sydney (National Parks and Wildlife Service, 1997a). From the early days of European occupation, western Sydney was extensively cleared for agriculture and grazing (Benson and Howell, 1990; National Parks and Wildlife Service, 1997a). Clearing for agriculture still remains a significant threat to biodiversity in western Sydney. However, the greatest pressure on remaining habitat is currently the demand for housing and associated infrastructure and services (National Parks and Wildlife Service, 1997a).

A number of major developments are proposed or currently in progress in western Sydney. Most notably, the development of the Sydney Olympics site at Homebush Bay, the Penrith Lakes Scheme, the upgrading of the M4 and M5 motorways and the proposed Western Sydney Orbital. Developments such as these proposals, the proposed Second Sydney Airport and ongoing urban development, contribute to the increasing pressures on natural resources in the region.

The following discussion centres on the regional impacts of the proposal on biological diversity, particularly in relation to species and communities considered threatened and therefore most vulnerable to development pressures.

The predominant vegetation community at the sites of the airport options are Cumberland Plain Woodland and River-flat Forest, considered endangered ecological communities in western Sydney (National Parks and Wildlife Service, 1997a). Remnants of Cumberland Plain Woodland and River-flat Forest in western Sydney support a large number of significant plant species and represent a significant habitat resource for fauna. However the habitat quality of these communities is generally poor, with many remnants small and degraded by weed invasion, feral animals and dieback (National Parks and Wildlife Service, 1997a). Many of the original fauna have been replaced by ecological generalists that can utilise a wide variety of habitat resources, and edge specialists, which occupy the boundaries between vegetated and open areas. Bushland corridors, particularly riparian corridors, have become important habitat refuges for native fauna, owing to the extensive clearing of woodland in western Sydney.

Approximately seven percent, equivalent to 8,550 hectares, of the original distribution of Cumberland Plain Woodland remains in western Sydney (National Parks and Wildlife Service, 1997a). At present only 4.4 percent of the remaining Cumberland Plain remnants are protected in conservation reserves.

The Second Sydney Airport would involve the removal of up to 149 hectares of this community, representing two percent of its current total area in western Sydney. Development of the airport would contribute in the short-term to the ongoing clearance of Cumberland Plain Woodland in western Sydney and would therefore constitute an activity considered to threaten the long-term survival of this community. However, long-term management of vegetation would involve conservation, rehabilitation and revegetation of up to 303 hectares (under Option B) of Cumberland Plain Woodland (refer *Section 14.8*). This would include a minimum of 83 hectares to be revegetated with Cumberland Plain Woodland and River-flat Forest species to link the currently fragmented remnants (refer *Table 14.7*). The minimum area of vegetation proposed for long-term conservation at the sites of the airport options (222 hectares) represents more than two percent of the remaining Cumberland Plain Woodland in western Sydney. The protection and long-term management of this community within the airport sites would contribute to the long-term conservation of Cumberland Plain Woodland within the region.

According to the *Western Sydney Urban Bushland Biodiversity Survey* (National Parks and Wildlife Service, 1997a), River-flat Forest is considered to be amongst the most threatened vegetation communities in western Sydney. Approximately nine percent of its original area, equivalent to 3,825 hectares, remains in western Sydney. Current threats to this community include clearance of riparian vegetation, modification of natural flow regimes, grazing, mowing and competition from weed species. A maximum of 3.1 hectares of this community would be removed under the proposal, representing less than 0.1 percent of the area remaining in western Sydney. Although the area of River-flat Forest to be removed is relatively small in a regional context, the proposal represents an activity that contributes in the short-term to the ongoing degradation of River-flat Forest in western Sydney.

The rehabilitation and long-term protection of up to 16.4 hectares of River-flat Forest is proposed at the airport sites (refer *Table 14.6*). The proposal also includes additional areas for revegetation with River-flat Forest species to continue and enhance existing riparian corridors at the airport site (refer *Section 14.8*). The development of the airport would therefore contribute to the long-term conservation of this vegetation community in western Sydney.

Overall, it is considered that the proposed management of terrestrial ecosystems at the Second Sydney Airport site would contribute in the long-term to conservation of endangered ecological communities in western Sydney and contribute to maintaining regional biodiversity.

Aquatic ecosystems in western Sydney are also under pressure from development, pollution inputs and degradation. Proposed stormwater management at the airport sites has been designed to minimise impacts on the quality and quantity of water returning to adjacent creeklines. However, construction of the airport would require removal of some sections of natural creek line. The proposed removal of Badgerys Creek under Options B and C would contribute to the ongoing pressure on the aquatic system within the region.

14.7.3 Greenhouse Strategy

A number of submissions express concern that the flora and fauna assessment in the Draft EIS did not evaluate the proposal against the objectives of the *National Greenhouse Response Strategy* (Commonwealth of Australia, 1992b). The strategy is discussed in terms of air quality in *Chapter 11* of this Supplement. It is aimed largely at reduced emissions of greenhouse gases, such as carbon dioxide, methane and ozone. Large scale deforestation has been identified as a contributing factor to global warming associated with the 'greenhouse effect'. However, vegetation clearance associated with the proposal would not have any detectable effect on the greenhouse effect at a global scale. In the longer term the rehabilitation and revegetation of vegetation communities at the airport site would not reduce the overall amount of vegetation at the site.

14.8 Environmental Management

Environmental management of flora and fauna during construction and operation was addressed in Part D of *Technical Paper No. 8* and in Chapter 17 of the Draft EIS. In response to issues raised in submissions, environmental management measures are further defined.

Management of flora and fauna during construction and operation of the airport would be based on the goals of ecologically sustainable development and the conservation of biological diversity. The aims of flora and fauna management would be to:

- mitigate the cumulative impacts of the proposal on regional biodiversity;
- minimise impacts on threatened flora and fauna;
- protect and enhance habitat for threatened species, populations and ecological communities wherever possible; and
- minimise the potential for bird and bat strike.

The first three of these aims are consistent with the objectives of the *NSW Biodiversity Strategy* (National Parks and Wildlife Service, 1999). Specific management strategies and actions designed to achieve the above management goals are detailed in the following sections. The management measures proposed are based on the current master plans and would require further evaluation during the detailed design phase.

Environmental management of flora and fauna during construction and operation is addressed further in the environmental management plan contained in *Appendix* M of this Supplement.

14.8.1 Endangered Ecological Communities

Management strategies for endangered ecological communities include retention of vegetation within the sites of the airport options; consideration of off-site conservation of compensatory habitat; and rehabilitation and management of on-site and off-site vegetation. The strategies aim to mitigate the direct, cumulative and long-term impacts of the Second Sydney Airport on endangered ecological communities within the airport sites. Each strategy implemented as a separate measure would not sufficiently mitigate the potential impacts and hence a combination of all three strategies is proposed to achieve the management goals for flora and fauna.

Table 14.8 summarises the areas of endangered ecological communities to be retained as a result of on-site revegetation and off-site mitigation measures. As a result of the mitigation measures proposed below, the total areas of endangered ecological communities to be preserved is comparable with the existing remnant area for each of the airport options.

Table 14.8 Areas of Remnant Vegetation to be Removed and Conserved for Each Airport Option

Airport Option	Existing Remnant Vegetation[1] (hectares)	Vegetation to be Removed[2]	Remnant Vegetation to be Retained[2] (hectares)	Proposed Revegetation[2] (hectares)	Off-site Compensatory Habitat[3] (hectares)	Total Proposed Area of Vegetation to be Managed in Long-Term (hectares)
A	201	124	77	83	62	222
B	307	143	164	139	0	303
C	272	150	123	110	40	273

Notes:
1. *Represents the total area of remnant vegetation within the boundary of each airport option.*
2. *Calculated based on the assumption that vegetation conservation measures are implemented and on constraints of current master plans, with provision for relocation of detention ponds and support facilities during detailed design.*
3. *Off-site compensatory areas only include those immediately outside airport boundaries, for Option A and C; that is, survey areas 21, 22, 23 and 30 (refer Figures 14.3 and 14.5).*

On-site Conservation

The large hard surface area required for the airport and the need to minimise the risk of bird and bat strike (refer *Technical Paper No. 10*) would limit opportunities for retention of all vegetation and protection of habitat within the sites of the airport options. As a consequence, two large areas of existing vegetation on the sites would be cleared during development of the airport. Remnant endangered and ecological communities which could be retained within each airport option are as shown on *Figures 14.3, 14.4* and *14.5*.

The retention of vegetation on the airport sites would also reduce potential impacts on stream habitats. *Table 14.9* shows the length of stream habitat removed assuming with vegetation retention, compared with estimates from the Draft EIS (refer Table 6.2 of *Working Paper No. 7*) that were based on the assumption that all creeks and vegetation within the airport options would be removed. The lengths of stream habitat removed with vegetation retention are reduced for each creek, under all airport options, from those assumed for the Draft EIS.

Table 14.9 Estimates of Length of Streams to be Removed During Construction

Stream	Option A		Option B		Option C	
	With Proposed Management Measures (kilometres)	No Management Measures (Draft EIS Estimate)	With Proposed Management Measures (kilometres)	No Management Measures (Draft EIS Estimate)	With Proposed Management Measures (kilometres)	No Management Measures (Draft EIS Estimate)
Badgerys Creek	**0**	0	**4.3**	5.4	**4.7**	5.7
Oaky Creek	**2.2**	3.0	**2.2**	3.0	**3.2**	3.9
Cosgroves Creek	**0**	1.8	**0**	1.5	**0**	0
Total	**2.2**	**4.8**	**6.5**	**9.9**	**7.9**	**9.6**

Note: 1. *Refer to Table 6.2 of Working Paper No. 7.*

show that the impacts on endangered ecological communities and creek systems could be significantly reduced with on-site vegetation retention. With appropriate management of these remnants, as discussed in this section, on-site conservation of vegetation would lessen the severity of impacts on flora and fauna habitat.

Regeneration and Revegetation

The majority of remnant endangered ecological communities within the airport sites are degraded by weed invasion, feral animals, and grazing. Disturbance from agricultural activities and grazing represent the key threats to the viability of these communities. River-flat Forest occurs along drainage lines, which are often sites of significant weed invasion in rural areas as a result of elevated nutrient loads and flooding.

The aim of this management strategy is to rehabilitate endangered ecological communities retained on-site to a near-natural state and hence improve their ecological and conservation value. Vegetation management would involve a program of regeneration, involving modern bush regeneration techniques and revegetation, which involves planting and/or seeding of native species in designated areas.

Regeneration activities would be undertaken in existing remnants and might include weed control, low intensity control burns and installation of appropriate sediment controls. Revegetation would be undertaken in areas considered inappropriate for regeneration due to their highly degraded condition, or between vegetation remnants suitable for linking and for soil erosion control and landscaping purposes in areas subject to earthworks.

A revegetation and regeneration plan would be drafted prior to construction of the airport and would apply to pre-construction, construction and operational phases. Potential regeneration/revegetation sites have been identified within the sites of the airport options and are shown on *Figures 14.3* to *14.5*. The locations of the sites are based on remnants available for retention of larger size, higher ecological value, ability to be linked to adjacent remnants and ability to be revegetated to a near natural state. It is assumed in *Figures 14.3* to *14.5* that a cleared zone 150 metres wide would extend out from the centrelines of the runways, some additional clearing would be required to comply with Obstacle Limitation Surfaces, and that certain support facilities or structures could be relocated during detailed design phase to reduce the area of clearing necessary.

Revegetation would also assist in connecting isolated stands of River-flat Forest along the Badgerys Creek corridor, thereby improving the habitat quality of the corridor in the sections that would be retained. In the long-term, revegetation would improve connectivity within the Badgerys Creek corridor and between Badgerys Creek corridor and South Creek corridor. *Figure 14.3* shows that, of all the airport options, Option A allows the greatest proportion of the Badgerys Creek corridor, containing the largest remnant of River-flat Forest within the airport sites, to be preserved. *Figure 14.5* indicates that Option C allows a number of substantial remnants (particularly Sites 19 and 46) of Cumberland Plain Woodland to be protected. With appropriate regeneration techniques, these remnants could be linked together to form a relatively large habitat area.

Pre-construction management actions would involve collecting seeds and propagative material of threatened species and communities to be impacted by the proposal; assessing the regeneration potential of vegetation to be retained on-site and determining priorities for regeneration and revegetation activities.

Ongoing management of on-site and off-site vegetation would be required throughout the long-term operation of the proposal. The regeneration plan would outline an appropriate strategy for vegetation management. Bush regeneration programs would be implemented to improve and maintain the condition of Cumberland Plain Woodland and River-flat Forest remnants within the airport site.

Off-site Conservation

Impacts of the proposal on endangered ecological communities are not completely mitigated through on-site conservation measures. As a means of compensating for the negative impacts of the proposal on ecological communities, land outside the sites of the airport options has been identified as potential off-site conservation areas. Off-sites areas of remnant vegetation have been identified immediately surrounding the airport site and in the western Sydney region.

Areas adjacent to the sites of the airport options include potentially noise affected areas and areas within other airport options which could be purchased and managed for conservation. Existing Commonwealth Government policy for the Second Sydney Airport provides for the voluntary acquisition of residential properties within the 35 ANEF contour for the 1985 airport proposal. Small remnants of Cumberland Plain Woodland and River-flat Forest exist within these areas on properties owned by the Commonwealth or proposed for voluntary acquisition. Potentially noise-affected properties have also been acquired or proposed for acquisition along the eastern side of Badgerys Creek that contain River-flat Forest remnants. The protection of these remnants would reduce impacts on the flora and fauna habitat values of the Badgerys Creek corridor. The potential for conservation and rehabilitation of these areas would be investigated prior to construction of the airport as part of the environmental management plan (refer *Appendix* M).

Under Option A, remnants 30, 21, 22 and 23 are outside the airport boundary but could be purchased as 'compensatory habitat' (refer *Figure 14.3*). Under option C, remnants 21, 22, and 23 are also outside the airport boundary but could be purchased and managed (refer *Figure 14.5*). *Table 14.7* shows the increase in area of endangered ecological communities as a result of various mitigation measures.

An additional management strategy is proposed which aims to conserve, manage and rehabilitate areas of Cumberland Plain Woodland and River-flat Forest in coordination with planning for conservation of these communities in the western Sydney region. The advantage of this approach is that the off-site compensatory habitat identified may be more strategically placed and result in a greater contribution to the overall conservation and management of these communities. This measure would require further investigation and has therefore not been considered in the assessment of impacts provided in *Section 14.7* of this Chapter.

Possible criteria for identifying such off-site conservation areas include:

- Commonwealth owned land (or Crown Land);
- sites identified as 'core biodiversity areas' for Cumberland Plain Woodland and River-flat Forest by the National Parks and Wildlife Service (1997a);
- sites that represent a comparable ecosystem to that which exists on the airport sites and have equivalent or better value as wildlife habitat; and
- sites that contain equivalent or similar areas of the types of Cumberland Plain Woodland and River-flat Forest to be removed from the airport sites.

Core biodiversity areas contain significant remnants of plant communities that are poorly represented in conservation reserves or not present in the National Parks estate (National Parks and Wildlife, 1997a). The proposal is that significant stands of remnant vegetation within government-owned land would be identified, designated for conservation and zoned accordingly. Areas could be conserved by entering into voluntary conservation agreements with the National Parks and Wildlife Service, or by creating Commonwealth conservation reserves. Degraded areas within these sites would be rehabilitated through bush regeneration programs, as discussed below.

Potential areas for off-site conservation of Cumberland Plain Woodland on currently unprotected Commonwealth-owned land are shown on *Figure 14.2* and include:

- RAAF Orchard Hills;
- Australian Defence Industries (ADI) site, Penrith;
- Shanes Park; and
- Holsworthy Military Area

Other sites identified by the National Parks and Wildlife Service (1997a) as having conservation significance for Cumberland Plain Woodland on non-government land include:

- Kemps Creek;
- Prospect Reservoir;
- Hawkesbury Reserve;
- Lansdowne Park;
- Boral Lower Canal (Prospect);
- Australia's Wonderland;
- Hoxton Park;
- Appin;
- Fairfield City Farm; and
- south of Mulgoa Nature Reserve.

Potential areas for protection of River-flat Forest on currently unprotected Commonwealth-owned land (National Parks and Wildlife Service, 1997a) are (refer *Figure 14.2*):

- RAAF Orchard Hills; and
- Holsworthy Military Area.

Other non-government sites identified as having conservation significance for River-flat Forest include:

- Kemps Creek;
- South Creek;
- Nurragingy Council Reserve; and
- Rickaby's Creek.

Alternatively, a contribution could be made towards establishment of conservation areas within the green corridor/parklands proposed for the western Sydney region. This area is to be defined by a Regional Environmental Plan currently being prepared by the Department of Urban Affairs and Planning.

Off-site conservation of endangered ecological communities would increase the proportion of these communities that is protected in conservation reserves, and with ongoing maintenance, assist in ensuring their long-term survival. An off-site conservation area would also provide habitat for a range of threatened fauna, identified in *Technical Paper No. 8*, that occur in woodland habitats in western Sydney. Off-site conservation and management would therefore largely ameliorate the long-term impacts associated with the proposal.

14.8.2 *Pultenaea parviflora*

The management strategy for *Pultenaea parviflora* would aim to re-establish the genetic material of the existing population in on-site and any off-site conservation areas following construction of the airport. All areas of the Cumberland Plain Woodland proposed above provide potential sites for the re-introduction of propagative material.

The existence of the population was recognised in the *Second Sydney Airport Site Selection Programme Draft Environmental Impact Statement* (Kinhill Stearns, 1985a). In 1989, the then Department of Transport and Communications engaged the Royal Botanic Gardens to undertake a conservation program for *Pultenaea parviflora*. The program has since been carried out by Mount Annan Botanic Gardens and involved the collection of seed and material from the population, storage of seed, establishment and maintenance of an ex-situ (off-site) population in differing conditions, with subsequent transplanting and germination trials. The viability of a small sample of seed was tested in 1997. The program continues with further work being undertaken to determine the recruitment potential of translocated specimens (Offord, 1998, *pers. comm.*).

This conservation program will determine the most successful method for re-establishing this threatened species at the airport site. In addition, the information gained via this program will assist in the planning and management for long-term conservation of the species.

It is proposed that seed and stock produced by the conservation program would be utilised in on-site conservation areas and in landscaping. The Mount Annan Botanic Gardens would be consulted during preparation of the landscaping concept in order to ensure the success of the translocation or planting of seed. The feasibility of introducing the species into off-site conservation areas would also be assessed in consultation with the Mount Annan Botanic Gardens.

14.8.3 Cumberland Plain Large Land Snail

The mitigation of potential impacts to the Cumberland Plain Large Land Snail would involve:

- minimising habitat removal and fragmentation by careful reconsideration of the siting of proposed transport and services corridors;
- retention of Cumberland Plain Woodland remnants containing suitable habitat for the species wherever possible;
- regeneration of existing and potential habitat within the airport sites; and
- relocation of populations, preferably to on-site conservation areas or to nearby off-site conservation areas.

If some of the survey sites containing remnant Cumberland Plain Woodland known to contain the Snail were allowed to regenerate, and were connected to form a larger remnant, the long-term viability of the local population would be likely to be assured, provided the proposed management measures were successful.

It remains to be tested whether relocation of existing Snail populations to either on-site or off-site conservations areas would be successful, as this has never been attempted for this species. It is proposed that a compact relocation experiment be set up within the site and monitored for at least two years. This would involve moving a small number of individuals to two different types of locations; one with an existing population and one without, plus a control population which would be one of the known populations. This would allow new data on the fecundity, life history, timing of reproduction, feeding and habitat requirements of the species, in addition to the distance over which individuals move.

Other disturbance factors that might have impacts on the future survival of existing Snail populations include the species' susceptibility to fire; various toxins such as herbicides; the spread of exotic plants, for example, *Olea europa* (African Olive); competition with introduced species of snails and slugs, for example, *Helix aspersa* (Garden Snail); and predation by rats and *Tiliqua scincoides* (Eastern Blue-Tongue Lizard). The impacts of these factors on the survival of the species are not currently well understood, although they may be better understood during implementation of proposed mitigation measures. Appropriate monitoring, discussed in *Section 14.8.6*, would be designed to detect and respond to the impacts of various disturbance factors.

However, other major factors that must also be taken into consideration include the implications relocation would have on the genetic viability and diversity of the populations concerned and the species overall. This becomes especially important if any or all of the populations have to be relocated to off-site conservation areas. It must also be realised that it is highly likely that individuals would be lost and/or left behind during the relocation process, so no guarantees can be given that all individuals from any given population would be found.

However, it is considered that the likelihood of the Cumberland Plain Large Land Snail surviving the relocation process is reasonably good, especially if relocated to areas of a similar nature and proximity (refer *Appendix F6*).

14.8.4 Bat Populations

Relocation of the bat populations of *Chalinolobus gouldi* (Goulds Wattled Bat) and *Mormopterus sp. 1* at Badgerys Creek Community Hall would be undertaken prior to construction of the airport. National Parks and Wildlife Service would be consulted to determine suitable relocation sites for the populations.

14.8.5 Other Threatened Species

Many of the regionally significant flora species recorded, and threatened fauna potentially occurring at the airport sites, are reliant upon woodland and riparian habitats that are present in the form of Cumberland Plain Woodland and River-Flat Forest, respectively. Thus conservation of these endangered ecological communities, as described in *Section 14.8.1* of this Chapter, would conserve and enhance habitat for a range of flora and fauna species of conservation significance. This could involve using regionally significant flora in proposed revegetation programs. In turn, the successful implementation of regeneration and revegetation programs would also improve the quality of habitats for significant fauna, including birds, reptiles, amphibians and aquatic fauna.

14.8.6 Monitoring

The aims of the monitoring program would be to ensure the long-term success of the revegetation and regeneration program described in the preceding section. These aims are additional to those discussed in Section 17.5.2 in the Draft EIS. The monitoring program would be outlined in the environmental management plan for the operational phase of the proposal. The performance of environmental management measures would be assessed against a set of criteria specific to monitoring programs. Suggested performance criteria for each management measure are outlined in *Appendix* M of this Supplement.

Endangered Ecological Communities

A program for monitoring of endangered ecological communities protected in on-site and off-site conservation areas would be incorporated into the revegetation and regeneration plan. Monitoring would aim to measure changes in ecosystem health in Cumberland Plain Woodland and River-flat Forest remnants in on-site and off-site areas resulting from regeneration activities. Monitoring of any area reserved for compensatory habitat should be undertaken to document the status of the weed species present, the condition of the remnant and the regeneration of native species. In particular, transplanting to, or seeding of, an off-site conservation area should be monitored to determine the effectiveness of the strategy.

Site assessments would be conducted regularly by a qualified bush regenerator or botanist to measure indicators of community health, such as:

- distribution and abundance of weed species;
- disturbance, such as clearing, grazing, fire and feral animals;
- condition of native vegetation;
- diversity and abundance of native and exotic species; and
- presence of native fauna and fauna habitats.

Pultenaea parviflora

Monitoring of *Pultenaea parviflora* would aim to measure the success of the ex-situ conservation program being undertaken by Mount Annan Botanic Gardens. This would involve regular inspections of the health of re-introduced populations in on-site and off-site conservation areas. Monitoring would be undertaken by a botanist from the Mount Annan Botanic Gardens as part of the conservation program.

Cumberland Plain Large Land Snail and Bat Populations

Specific relocation and monitoring strategies for the Cumberland Plain Large Land Snail, and bat populations would be prepared prior to proposed relocation activities. Monitoring programs would aim to determine the distribution, abundance, breeding status and general health of these populations prior to, and following, translocation to provide base line data for future assessments. This would allow the success of relocation to be assessed in subsequent years. The populations would continue to be monitored for an appropriate time following relocation to ensure they survive and reproduce successfully.

14.9 Overview of Flora and Fauna

Conservation Significance

The sites of the airport options are considered to be of State significance for flora and fauna based on the following attributes:

- remnants of the endangered ecological communities Cumberland Plain Woodland and River-flat Forest, considered to be of regional conservation significance;
- a population of the endangered plant *Pultenaea parviflora* that is considered to have regional conservation significance;
- a population of the threatened Cumberland Plain Large Land Snail considered to be of State conservation significance; and
- a wildlife corridor along Badgerys Creek of regional significance.

Impact Assessment

Impacts on flora and fauna have been reassessed taking into account the revised conservation significance of the site and the proposed environmental management measures developed to mitigate the impacts of the proposal. These measures include rehabilitation of degraded vegetation remnants, revegetation of areas to link fragmented habitat and programs to conserve threatened species at the site. These environmental management measures are based on the current master plans and would require further investigation during the detailed design phase of the project.

Flora

In the absence of management measures, impacts on native flora would be similar under all airport options, although the area of endangered ecological communities and the number of regionally significant species cleared during construction would be greater under Options B and C.

Taking into consideration the proposed management measures, development of the proposal would require the removal of 124, 143 and 150 hectares of endangered ecological communities, under airport options A, B and C, respectively. In addition, one plant species of national significance (*Pultenaea parviflora*) and up to 37 species of regional significance would be directly affected by the proposal. All three options would involve the removal of a regionally significant population of the endangered plant *Pultenaea parviflora*.

Fauna

The proposal would affect the habitat of up to 22 terrestrial fauna species of conservation significance, including three species of State significance and 19 species of regional significance. This includes one additional species of State significance and three of regional significance that were recorded during surveys for this Supplement. The proposal might also affect the habitat of a further 70 significant species that have been recorded in the region and are potential transitory visitors to the sites. These include two species of national significance, 13 species of State significance, 48 of regional significance, five bird species listed under international agreements and two aquatic species identified as having high conservation value. Of these, three species of State significance and 28 of regional significance have been recorded in the Liverpool local government area by the National Parks and Wildlife Service (1997a).

The impacts of aircraft noise on wildlife inhabiting the area of the Greater Blue Mountains Area World Heritage Nomination are not likely to be significant.

Populations of Cumberland Plain Large Land Snail at the sites of the airport options are considered to be of State significance. All three airport options would involve removal of the Cumberland Plain Woodland remnants which support these populations.

Management Measures

Flora

Mitigation of impacts on endangered ecological communities would involve retention of vegetation remnants within the airport sites wherever possible and the regeneration of these remnants. Long-term management would involve revegetation in areas considered inappropriate for regeneration due to their highly degraded condition, or in areas between vegetation remnants suitable for linking with regenerated ecological communities. Further, investigations would be undertaken into the possible conservation of areas of similar habitat off-site as an additional compensatory measure. The areas of endangered ecological communities proposed for protection and management are comparable to the existing areas of vegetation on the airport sites. Hence, the proposed management measures would largely mitigate the potential long-term impacts of the proposal on endangered ecological communities and contribute to their conservation within the airport sites.

Seed and stock of *Pultenaea parviflora* would be introduced into similar habitats within on-site conservation areas as part of the ongoing ex-situ conservation program at the Mount Annan Botanic Gardens. Long-term monitoring of the ecological health of retained vegetation and re-introduced *Pultenaea parviflora* populations would be undertaken as part of the environmental management plan for the proposal. Provided the proposed management measures are successful, they would contribute to the long-term conservation of *Pultenaea parviflora* within the airport sites.

Fauna

Environmental management of the potential impacts to the Cumberland Plain Large Land Snail would involve retention of remnant Cumberland Plain Woodland known to contain the snail and the potential relocation to suitable on-site conservation areas of a similar nature and in close proximity. It is considered that these measures would contribute to the continued viability of the local population at the sites of the airport options.

Conclusion

In the short to medium-term the impacts of construction are considered to be high largely as a result of clearance of regionally significant endangered ecological communities and a regionally significant population of the endangered *Pultenaea parviflora*. In the long-term however, the conservation significance of the remaining remnants would be enhanced provided regeneration and rehabilitation works are successful. The area of remnant vegetation to be retained and the area of regeneration would contribute to the long-term viability of the endangered ecological communities at the airport sites. Similarly, the success of the proposed management of *Pultenaea parviflora* would ensure its long-term conservation within the sites of the airport options.

Of the three Badgerys Creek Airport options, Option A would represent the least impact on flora and fauna. This is primarily due to the retention and proposed enhancement of the regionally significant Badgerys Creek wildlife corridor. Option C is preferred to Option B, as the remnants which would be retained are of higher conservation value and would provide higher quality habitat for the Cumberland Plain Large Land Snail.

Chapter 15

Agriculture, Energy and Waste

Chapter 15
Agriculture, Energy and Waste

15.1 Summary of the Draft Environmental Impact Statement

15.1.1 Methodology

The potential impacts of the proposed Second Sydney Airport on agriculture were assessed in the Draft EIS by reviewing local and regional background information; consulting with organisations directly involved in agriculture; and reviewing and updating the agricultural survey conducted for the *Second Sydney Airport Site Selection Programme Draft Environmental Impact Statement* and *Supplement* (Kinhill Stearns, 1985a; 1985b). A detailed survey of 255 existing agricultural operations in the area was also carried out, using a combination of telephone surveys and field visits.

Energy requirements and the amount of waste likely to be generated during the construction of the airport were estimated from *Second Sydney Airport Planning and Design* (Second Sydney Airport Planners, 1997a). Potential energy requirements and data on operational wastes produced at major airports were determined after consultation with the operators of existing airports at Sydney and Melbourne.

15.1.2 Impacts on Agriculture, Energy and Waste

Agriculture

Badgerys Creek is located at the fringe of Sydney's urban development, and contains a number of large agricultural enterprises, including a poultry farm and a 1,500 cow dairy. These enterprises play a significant part in the regional production of agricultural produce. Other agricultural enterprises include extensive grazing of beef cattle and agisted horses, and small scale market gardens and nurseries providing fruit, vegetables and plants for the Sydney market.

The majority of the area of the sites of the airport options is currently used for agricultural purposes. Closure of these enterprises would lead to an estimated annual loss of production of $0.6 million for Option A, $2.3 million for Option B, and $1.7 million for Option C. The total value of agricultural production at Badgerys Creek is small relative to the total Sydney regional output, which is estimated at $1 billion (Department of Agriculture, 1995).

Potential impacts of the proposal on agricultural areas surrounding the sites of the airport options included dust generated during construction, which would impair livestock activities and reduce the quality of produce especially from market gardens and nurseries. Elevated noise levels associated with construction and operation could possibly impact on egg-laying, animal health and milk production, although the extent of this impact would depend on many factors. Overseas research on this subject is inconclusive.

Energy

Energy use during construction of the airport was estimated to be approximately 3,240,000 gigajoules (equivalent to 90 million litres of fuel), about 55 percent of which would be used in earthworks.

Operational energy requirements were estimated at about 830,000 gigajoules of electricity and 150,000 gigajoules of gas per annum when the airport reaches 30 million passengers per year. Aircraft fuel requirements would be about eight million litres per day of aviation fuel (Jet A1), and 30,000 to 35,000 litres per day of AvGas, for piston-engined aircraft used by general aviation and regional airlines.

The demand for natural gas would depend primarily on whether cogeneration was adopted. Design of airport facilities, such as buildings, would be in accordance with accepted energy design principles. Layout of runways and taxiways to reduce taxiing distances and times, and efficient scheduling and control of takeoffs and landings, would reduce fuel usage.

Waste

Construction

Depending upon the airport option, up to 120 residences, 30 commercial buildings, farm sheds, more than two kilometres of pipes, and 25 kilometres of roads would be removed from the airport construction site. Prior to undertaking demolition, a detailed survey would be undertaken to identify and locate any potentially hazardous wastes, such as asbestos, and readily reusable or recyclable items, such as concrete pipes and culverts.

Trees and shrubs would be processed on-site into wood chip or mulch and stockpiled for later use. Top soil would be stripped and stockpiled for reuse. Any merchantable timber would be harvested and sold. A balanced cut-and-fill earthworks design would avoid generating any surplus spoil as described in Chapter 9 of the Draft EIS. Other wastes, such as concrete and bitumen debris could be crushed and used as fill material.

By adopting recycling and reuse principles, the waste generated during construction could be reduced. It was estimated that up to 50 percent of demolition wastes could be recycled either on-site or off-site. Other construction and building wastes could be collected, stored and transported off-site for disposal to an off-site landfill which would be likely to be in western Sydney.

A temporary plant would be installed on-site to treat sewage generated during airport construction. Residual solids from the plant would be disposed of in an off-site sanitary landfill.

Facilities would be provided in site offices to enable general garbage and recyclables to be segregated. Waste oils and fluids would be stored in dedicated tanks for collection by waste contractors, and used drums returned to suppliers or recycled. Non- specification concrete or asphalt would either be recycled into the site batching plants, or utilised as general fill in bulk earthworks.

Operation

For an airport handling 30 million passengers per annum, up to 9,000 tonnes of quarantine waste (or 60 percent of total waste) and 6,000 tonnes of general solid waste per annum could be generated.

Quarantine waste would be sterilised on the site to permit co-disposal with non-quarantine waste in an off-site landfill. Oil and waste fuel would be stored in dedicated tanks for recycling. Drums and machine parts would be returned to suppliers or collected by recyclers.

An on-site sewage treatment plant, if constructed, would produce sludge, grit and screenings for disposal. Sludge would potentially be used for composting on-site, while grit and screenings would be disposed of to an off-site sanitary landfill.

15.2 Summary of Agriculture, Energy and Waste Issues

15.2.1 Issues Raised in Submissions

Agriculture

Concern was expressed in submissions that the construction and operation of the airport would require the closure or removal of a number of agricultural enterprises, such as Ingham's Poultry Multiplication Unit, and that the potential economic losses of this were not adequately addressed in the Draft EIS.

In addition, concerns are also expressed regarding the indirect impacts to agriculture, including the probability that service industries associated with the airport would eventually push out remaining agriculture in the area adding to the cumulative loss of agricultural production in the Sydney region.

Potential for the operation of the airport (particularly noise) to adversely affect production of remaining agricultural areas, the costs of relocation and the difficulty of locating suitable agricultural land elsewhere in the Sydney region particularly for enterprises such as dairies were other concerns expressed in submissions.

Energy

Energy conservation, including the adoption of appropriate measures and the application of energy efficiency principles were considered to be only superficially discussed in the Draft EIS. These concerns were raised by the Western Sydney Alliance and the NSW State Government, among others. The Auditor also noted that there was no attempt to indicate the potential energy savings that could be achieved.

The contribution that the airport would make to greenhouse gas emissions was also raised in submissions including those by Integral Energy and the NSW State Government. The view was expressed that alternative energy sources such as cogeneration should be considered because of their potential benefits for greenhouse gas emissions and regional air quality.

Waste

Concern was expressed that potential disposal sites for solid waste had not been identified in the Draft EIS. In the submission from the NSW State Government it was stated that the predicted 15,000 tonnes of waste generated per year is comparable to the waste generated by a community of 50,000 people, resulting in significant impacts on regional disposal facilities. Further concerns were expressed in submissions relating to the total quantity of waste likely to be generated by the airport, information on which was considered to be insufficient by organisations such as the Macarthur Waste Board. The management of waste was also considered not to have been addressed adequately in the context of the NSW waste planning and regulatory framework.

Consideration of liquid waste disposal methods was stated to be poor, in submissions from the Western Sydney Alliance, the Western Sydney Regional Organisation of Councils Ltd and the Macarthur Waste Board among other submissions. Comments were also made in submissions that further information should have been provided about facilities for treating and disposing of quarantines waste.

Submissions expressed concern that waste produced by the diverse range of industries and commerce that would service the airport should have been considered in the Draft EIS. Concern is expressed that this waste would need to be added to the waste generation estimates for the airport itself to reflect the total impact of the Second Sydney Airport on the waste stream in western Sydney. These issues, which were raised, among others, by the NSW State Government and the Macarthur Waste Board submissions, led to the conclusion that the Draft EIS and *Technical Paper No. 9* were inadequate.

15.2.2 Issues Raised by the Auditor

The Auditor found that while the issue of agricultural resources had been treated adequately, the off-site effects of the airport on agriculture was given only cursory treatment. In addition, the Auditor found that waste and energy issues had received only superficial coverage.

15.3 Responses to Agriculture, Energy and Waste Issues

15.3.1 Methodology and Scope of the Assessment

In the Draft EIS, resources, energy and waste issues were dealt with in one chapter (Chapter 18). In response to issues raised in submissions, the chapter in which some issues are addressed has been changed. Issues associated with the distribution network for energy (gas and electricity) are addressed in *Chapter 7* of this Supplement and greenhouse gases discussed in *Chapter 11*. Issues related to mineral resources such as coal and light firing clay are addressed in *Chapter 12* and issues related to sewage effluent and stormwater are dealt with in *Chapter 13*. This chapter deals with agricultural production, energy usage issues and waste generation and management.

A number of organisations involved in the waste and energy management and supply areas were contacted during the preparation of this Supplement to provide more up to date information than that presented in the Draft EIS. Agricultural issues were addressed using existing available information from the Draft EIS and *Technical Paper No. 9*. This was supplemented by consideration of methods or procedures which might be used to better manage the impacts of the airport construction and operation on agricultural activities within and surrounding the airport sites.

15.3.2 Agriculture

Existing Agricultural Production Within Airport Sites

Construction of the airport would have a direct impact on local agricultural production because of loss of productive land. The sites of the airport options are located on the urban fringe of Sydney, in an area primarily used for agriculture with large enterprises of dairy or beef production, as well as small rural holdings with a few cattle and small areas of fruit trees. In particular, a number of existing agricultural enterprises, which contribute to wider regional production, a poultry farm and a large dairy, would be affected. The Sydney regional output is estimated to be $1 billion and some of these including the poultry unit and higher quality horse establishments, could be expected to relocated.

Rural land throughout Australia has been classified by its suitability for agricultural use. The system adopted by NSW Agriculture uses the following five classes:

- Class 1 - arable land for intensive cultivation where constraints to sustained high levels of agriculture production are minor or absent;
- Class 2 - arable land suitable for regular cultivation for crops but not suited to continuous cultivation;

- Class 3 - grazing land or land well suited to pasture improvement. It may be cultivated or cropped in rotation with pasture. The overall level of production is moderate as a result of edaphic or environmental constraints;
- Class 4 - land suitable for grazing but not for cultivation. Agriculture is based on native pastures or improved pastures established using minimum tillage techniques; and
- Class 5 - land unsuitable for agriculture or at best suited only for light grazing.

Table 15.1 outlines the proportion of agricultural land according to these classifications for each option.

Table 15.1 Area Sites of the Airport Options by Agricultural Land Classification

	Option A		Option B		Option C	
Class	Area[1]	Proportion	Area[1]	Proportion	Area[1]	Proportion
1	-	n/a	-	n/a	-	n/a
2	136	8%	290	10%	256	9%
3	1,564	92%	2,581	89%	2,565	90%
4	-	-	29	1%	29	1%
5	-	n/a	-	n/a	-	n/a
Total	**1,700**	**100%**	**2,900**	**100%**	**2,850**	**100%**

Source. *PPK Environment & Infrastructure, 1997.*
Note: *1.* *Approximate area measured in square metres.*

The agricultural classification of land within the airport sites suggests that the majority of the land is most suitable for grazing and pasture improvement. This classification is consistent with the actual land use where grazing either of beef cattle or horses and some semi-intensive grazing of dairy cattle are the predominant agricultural land uses. Table 18.2 of the Draft EIS is presented below as *Table 15.2*. This table was subject to formatting errors in the Draft EIS.

Examination of *Table 15.2* shows that 80 percent of the agricultural area within Option A and 71 percent of the agricultural area within Options B and C are used for grazing. Intensive livestock and cropping industries make up only a small percentage of total land use, due mainly to the nature of their production systems. Nevertheless, these types of land uses make a valuable financial contribution to the agricultural output of the area. The sites of the airport options contain a number of large enterprises, namely a 1,500 head dairy and a poultry farm. These enterprises play a significant part in the regional production of agricultural produce. There are also a large number market gardens and nurseries located in the area producing fruit, vegetables and plants for the Sydney market.

Table 15.2 Present Agricultural Land Use at Badgerys Creek

Industry	Option A Hectares	Option A Percent	Option B Hectares	Option B Percent	Option C Hectares	Option C Percent
Extensive Grazing						
Beef cattle	756	50	1,016	42	1,013	46
Horse agistment/ thoroughbred horse spelling	150	10	170	7	185	8
Mixed grazing	80	5	80	3	119	5
Semi-Intensive Grazing						
Dairying	40	3	175	11	70	3
Trotting horse training/ spelling	190	12	200	8	190	9
Sub Total	**1,216**	**80**	**1,641**	**71**	**1,577**	**71**
Intensive Livestock (Poultry)	10	1	185	8	143	6
Intensive Cropping	50	3	155	6	148	7
Rural Small Holdings[1]	250	16	363	15	354	16
Total Agriculture	**1,526**	**100**	**2,344**	**100**	**2,222**	**100**
Other[2]	180		458		616	
Total Area of Options	**1,700**		**2,900**		**2,850**	
Percentage used for Agriculture	90		80		78	

Source: *PPK Environment & Infrastructure, 1997.*
Notes: *1. Deer and ostrich farms are included as rural small holdings as they are not the major source of income for the owners.*
2. Other land use includes non-agricultural businesses, vacant land and residential blocks with no agriculture.

Direct Impacts of Airport Construction

Construction of the Second Sydney Airport would result in existing agricultural enterprises within the sites of the airport options either ceasing operation or having to relocate to other areas. While this would reduce the agricultural production in the immediate area, estimated at between $0.6 million to $2.3 million, depending on the airport option, it is likely that other agricultural enterprises in the Sydney region would increase their production to overcome this likely fall in production.

Most of the agricultural activities located at Badgerys Creek are there because of their proximity to markets. Horse training and spelling facilities are located close to Sydney residents who own the horses. The chicken broiler enterprises are situated near processing plants. These, and similar, industries would be adversely affected, to a greater or lesser extent, depending on the industry, by the need to relocate. Also, the relocation of these activities is not simple and it could take considerable time to find and secure sites convenient to markets or processing plants. In many cases, there would be a need to relocate to more distant locations.

Submissions raising concern about this potential loss of agricultural production are correct insofar as there would be some level of adverse impact. To place that impact in perspective, however, consideration should be given to the following factors:

- the sites of the airport options are not classified as prime agricultural land and existing agricultural activities do not depend on the special characteristics of the land itself to continue operating;

- while the estimated value of the loss in agricultural production at the local level might be significant, it would, however, be insignificant compared to the overall production of the Sydney region, accounting for between 0.06 percent to 0.23 percent of the total regional agricultural production;
- all of the properties within the site proposed for Option A and 65 to 70 percent of the land required for Options B and C is owned by the Commonwealth Government. Consequently, many agricultural activities operate under lease and the lease holders would have a considerable length of time to investigate and secure alternative sites;
- properties that may be acquired for Options B and C could be leased back to the former owner for a period of time prior to construction commencing. This would also provide the existing operator the opportunity to investigate and secure alternative sites; and
- all land requiring full or partial acquisition for the development of the Second Sydney Airport would be subject to the *Lands Acquisition Act 1989*. Two forms of acquisition are possible under this Act, namely, acquisition by agreement or acquisition by compulsory processes. The former case relies on an agreement to be reached between the Commonwealth and the owner of the property on price while the latter provides for entitlement for compensation.

Regional Agricultural Impacts from Urban Encroachment

Submissions raised concern about the potential for service and support industries and airport associated infrastructure to encroach on agricultural land around the airport.

The Department of Agriculture (1995) regards agricultural land in the Sydney region as being important not only because of its role in providing Sydney residents with fresh fruit but also because of the non-agricultural benefits which can accrue through protection of agricultural land, often simply for its amenity value and non-urban use. About 90 percent of the perishable vegetables produced in New South Wales are grown in market gardens in and around Sydney. The Sydney region also accounts for 61 percent of the State's total area devoted to nurseries and flower production and 55 percent of the total area under turf. Poultry production in the Sydney region accounts for 61 percent of the State's total and the region produces eight percent of its milk.

NSW Agriculture estimates annual farm gate production in the Sydney region to be worth approximately $1 billion with flow-on effects to the economy estimated at in excess of $2 billion (Department of Agriculture, 1995).

Encroachment of urban development onto agriculturally productive land in the Sydney region is a major metropolitan planning issue. Ongoing maintenance of areas of productive agricultural activity would depend on State and local strategic and statutory planning policies, the demand for urban land, the urban capability of the land and the capacity to deal with potential conflicts caused by the juxtaposition of urban development to intensive agricultural activities.

The Second Sydney Airport would increase pressure for urban development to replace agricultural activities. This may take the form of industrial and commercial activities, especially those that would benefit from close proximity to the airport, and potential residential development, perhaps surrounding a new rail link to the airport. Whether these types of activities occur would, however, rely on the implementation of new planning policies by State and local government permitting such development. It should be noted, as described in Chapter 10 of the Draft EIS, that the land requirements for direct employment for Options B and C could be accommodated within lands provided within the airport sites.

The Second Sydney Airport's creation and operation would, per se, lead to an inevitable encroachment on agricultural activities located outside the boundary of the airport. This is because the location and rate of any potential loss of agricultural land in areas surrounding the airport would be dependent on a range of factors, such as the zoning and land use decisions of the State and Local Governments, to be taken independent of the construction and operation of an airport. Thus it is difficult to forecast confidently the rate and location of land use change in the vicinity of this stage of planning for the airport development.

Chapter 10 of the Draft EIS identifies the potential for residential development adjacent to a new rail link and also the potential for employment generating development adjacent to the airport site. There would, however, be alternatives to such development, such as those discussed in *Chapter 7* of this Supplement. *Chapter 7* of this Supplement also notes that sufficient vacant employment lands presently exist in western Sydney to cater for predicted demands when the airport was handling 30 million passengers per year.

Impacts of Airport Operations on Agriculture

The effects of aircraft noise on livestock have not been extensively researched in Australia, with most studies relating to the effects on sheep and cattle. There have, however, been several studies conducted overseas, which include the effects of noise on poultry. Appendix B *of Technical Paper No. 9* contains a literature review of this issue.

Overall, most of the studies show that the impact of aircraft noise varies according to its intensity. As a general guide, the noise threshold expected to cause a behavioural response in animals is 85 to 90 dB (Head, 1993).

The research carried out and the information available is not extensive enough to form definitive conclusions. Animal behaviour and response under stress vary between, and within, species. Ewbank (1976) notes that relevant factors will include:

- the previous experience of animals with sudden and loud noises;
- their inherent nervousness (for example, laying hybrids compared with heavy breeds of poultry and thoroughbred horses compared with other horses);
- the level of background noise;
- whether or not the animal is housed in a building;
- whether or not the animal is with others of its own species;
- what the animal is doing at the time; and
- variation in the responses of individual animals.

Other findings of the research (Ewbank, 1976) include that:

- birds are more affected than mammals, and pigs more so than ruminants;
- species adapt when there is repetition of a stimuli; and
- noise related stress can be reduced by management practices.

Most of the agricultural activities in the immediate vicinity of the airport sites are unlikely to be adversely affected by aircraft noise on the basis of the research reviewed. The industries which are most likely to be impacted by aircraft noise would be those associated with poultry or thoroughbred horses, which are located within high noise areas. In the most extreme cases production losses may occur and relocation may be an appropriate management decision.

15.3.3 Energy

Energy Consumption

Construction of the airport would consume a considerable amount of energy, mainly in the form of liquid fuel for site equipment such as earthmoving machines and trucks.

Table 15.3 is extracted from information in the *Second Sydney Airport Planning and Design Regional Infrastructure Report* (Second Sydney Airport Planners, 1997c). It summarises the expected fuel consumption for different components of the construction of the airport, up to master plan capacity (up to 30 million passengers per year).

Table 15.3 Expected Fuel Consumption During Construction to Master Plan Capacity

Component	Fuel Consumption	
	Millions of Litres	Percentage of Total
Earthworks	50	55
Pavements	30	33
Building Works	5	6
Sundry Work	5	6
Total	**90**	**100**

Source: *Second Sydney Airport Planners, 1997c.*

Earthworks and pavements together would consume almost 90 percent of the fuel requirements for construction. They would therefore offer the greatest gains from the implementation of energy conservation measures, such as careful planning of earthworks, to avoid double handling of materials, and locating asphalt and concrete batching plants as close as possible to areas to be paved. Newer, more energy-efficient equipment would also contribute to energy conservation energy during construction.

Energy used during operation of the airport would comprise mainly electric power and fuel for aircraft and ground vehicles. Natural gas would also be consumed, for catering and food preparation in the terminal and flight catering facilities, as well as for producing hot water, and heating and cooling buildings. *Table 15.4* summarises the predicted energy requirements when the airport is handling 30 million passenger per year.

Table 15.4 Predicted Energy Consumption During Airport Operation

Energy Type/Usage	Consumption
Terminal and Ground Facilities	
Electricity Consumption	830,000 gigajoules per annum
Natural Gas Consumption (with Cogeneration)	6,000,000 gigajoules per annum
Natural Gas Consumption (without Cogeneration)	150,000 gigajoules per annum
Aircraft	
Jet A1 Fuel	8 million litres per day
AvGas	30,000 to 35,000 litres per day

Source: *Second Sydney Airport Planners, 1997c.*

The maximum instantaneous demand for electricity at the airport is estimated to be of the order of 80 megavolt amperes, for master plan size (30 million passengers per annum). Major energy demand centres would be the international and domestic terminals (collectively about 50 percent) and the aircraft bases (about 30 percent).

Energy Conservation Measures

Development of the Second Sydney Airport presents an opportunity for the incorporation of energy conservation and efficiency principles into the development of major infrastructure. These principles may be applied to the proposal at all stages from early design through construction to full operation and would be applied to facilities such as buildings, layout of runways, taxiways and incorporated into the airport environment strategy.

Design principles and guidelines established prior to the commencement of conceptual design should include a requirement that energy conservation and efficiency principles are applied to all buildings and operational procedures. These principles would include orientation of buildings to avoid large window areas facing east or west, use of awnings to shade windows, double glazing of windows to reduce heat losses in winter and reduce heat in the summer months and maximum use of natural lighting. They could also include 'smart building' systems, which are designed specifically to reduce energy consumption.

Potential Use of Cogeneration and Alternative Energy Sources

Table 15.4 shows that consumption of natural gas would vary considerably, depending on whether the airport was powered by electricity generated internally, at a dedicated cogeneration plant, or whether electricity was supplied externally from the electricity grid. Cogeneration would reduce the need for incoming power transmission lines, and the excess heat from the natural gas combustion process would be used to generate additional electricity (Second Sydney Airport Planners, 1997c) and could be used for heating of buildings and producing hot water.

As the airport demand for thermal (heat) energy would vary seasonally, the use of cogeneration would not be efficient for all power requirements. Cogeneration processes require a reasonably constant load for maximum efficiency.

Power generated by cogeneration is approximately 35 percent more expensive in terms of capital and annual running costs (Second Sydney Airport Planners, 1997a). However, any extra power so generated could potentially be fed into the electricity grid. The NSW electricity market is presently over-supplied with electrical generation capacity and electricity prices are currently depressed. The costs of cogeneration and externally supplied electricity would be similar if electricity prices were to increase by approximately 40 percent early next century (Second Sydney Airport Planners, 1997c).

Cogeneration and alternative energy sources, such as solar and wind generation, could not be expected to provide a reliable all-weather energy source for the efficient operation of the airport, although they could be considered as supplemental conventional sources of energy. Limited space may be available for energy producing plant and the potential for adverse safety impacts from elevated structures, such as wind turbines, would need to be investigated.

15.3.4 Waste

Waste Production and Management in Western Sydney

Waste generated from the airport needs to be considered in light of the surrounding region and the impact this waste might have on existing waste management facilities. The *Waste Minimisation and Management Act 1995* provides a framework for the management of waste on a regional basis. Regional Waste Boards have been established throughout the Sydney metropolitan area. The sites of the airport options fall within the area managed by the Western Sydney Waste Board. The Macarthur Waste Board covers the area south and south-west of the sites of the airport options. Most waste generated by the airport would be disposed of in landfills situated under either of the Board's controls.

Each Board has prepared a Regional Waste Plan (Nolan, 1998) which considers the volumes of waste generated from various sources within their areas both for the present and into the future. The Plans provide a strategy for receipt and management of this waste and its safe disposal. The Plans also include proposals for reuse and recycling of waste and for the minimisation of waste volumes generated.

It is NSW Government policy to reduce the volume of waste disposed to landfill by 60 percent per capita by the year 2000 (compared to 1990 volumes) (the *Waste Minimisation and Management Act 1995*, Part 1 Section 3). This reduction may be achieved by minimisation at source, waste avoidance, recycling either at source or through established recycling facilities, or reuse of the waste.

Total volumes of waste generated in each of the Waste Board Areas that are in proximity to the airport sites are set out in *Table 15.5*.

Table 15.5 Waste Generated in 1996 in Western Sydney and Macarthur Regions

	Tonnes Per Annum (1996)	
Type of Waste	**Western Sydney**	**Macarthur**
Municipal Waste	483,000	83,813
Commercial and Industrial	518,466	45,966
Construction and Demolition	231,815	88,626
Total	**1,233,281**	**218,626**

Source: Nolan (1997).

Waste can be classified as either putrescible or non-putrescible. Municipal waste is generally comprised of putrescible waste, while construction and demolition waste is generally non-putrescible. Commercial and industrial waste, such as would be generated by the Second Sydney Airport, is generally a mixture of the two types. Findings from the Sydney Airport waste audit (Waste Service NSW, 1993) found that up to 60 percent was putrescible (such as food wastes from foot outlets) and approximately 35 percent was non-putrescible (such as paper, bottles and cans).

The majority of Sydney's putrescible waste is disposed of to landfill. Currently the Lucas Heights Waste Management Centre is the facility which receives most of this material. Waste Service NSW operates the Lucas Heights facility as well as smaller landfills at Jacks Gully (in the Macarthur region) and Eastern Creek (in the Western Sydney region) (Nolan, 1998). Waste Service NSW makes day-to-day decisions about the destination of waste destined for each landfill and the amount of waste going to each facility can therefore change daily.

Waste Service NSW and Sutherland Council have recently come to an agreement through a mediation process that effectively reduces the amount of waste that can be disposed of at Lucas Heights from some one million tonnes per annum to approximately 575,000 tonnes per annum, after the year 2000 (Office of Environmental Mediation and Inquiry, 1997). This means that the availability of landfill space for putrescible waste disposal in Sydney will be severely reduced from January 2001.

The Regional Waste Plans for both Western Sydney and Macarthur Waste Boards indicate that current population growth in these regions is likely to continue (Nolan, 1998). Each region has developed a comprehensive program for community education and the achievement of waste reduction targets, although it is uncertain if these targets are achievable.

New facilities for the receipt, processing, composting, management and disposal of waste are proposed for each area and will be introduced progressively as required. In particular, Western Sydney Waste Board is planning to construct a number of waste pre-treatment facilities, which it believes will stabilise putrescible wastes and enable them to be disposed of in non-putrescible landfills (Western Sydney Waste Board, 1998).

Waste Service NSW is in the process of seeking approval to establish a new putrescible waste landfill at one of two possible locations in the Hunter Valley. This is to alleviate the shortage of landfill space in the Sydney region that is anticipated in 2001. There are also a number of private operators seeking to establish landfills in the Hunter Valley and one site is being considered near Goulburn. Waste Service NSW is intending to construct a waste composting facility, in the Sydney region, that could accept food waste and sewage sludge from the airport in future.

Disposal of Wastes Produced by the Second Sydney Airport

Construction

The major types of waste to be disposed of during the construction phase would vary from demolition waste to some commercial and industrial wastes. Contractors associated with construction of the airport would dispose of construction and demolition waste (after separation of recyclable materials) to existing landfill facilities in western Sydney. Commercial and industrial wastes, which would consist of a mixture of putrescible and non-putrescible waste could be disposed of by waste contractors at facilities specified in contracts made between the airport builders and the waste contractors and to landfills or transfer stations operated by Waste Service NSW, which currently disposes of most of Sydney's putrescible waste.

Waste Service NSW does not have the same extent of control over non-putrescible waste disposal as it does over putrescible waste. A large amount of non-putrescible waste (from construction and demolition sources especially) is either recycled or is disposed of in landfills not operated by Waste Service NSW. There is currently no shortage of landfills that can receive dry non-putrescible waste in the western Sydney area, and new landfill areas are continually being created from extractive industry operations.

Before airport construction commences, a waste management plan would be prepared as part of the environmental management plan for construction. This would address opportunities and methods for the minimisation of waste, recycling and reuse of waste generated by the airport. The plan would be prepared in consultation with the

Western Sydney Waste Board and in accordance with the provisions of the *Waste Minimisation and Management Act 1995.*

Operation

Waste generated during airport operation would be primarily of a commercial and industrial nature. It would consist of a mixture of quarantine and non-quarantine waste, approximately 9,000 and 6,000 tonnes per annum respectively (when the airport is handling 30 million passengers per year).

Stage 1 of the airport development, which is expected to be complete in 2006, is estimated to provide for about 10 million passengers per year. Waste generation would be proportional to the airport's capacity and is estimated at about 5,000 tonnes per year for Stage 1 operation. In other words, the amount of waste generated would increase gradually in proportion to the number of passengers per year, so that the predicted volume of waste, at the master plan level of development, would not require disposal at the outset of airport operations.

Quarantine waste would be sterilised by an autoclave process or the like before being disposed of with other putrescible wastes. Non-quarantine waste would be disposed of directly as putrescible waste, except for paper, glass and other recyclables that could easily be separated.

As mentioned previously, there are a number of potential disposal options for putrescible waste, including pre-treatment in facilities proposed by Western Sydney Regional Waste Board, disposal to Jacks Gully or Eastern Creek landfills, long-haul disposal to proposed facilities in the Hunter Valley or other locations outside Sydney, and composting of food wastes and sewage sludges in facilities established by Waste Service NSW.

Sterilisation of Quarantine Waste

Sterilisation of quarantine waste may be conducted within the airport sites or the waste may be transported to an off-site facility. Off-site treatment would avoid duplication of facilities but would require strict controls on the transport of the waste and the cleaning of transport vehicles. Sydney Airport currently uses off-site treatment and disposal of quarantine waste.

Impacts on Regional Waste Generation

Regional Waste Plans for Western Sydney and Macarthur regions have not included allowances for waste from the Second Sydney Airport within their waste projections. The estimated 15,000 tonnes of waste generated per annum when the airport is operating at 30 million passengers per year would be significant as a single source generator of waste. However, this would be small in proportion to the total volume of waste (1.2 percent of total waste or 2.9 percent of commercial and industrial waste) generated in western Sydney.

Given that the population growth rate for the region is estimated at 13 percent for the period from 1991 to 2001, at 30 million passengers per year the airport would contribute approximately the equivalent of only two years of estimated growth.

Waste Produced by Off-Site Development

As the airport develops, service industries may be established in the surrounding areas to provide support for or benefit from the airport's proximity to the operating airport. The extent and nature of this development would depend on a wide range of factors as described in *Chapter 7* of this Supplement. Waste generated by these industries would increase commercial and industrial waste volumes, in western Sydney, but it is impossible to realistically estimate by how much volumes would be increased. New facilities would have the advantage of being able to be planned to incorporate waste reduction and recycling facilities, which would reduce their potential contribution to waste volumes.

15.3.5 Environmental Management

Agriculture

In the Draft EIS it was suggested that compulsory acquisition payments made to agricultural producers forced to cease production and/or relocate because airport construction impacts would mitigate these impacts to a certain extent. Under the provisions of the *Lands Acquisition Act 1989* acquisition by agreement or acquisition by compulsory processes would only apply to those properties either wholly or partly required for the airport site. While outside current government policy, consideration could possibly be given to offering acquisition to cover relocation due to other reasons, including any demonstrated sensitivity of stock to noise or fumes and crop damage owing to dust.

Energy

Energy conservation measures would be integrated into the design and implemented during construction and operation of the airport – including all facilities, buildings, aircraft movements and other activities. During construction, the major opportunities for energy conservation would be during earthworks and paving. Energy conservation measures include careful planning of earthworks to avoid double handling of materials, locating batching plants as close as possible to areas to be paved, and the use of newer, energy-efficient equipment.

Energy efficient design of buildings and facilities would provide the greatest opportunities for energy conservation during airport operation.

An airport environment strategy, as described in *Chapter 25* of this Supplement, would set energy targets consistent with conservation and efficiency principles. Ongoing energy consumption would be monitored to identify areas where targets have not been achieved. Monitoring would also allow the efficiency of implemented conservation measures to be assessed and changes made where appropriate to achieve a better or sustained result. An annual energy audit could be included as a component of the environmental management plan for the airport.

Waste

The quantity of waste produced at the airport would be monitored on a regular basis. Monitoring would include regular sampling and analysis of waste types in accordance with the procedures established by the Environment Protection Authority. This would assist in the identification and implementation of waste minimisation practices.

The operation of the airport would implement the *Waste Minimisation and Management Act 1995* and subsequent amendments.

Quarantine waste is estimated to constitute 60 percent of the volume of waste generated by the airport. Steps would be taken by the airport lessee company to reduce the amount of quarantine waste generated by improving waste segregation practices. Sterilisation of this waste could be carried out prior to its co-disposal with non quarantine waste. Regular monitoring of the quality of quarantine waste would be undertaken both before and after sterilisation. A strict procedure would be established to ensure that immediate steps were implemented if any test results revealed contamination (or potential contamination) levels above guidelines set by the Department of Health or Environment Protection Authority.

15.4 Overview of Agriculture, Energy and Waste

15.4.1 Agriculture

Construction of the airport would have a direct impact on a number of locally significant agricultural enterprises, because properties would be acquired and the enterprises either relocate or cease operation. These enterprises, which include a poultry farm and a 1,500-head dairy make a significant contribution to wider regional production. Beef grazing, horse agistments and intensive vegetable cropping operations are also conducted from the sites of the airport options. The overall value of the loss of agricultural production at the local level might be significant, but it would be minor compared to the overall production of the Sydney region estimated to be $1 billion per year.

The majority of the land within the airport options has been classified as Class 3 by NSW Agriculture. This means that it is suitable for grazing activities, which may be cultivated or cropped in rotation with pasture, but is considered not to be prime agricultural land. Current use of the land reflects this classification. Most of the agricultural activities located at Badgerys Creek are situated there because of proximity to markets, while horse training and spelling facilities are located close to Sydney residents who own the horses. The chicken broiler enterprises are close to processing plants. The need for proximity could make relocation of some facilities difficult.

Many of the affected properties operate under lease from the Commonwealth Government and leaseholders would have a considerable length of time to investigate and secure alternative sites. Properties that may be acquired for Options B and C could be leased back to the former owner prior to construction commencing, providing an opportunity to investigate and secure alternative sites. All land requiring full or partial acquisition would be subject to the *Land Acquisition Act 1989*, which would provide for acquisition by agreement or compulsory acquisition.

Encroachment of urban development onto agriculturally productive land in the Sydney region is already a major metropolitan planning issue. The Second Sydney Airport would increase pressure for urban encroachment to occur, although, ultimately, applicable State and local government planning policies would determine the extent to which this would occur.

Operational effects of the airport on agricultural activities which continue in proximity to the airport depend upon a number of factors, including noise levels, the previous experience of animals with sudden and loud noises and variations in species and individual animals. On the basis of research most agricultural activities in the immediate vicinity of the airport sites are unlikely to be adversely affected by aircraft noise. However, industries most likely to experience adverse effects would be those associated with poultry or pure-bred horses, located in high noise areas.

15.4.2 Energy

Construction of the airport to the master plan stage would consume approximately 90 million litres of fuel, with earthworks and pavements accounting for 55 percent and 33 percent of this respectively. These works would therefore offer the greatest scope for implementation of energy conservation measures, including careful planning of earthworks to avoid double-handling of materials, locating batching plants as close as possible to areas to be paved, and use of newer energy-efficient equipment.

During airport operation, energy consumed would be comprised mainly of electrical power, fuel for aircraft and ground vehicles, natural gas for catering and food preparation, hot water production and heating and cooling of buildings. Consumption of electricity has been estimated at 830,000 gigajoules per annum when the airport is handling 30 million passengers per year airport.

When the airport is handling 30 million passengers per year annual natural gas consumption is estimated to be 150,000 gigajoules and six million gigajoules (with cogeneration). Cogeneration would mean a massive increase in natural gas consumption, in exchange for reduced reliance on external electricity supply. The majority of electricity needs would be able to be met by power generated at the airport, and environmental benefits flowing from this would be that waste heat from gas combustion could be used for generating additional power, heating of buildings and producing hot water.

The cost of generating electricity by cogeneration is currently about 35 percent more expensive than purchasing electricity from external suppliers. The airport would still need to be connected to the NSW electricity grid, but this could provide an opportunity to sell excess power generated to external electricity suppliers.

Alternative energy sources such as solar and wind generation could replace conventional sources of energy for limited non-critical applications at the airport.

There is an opportunity for energy conservation and efficiency principles to be incorporated into the Second Sydney Airport at all stages from early design, during construction, to full operation. Design guidelines should include a requirement to apply energy conservation principles to all buildings and operational procedures. Energy efficient design of buildings and facilities would provide the greatest opportunities for energy conservation during airport operation.

15.4.3 Waste

Waste generated during construction of the airport would include demolition waste and some commercial and industrial wastes. Construction and demolition waste would be more likely to be landfilled in the western Sydney region, after separation of recyclable materials. There is currently no shortage of landfill space for dry, non-putrescible wastes, as a result of extractive industry operations in this region. Putrescible wastes would be likely to be disposed of by Waste Service NSW, which currently disposes of most of Sydney's putrescible waste.

The Lucas Heights Waste Management Centre is unlikely to be available for disposal of putrescible waste from the airport after January 2001, although a number of other options exist. These include pre-treatment in facilities proposed by Western Sydney Waste Board, existing landfills in the Sydney region, and long haul disposal to proposed facilities in the Hunter Valley or other locations outside of Sydney.

Wastes generated during operation of the airport would be primarily of a commercial and industrial nature. They would consist of a mixture of quarantine and non-quarantine wastes. Quarantine wastes would be sterilised in an autoclave process or the like, before being disposed of with other putrescible wastes. Facilities for the sterilisation process could be located within or outside the airport site.

Regional waste plans for the western Sydney and Macarthur regions have not included allowances for waste from the Second Sydney Airport. However, the estimated 15,000 tonnes per year generated by 30 million passengers in 2016 would be small in proportion to the total volume of waste (1.2 percent of total waste or 2.9 percent of commercial and industrial waste) generated in western Sydney.

Waste produced by off-site, airport-related development would increase regional, commercial and industrial waste volumes, however, it is impossible to estimate the extent to which these volumes would be affected.

Chapter 16

Hazards and Risks

Chapter 16
Hazards and Risks

16.1 Summary of the Draft Environmental Impact Statement

16.1.1 Methodology

Hazard and risk issues investigated quantitatively included the potential for aircraft crashes into residential and industrial areas, risks associated with overflying the Defence Establishment Orchard Hills, and risks of an aircraft crashing into major water infrastructure, such as Warragamba Dam.

Aircraft crash risk contours and individual fatality risk contours were developed for each of the airport options (Options A, B and C), and for each possible mode of operation of the airport (*Airport Operation 1, 2* and *3*) for the air traffic scenarios in years 2006 and 2016. These contours enable the number of people who would be exposed to a fatality risk of more than one-in-one million to be estimated.

As well as the risks to an individual living somewhere near the airport, the possible number of fatalities on the ground that could occur in the event of an aircraft crash and the overall risk to society as a whole; that is, the societal risk of having the airport in its proposed location, were calculated for a number of scenarios.

Qualitative risk assessment was used to investigate such issues as adverse meteorological conditions, bird and bat strike, supply and storage of aircraft fuels, contaminated sites and bushfire risks.

16.1.2 Description of Risks Relating to Aircraft Crash, Meteorology, Defence Establishments and Other Major Risks

The NSW Department of Urban Affairs and Planning suggests that the individual fatality risk from a hazardous facility should not exceed a one-in-one million chance per year in residential areas (Department of Planning, 1990b). Applying this criterion to areas surrounding the airport, the estimated number of people in 2016 who would be exposed to a fatality risk greater than one-in-one million chance per year was 2,500 for Options A and B, and 9,000 for Option C.

The maximum risk of fatalities for each of the airport options was calculated to range from 2.2 fatalities every 100 years (for Option B - *Airport Operation 3*) to five fatalities every 100 years (for Option C - *Airport Operation 2*). The maximum risk for Option A was 2.5 fatalities every 100 years for *Airport Operation 1*.

The societal risks from the operation of any of the airport options would be lower than the existing societal risks for Sydney Airport.

The Draft EIS indicated that any one square kilometre of the Defence Establishment Orchard Hills would be exposed to an aircraft crash risk of one crash per 1,000 years under Option C and one crash per 100,000 years under Options A and B, and that the risk of an aircraft crash resulting from an accidental explosion at the facility would be approximately 8.6 in a billion chance per year.

Modern navigational aids, safety standards and operational practices mitigate the effect of adverse meteorological conditions, such as high intensity rainfall, thunderstorms, low cloud and fog, on aircraft operations.

No regular bird or bat movements would conflict with proposed runway orientations; therefore, in the absence of any waste disposal facilities that might attract birds to the vicinity of the airport site, the risk of bird or bat strike would not be significant.

The highest level of risk to water supply infrastructure (one crash per 1000 years per square kilometre) would be from Option C. This would affect the section of the Sydney Water Supply Pipeline connecting Warragamba Dam and Prospect Reservoir. Other water supply facilities, such as Prospect Reservoir and Warragamba Dam, would face aircraft crash risks of one crash per 10,000 years per square kilometre from Options A and B.

16.2 Summary of Hazard and Risk Issues

16.2.1 Issues Raised in Submissions

Methodology

Submissions from the NSW Government, Western Sydney Alliance and Goulburn City Council indicated that the methodology used to identify hazards and risks was inadequate. These inadequacies related to the calculation of existing risks and the analysis of existing data, among other issues. There were additional concerns expressed by various groups, including the Camden Residents' Action Group, Communities Against an Airport in Western Sydney and the Holroyd Association Against Airport Noise, that the documentation of the methodology was insufficient. Concerns were also expressed in submissions that insufficient data were used to establish the risk criteria.

Aircraft Movements

Submission, such as that prepared by the Western Sydney Alliance considered that using 245,000 aircraft movements rather than 360,000 aircraft movements per annum for analysis resulted in a significant underestimate of the estimated risk.

Crash Probability Location Distribution Analysis

Submissions from the Western Sydney Alliance and others raised concerns that there had been inadequate treatment of crash location probability distribution analysis, and that there was insufficient methodological documentation, in particular about the breakdown of aircraft movements by aircraft type, direction of destination and stage length.

Risk Contours

Campbelltown City Council, amongst others, suggested that there were anomalies that should be eliminated in the calculation of risk contours, indicated by a concentration of the one crash per 100,000 years contour, at a 20 kilometre distance from the runway thresholds. Holroyd Council and others also commented that there was no assessment of the risk of plane crash on approach and climbing (distances of up to 90 kilometres from the airport).

Uncertainties and Accuracy

Submissions from the Western Sydney Regional Organisation of Councils and others commented that uncertainties about the data and analysis methodology should be addressed and stated.

Fatalities Within Airport Boundaries

The risk of fatalities from aircraft crashes that occur within the airport boundaries was identified by the NSW Government and others as an issue that was not addressed in the Draft EIS.

Existing Risks Associated with Sydney Airport

A range of concerns regarding the implications of a Second Sydney Airport on existing risks associated with Sydney Airport were raised in submissions. These concerns included comments from the Western Sydney Alliance that there would be an increase in risk to areas in the proximity of Sydney Airport due to restrictions in the use of runways and more confined air space, and that this was not assessed. Goulburn City Council and Camden Council noted that there was a lack of consideration of interaction of air traffic from other regional airports, as well as Sydney Airport. While the Western Sydney Alliance and others, such as the Camden Residents Action Group, expressed concern that all known mechanisms of loss were not considered in the quantification of risk and that treatment of existing risks associated with Sydney Airport was inadequate.

Comparative Risks with Other Airports and Losses Other Than Fatalities

The lack of a risk assessment comparing the proposed airport with other airports outside the Sydney basin was also raised as an issue in submissions. An additional issue raised in submissions concerned addressing loss in terms other than fatalities. It was considered that the Draft EIS failed to examine the potential of an aircraft crashing leading to catastrophic loss in economic and societal terms, rather than just loss of life. Examples such as disruption to power or water supplies and the flow-on economic effects were specifically cited.

Dangerous Goods

Liverpool City Council and others expressed concern that there was inadequate consideration of fuel storage, transport of fuel by road tanker and fuel handling issues. Wollondilly Shire Council and others noted that there was no consideration of hazards arising from the use of other dangerous goods, such as compressed natural and liquefied petroleum gases, other than aviation fuel stored or handled at the airport during construction and operation.

Aircraft Crashes into Major or Sensitive Facilities

Schools, Hospitals, Child-care and Aged Care Facilities

The Western Sydney Alliance, groups such as Communities Against an Airport in Western Sydney, and others, expressed concern that the location of schools and hospitals, which have lower suggested risk criteria than residential areas, was not taken into account and also pointed out that there was no specific consideration of the impact of a crash into hospitals, aged care centres or educational and community facilities.

Major Water, Gas and Electricity Infrastructure

The NSW Government and others stated that there was inadequate discussion of the impact of a crash (including consequences for Sydney) into major water infrastructure (dams and pipelines) and of the impact of a crash (including consequences for Sydney power supply) into major energy infrastructure such as power lines, major electrical substations or the Moomba to Sydney natural gas pipeline.

The Western Sydney Alliance and others stated that there was a lack of consideration of the impact of a crash into the chlorination plant at the Prospect Reservoir Complex and they suggested that such an incident would have serious health effects on surrounding residential areas.

Defence Establishment Orchard Hills

The Western Sydney Regional Organisation of Councils, Goulburn City Council and others stated that insufficient consideration had been given to the impact of a crash into the Defence Establishment communications network and ordinance depot at Orchard Hills. Concern was expressed that such an event would result in a significantly increased mass explosion hazard, should a fully laden aircraft crash.

External Risk Factors

Communities Against an Airport in Western Sydney and others were concerned that insufficient treatment was given to the effect of bird and bat strike on crash rates, in addition to the consequences of adverse weather, seismic activity, burn-offs and bushfires, and topography. It was suggested that only local bushfires were considered and that smoke plumes at 1,000 to 3,000 metres that had been produced in December 1997 over a two-week period, and which were typical of worst-case conditions, should have been assessed.

Emergency Plans and Security Issues

The NSW State Government and others suggested that there was a lack of discussion about emergency plans and security issues.

Operational Risks and Hazards

The Western Sydney Alliance and others suggested that there was no consideration of road traffic accidents (off-site) resulting from increased traffic to and from the airport.

Other Hazard and Risk Issues

A lack of assessment of construction hazards to workers and the public was noted by Liverpool City Council and others. Concern was also expressed about the effects of electromagnetic radiation from radar towers.

It was suggested by Camden Council that there was a failure to consider the effect of changes in the perception of risk on the health of people. Liverpool City Council stated that an assessment of hazards and risks to flora and fauna should also have been undertaken.

16.2.2 Issues Raised by the Auditor

The Auditor concluded that most areas of the hazard and risk study were appropriate, and that issues such as risks from bird and bat strike, fires, overflying of the Defence Establishment Orchard Hills, contaminated sites and fuel supply and storage were adequately addressed. However, the Auditor raised concerns about the analysis being based on 245,000 rather than 360,000 aircraft movements per annum and that fatalities within the airport boundaries were not analysed. The Auditor also noted that there was no discussion of the effects of airport operations on other airports in Sydney, and that there was only cursory discussion of adverse meteorology, seismic activity, emergency plans and security issues. It was also mentioned by the Auditor that the Draft EIS presented results in such a way as to imply a higher level of accuracy than was warranted.

16.3 Response to Hazards and Risks Issues

16.3.1 Methodology

Aircraft Movements

The forecast annual number of aircraft movements to and from the Second Sydney Airport was an important input into the risk model. The rationale for basing all the assessments undertaken for the Draft EIS on 245,000 rather than 360,000 aircraft movements was given in Section 1.3 of the Draft EIS. More detailed information on these aircraft movements was also presented in *Technical Paper No. 3*. This included:

- allocation of aircraft operations to runway directions;
- allocation of flight paths;
- breakdowns of international movements and domestic movements (day and night);
- forecasts of aircraft movements per year by aircraft type;
- percentage of aircraft movements by origin and destination; and
- percentages of aircraft movements by stage length.

The same data set used for noise analysis was used for the hazard and risk assessment of aircraft crashes. Further information is available in the *Second Sydney Airport Planning and Design Annual Aircraft Movements Analysis Report* (Second Sydney Airport Planners, 1997b).

Crash Location Probability Distribution Analysis

Some submissions suggested that there had been inadequate treatment of crash location probability distribution analysis and insufficient methodological documentation. The methodology used for the quantitative aircraft crash risk assessment was summarised in the Draft EIS and documented in *Technical Paper No. 10*. The data sets and computer program were complex, and could not be included in the Draft EIS or *Technical Paper No. 10*. Permission to publish certain reference material could not be obtained from the copyright holders.

Risk Contours

Questions were raised about the methodology used to carry out risk modelling. For example, that the end points of risk contours were joined by artificial loops and that in fact the contours should not have been closed. It was also noted that a large number of similar contours were situated 20 kilometres from the runway thresholds, and the question was also raised as to why the contours were not extended to a distance of 90 kilometres from the airport.

Historical data shows that crash rates applicable to aircraft in the vicinity of an airport (during take-off/initial climb and landing/final approach) are much higher than those that apply during other phases of the flights. A crash during 20 kilometres of flight distance from an airport was considered to be in the 'vicinity' of the airport for risk modelling purposes. The end points of the contours generated by the computer model represented the limits of an area defined as being in the vicinity of the airport, beyond which the risks were substantially lower. Contours showed the approximate locations of certain risk levels, but should not have been taken to indicate sharp changes in risk levels.

Uncertainties and Accuracy

Risk contours presented in the Draft EIS were intended to show the upper bound or most pessimistic estimate of levels of risk that could occur, based on a number of conservative assumptions, which were detailed in *Technical Paper No. 10*. Crash rates used for the study were generally based on Australian air safety records, which contained data on the number of fatalities associated with aircraft crashes, over a number of years. Data from the United States was used for high capacity air transport because the number of aircraft crashes with fatalities that occurred in Australia was too low to enable meaningful crash rates to be calculated. In recognition of the uncertainties associated with the risk modelling work, the estimated number of people located within each one chance-in-one million risk contour was rounded to the nearest 500.

Another issue related to uncertainty was the potential for risk levels to change, depending on variations in modes of operation and flight paths. For the Draft EIS, three different modes of airport operation were investigated for each airport option, when the airport is handling 10 million and 30 million passengers per year. For the mode which resulted in maximum risk when the airport is handling 30 million passengers per year, that is, *Airport Operation 1, 3* and *2* for Options A, B and C respectively, risk contours were presented in the Draft EIS and *Technical Paper No. 10*. Each mode of operation resulted in slightly different levels of crash risk and fatality risk being experienced in the various areas around the airport site.

The decision to show only one mode was based on the premise that flight paths could change over time and that the case shown was representative. Should flight paths change as a result of government policy or for operational reasons, risk levels would also change in the areas surrounding the airport. However, it was generally the case that higher levels of risk occurred in areas along extended runway centre lines within 20 kilometres of the airport options.

Should the flight paths change from those depicted in this EIS, the level of risk along the modified flight paths would remain similar to that described in Chapter 19 of the Draft EIS. Changes to flight paths would not result in significant increases in risk levels in those areas situated further than 20 kilometres from the airport.

Fatalities Within Airport Boundaries

Another issue raised in submissions was that of fatalities associated with crashes within the airport boundaries which were not addressed in the Draft EIS. Aircraft accidents or the effects of aircraft accidents that could occur at the airport were considered to present a low risk to populations in the area outside the airport perimeter. Based on analysis undertaken for the *Proposed Third Runway Sydney (Kingsford Smith) Airport Draft Environmental Impact Statement* (Kinhill, 1990) which examined estimated radiated heat intensities for aircraft collisions occurring during ground movements, it was concluded that:

> *the radius of the area seriously affected by collisions involving general aviation aircraft, even if colliding at speed, would almost always be confined to the airport. Collisions involving scheduled aircraft could, depending on the location of the collision and the speed of the aircraft at the time, affect people and property beyond the airport boundary (Kinhill, 1990, 25-4).*

While the probability of an aircraft crash during take-off and landing would be highest closer to the airport, associated on-ground crash fatality risks would actually be low within the airport site; especially near the ends of the runways, where a crash would be most likely to occur. Nonetheless, airport employees would have greater exposure to totality risk than the general public. Even if a crash occurred closer to the terminal, the level of risk to the general public would be relatively low. The *Building Code of Australia*, and the *NFPA415 (Standard on Airport Terminal Buildings, Fuelling Ramp Drainage and Loading Walkways)*, an internationally recognised fire code pertaining to construction of airport facilities, specifies safe distances from runways, where accidents would be most likely to occur; buildings are designed in accordance with these standards to provide increased fire protection for such a situation.

Existing Risks Associated with Sydney Airport

Comments were made that there was inadequate treatment of existing risks associated with Sydney Airport, implying that at any location the level of risk of aircraft crashes from each airport would be additive. This would not be the case, as each airport would have its own defined airspace. Interaction between the flight paths would not result in an increased level of risk, as vertical and horizontal separation would be maintained as part of air traffic control procedures. This is discussed in *Chapter 20* of this Supplement.

Comparative Risks with Other Airports

Comparison of the risk assessment results with results for overseas airports was suggested as a way of assessing the risks associated with the Second Sydney Airport. Hazard and risk studies of Manchester Airport's proposed second runway and Schipol Airport in Amsterdam were used for the Draft EIS to provide a comparison of aircraft crash rates with that adopted for the Second Sydney Airport. However, the differences in air traffic volumes and population distributions between these airports and the Second Sydney Airport meant that the results were not directly comparable. In the Draft EIS, risks for the Second Sydney Airport options were compared with a societal risk curve generated for Sydney Airport. It was reasoned that a local airport, such as Sydney Airport, which would have similar air traffic volumes to the proposed Second Sydney Airport, would provide a more valid comparison of risk levels than overseas airports.

Losses Other Than Fatalities

A failure to address loss in terms other than fatalities was noted in submissions. Of especial concern were such issues as disruption to power or water supplies and the flow-on economic effects of such disruptions. Risk levels were assessed in terms of immediate human fatalities on the ground. While consequences of aircraft accidents would include injuries and property damage, comprehensive quantitative data on impacts other than fatalities was not available. It could only be assumed that for every fatality recorded, there would have been a significant number of injuries that were not recorded.

Impacts of aircraft crashes on water supply infrastructure were discussed in the Draft EIS. Further details, and a discussion of potential impacts of aircraft crashes on power supplies, are provided in *Section 16.3.2* of this Chapter. Detailed analysis of flow-on economic effects is beyond the scope of the EIS because of the wide range of potential scenarios and because such an analysis would involve an unacceptable degree of speculation.

Risks to Other Areas

It was commented that there would be an increase in risk to areas in the proximity of Sydney Airport due to the restrictions in the use of its runways and more confined airspace. Possible interaction with the Sydney Airport flight paths has been investigated by Airservices Australia and is discussed in *Chapter 20* of this Supplement.

16.3.2 Impacts on Major or Sensitive Facilities

Schools, Hospitals, Child-care and Aged Care Facilities

According to guidelines issued by the NSW Department of Urban Affairs and Planning (Department of Planning, 1990b) hospitals, schools, child-care facilities and aged care facilities should not be exposed to individual fatality risk levels in excess of 0.5 in one million chance of a fatality each year.

Individual fatality risk contours corresponding to 0.5 chance in one million per year of a fatality were plotted for the airport operation mode with highest risk, when the airport would be handling 30 million passengers per year. Hospitals, child care facilities, aged care facilities and schools within the contours were identified for each airport option. The facilities contained within the 0.5 chance in one million of a fatality per year contours are shown in *Table 16.1* and the contours are shown in *Figures 16.1* to *16.3*. In summary, the following were contained within these contours:

- Option A: one child-care centre and four schools;
- Option B: two child-care centres and two schools; and
- Option C: four child-care centres and seven schools.

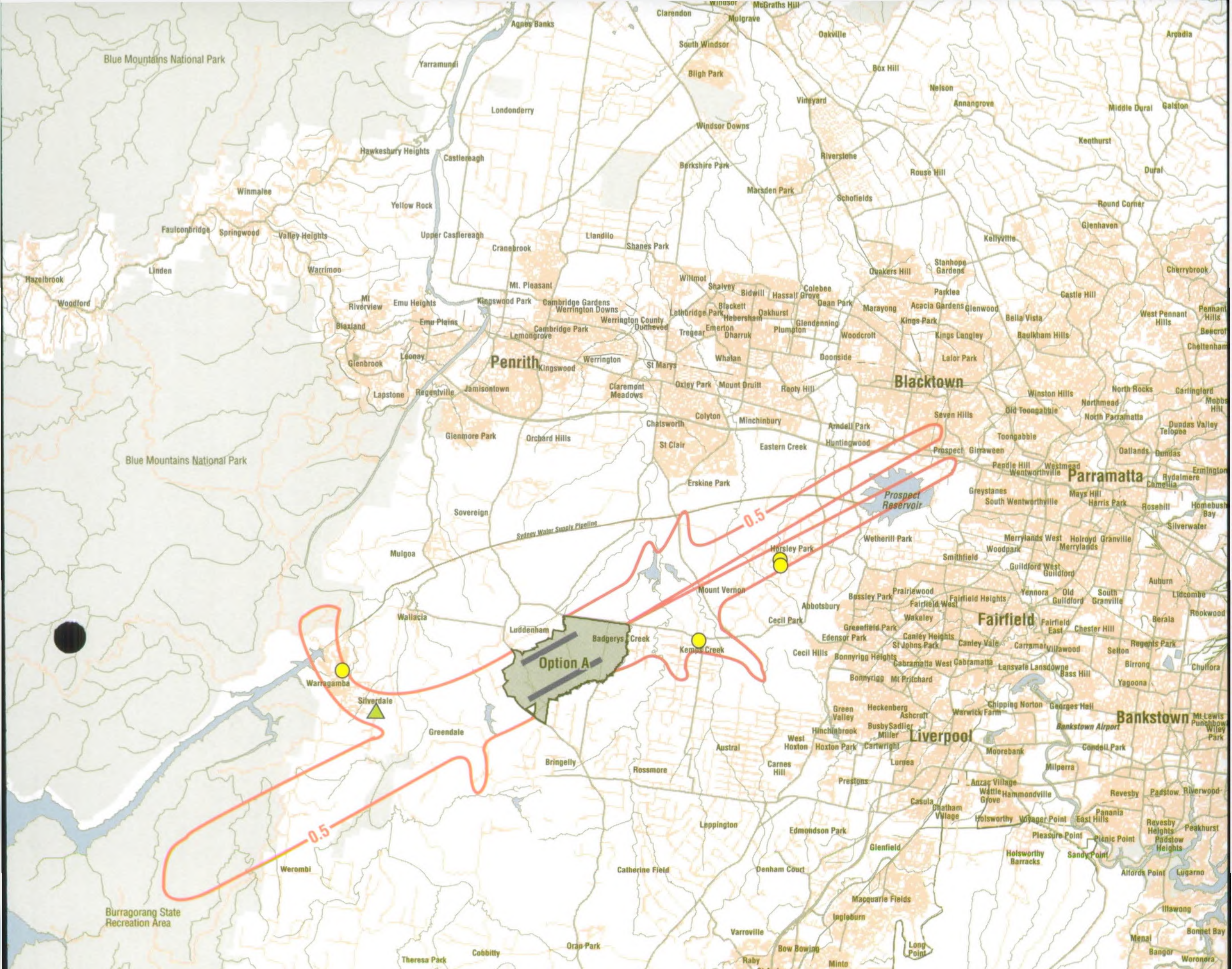
Table 16.1 Sensitive Uses Exposed to Facility Risk Greater Than 0.5 Chance in One Million Per Year[1] with Second Sydney Airport Operating at 30 Million Passengers Per Year

Facility	Option A	Option B	Option C
Childcare Facilities			
Silverdale Childcare Centre, Silverdale	●	●	-
Luddenham Kindergarten, Luddenham	-	●	-
St Marys Kindergarten, St Marys	-	-	●
Kingswood Preschool, Kingswood	-	-	●
Yoorami Childcare Centre, Werrington	-	-	●
Childcare Centre (name unknown) Werrington County	-	-	●
Schools			
Horsley Public School, Horsley Park	●	-	-
Marion Primary School, Horsley Park	●	●	-
Llandillo Public School, Llandillo	-	-	●
Kemps Creek Public School, Kemps Creek	●	●	-
Bringelly Public School, Bringelly	-	-	●
Cobbity Public School, Cobbity	-	-	●
St Marys Public School, St Marys		-	●
Warragamba Dam Public School	●	-	-
Werrington Public School, Werrington	-	-	●
Werrington County Public School, Werrington County	-	-	●
St Marys High School, St Marys	-	-	●

Note: 1. No hospitals or aged care facilities were identified within 0.5 chance in one million of a fatality per year contours.

Major Water Infrastructure

Sydney Water was consulted and provided an assessment of the worst-case consequences of aircraft crashes into major water infrastructure.



Risk of fatality per year due to aircraft crash (0.5 chances in 1 million per year fatality risk) —0.5—

Child care

Primary school

Urban areas (indicated by local roads)

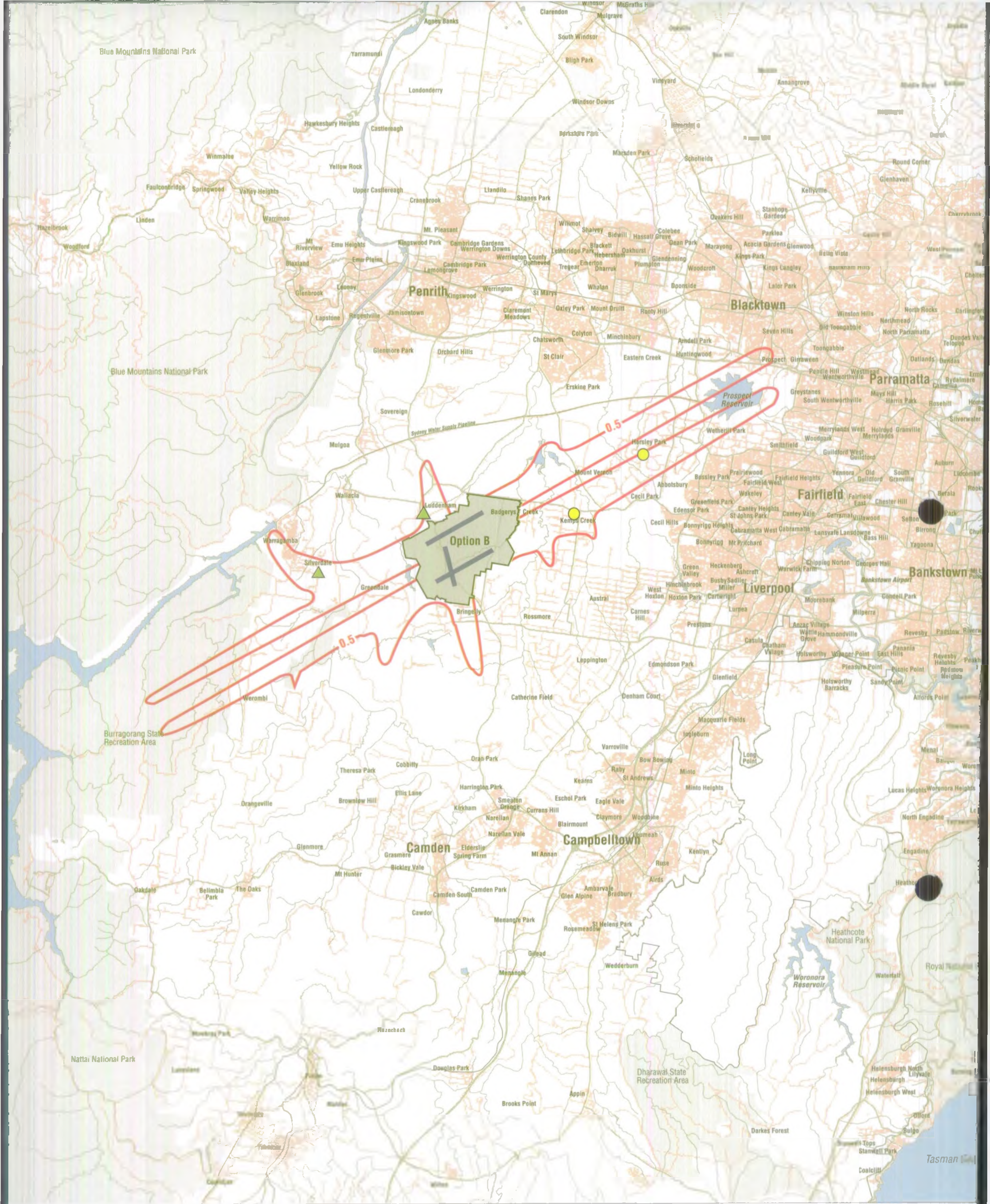
Figure 16.1

Individual Fatality Risk Contours for Option A

Note: Based on Air Traffic Forecast 3 in 2016 and Airport Operation 1. This type of operation would have the highest overall risk of fatality. Other airport operations have different risk profiles.

TN MN

0Km 10Km

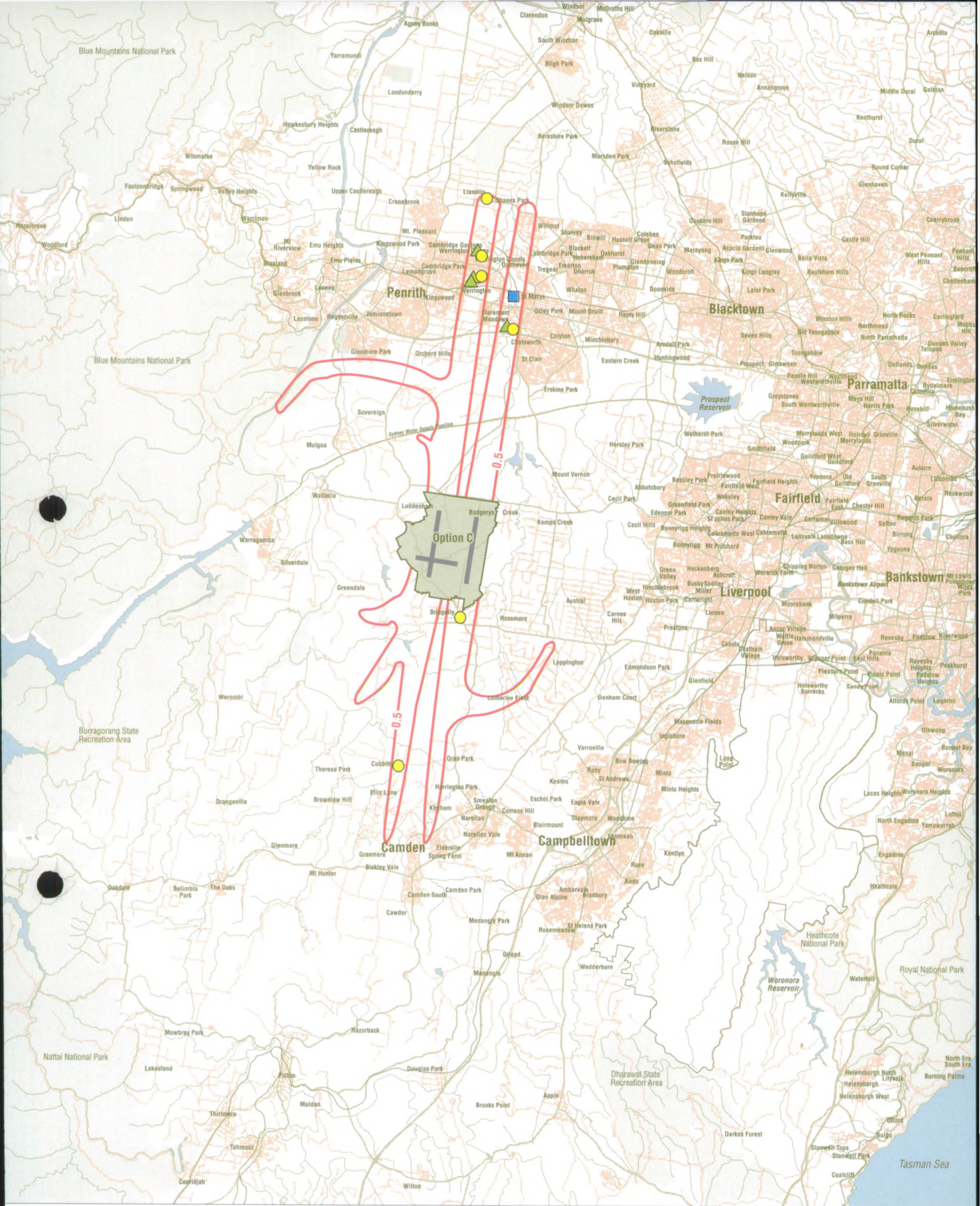


Risk of fatality per year due to aircraft crash (0.5 chances in 1 million per year fatality risk) — 0.5 —
Child care
Primary school
Urban areas (indicated by local roads)

Figure 16.2
Individual Fatality Risk Contour for Option B

Note: Based on Air Traffic Forecast 3 in 2016 and Airport Operation 3. This type of operation would have the highest overall risk of fatality. Other airport operations have different risk profiles.

TN MN N 0Km 10Km



Risk of fatality per year due to aircraft crash (0.5 chances in 1 million per year fatality risk) —0.5—

Child care

Primary school

Secondary school

Urban areas (indicated by local roads)

Figure 16.3

Individual Fatality Risk Contours for Option C

Note: Based on Air Traffic Forecast 3 in 2016 and Airport Operation 2. This type of operation would have the highest overall risk of fatality. Other airport operations have different risk profiles.

TN MN N

0Km 10Km

Table 16.2 summarises risks and worst-case consequences of crashes into Sydney Water facilities.

Table 16.2 Airport Useability for Different Aircraft Types

Incident	Estimated Risk of Crash	Worst-case Consequence of Aircraft Crash
Aircraft Crash into Warragamba Dam Gates	• Greater than one crash per 10,000 years per square kilometre for Options A and B. • Option C outside estimated minimum risk of aircraft crashes.	• Significant loss of water supply. • Flooding and downstream impacts; application of water restrictions. • 1.6 million water users affected.
Aircraft Crash into Lake Burragorang and Catchment	• Greater than one crash per 10,000 years per square kilometre for Options A and B. • Option C outside estimated minimum risk of aircraft crashes.	• Contamination of water supply from chemicals and bush fires. • Potential impacts on structures and ecology of catchment.
Aircraft Crash into Sydney Water Supply Pipeline	• Greater than one crash per 10,000 years per square kilometre for Options A and B. • Option C outside estimated minimum risk of aircraft crashes.	• Significant interruptions to service. • 1.3 million users affected. • Requirements for alternative supply via Cordeaux, Cataract, Nepean and Prospects Dam.
Aircraft Crash into Prospect Reservoir Complex	• Greater than one crash per 10,000 years per square kilometre for Options A and B. • Option C outside estimated minimum risk of aircraft crashes.	• Flooding and downstream impacts. • Loss of capability to filter and transfer water. • Potential for chlorine gas release (maximum 80 tonnes). • 1.3 million water users affected. • Requirements for alternative supply via Cordeaux, Cataract, Nepean and Prospects Dam.
Aircraft Crash into Orchard Hills Water Filtration Plant	• Greater than one crash per 10,000 years per square kilometre for Options A and B. • Greater than one crash per 10,000 years for Option C.	• Loss of capability to filter water. • 200,00 water users affected. • Potential for chlorine gas release (maximum four tonnes).
Aircraft Crash into Sewage Treatment Plants	• No assessment made in Draft EIS.	• Health and environmental impacts.

Source: Sydney Water, 1998, pers. comm.
Note: 1. A notional value of 1 x 10^{-6} per year has been assumed for the Probable Maximum Flood in other studies (Pearce, 1994).

Major Electricity Infrastructure

Transgrid and Integral Energy were consulted during preparation of this Supplement about potential impacts on electrical infrastructure of an aircraft crash into major infrastructure such as transmission lines or major electrical substations. They advised that there is a large concentration of major electrical infrastructure in western Sydney, largely as a result of the area being sparsely populated when the NSW network was developed (Transgrid, 1999, *pers. comm.*, 28 January).

Major infrastructure falls into there categories:

- single transmission line;
- two or more sets of transmission lines closely coupled together; and
- major substations.

If an aircraft was to crash into a single transmission line, power would automatically be diverted to other lines. Electricity would continue to be supplied, possibly with less efficiency, until repairs were made. However, blackouts could affect limited geographic areas until emergency towers and lines were erected.

The impact of an aircraft crash affecting more than one transmission line would be more severe. In the worst-case, widespread disruption to electricity supplies could be expected over some hours, followed by progressive supply restoration as partial repairs were completed. In severe cases, rationing of power supplies in Sydney and other parts of NSW might be necessary over several days while emergency structures were erected.

The impact of an accident at a major substation would depend on the nature and extent of physical damage. Initial effects could be similar to worst-case impacts on multiple transmission lines, but the repair time could be much longer, resulting from the probability that equipment might not be readily available, and may have to be manufactured or imported. Arrangements would need to be made to bypass affected infrastructure, and partially restore supplies as soon as possible. Full restoration of the facilities, however, could take months or years (Transgrid, 1999, *pers. comm.*, 28 January).

Nonetheless, it is important to put the level of risk in context. Only two substations, under Options A and B, are located between the one crash in 10,000 years per square kilometre and one crash in 100,000 years per square kilometre contour. In Option C no substations are located within the one crash per 100,000 years per square kilometre contour. If it is assumed that the most vulnerable part of these substations measure 100 metres by 100 metres, the frequency of aircraft crash on that part would be between one crash in one million and one crash in 10 million years.

The frequency of aircraft crashes on energy infrastructure outside the one chance in 100,000 years per square kilometre contour would be even lower. It should also be noted that the contours refer to crashes of aircraft of all sizes. In *Technical Paper No. 10*, it was reported that small aircraft were more than four times more likely to crash around the Second Sydney Airport than larger aircraft. Therefore, the frequency of large aircraft crashes, which have a greater potential for damage, would be only a small proportion of the total frequency represented by the contours.

A number of major electricity transmission lines traverse the areas within the one crash per 100,000 year or greater per square kilometre contour. The predicted frequency of aircraft crashes for each kilometre of the transmission line would vary, depending on which contour the transmission line traversed. It is expected, however, that the predicted maximum frequency of aircraft crashes per square kilometre for this infrastructure would be similar to that estimated in *Technical Paper No. 10* for the Sydney Water Supply Pipeline; that is, one crash per 1,000 years per square kilometre. Actual risk levels for any section of the line that would be affected by a single aircraft crash would be less than this because the projected area of such a section of transmission lines and towers would be far less than one square kilometre.

Major Gas Infrastructure

Sections of the Moomba to Sydney gas pipeline and ethane pipeline are contained within the one crash per 100,000 years per square kilometre contours, as shown in the Draft EIS. The actual risk to a given section of pipeline would be lower than this because its projected area would probably be far less than one square kilometre. This risk would be further reduced by the fact that they are buried rather than above-ground pipelines. In any case, if any damage was to occur, valves in the pipelines would automatically isolate the gas supply. Recent experience in Victoria suggests that repairs to the pipelines would be likely to take several weeks, in the event of major damage, and gas supplies could be severely restricted during this period.

Defence Establishment Orchard Hills

Risks associated with overflying the Defence Establishment Orchard Hills were addressed in detail in *Technical Paper No. 10*.

16.3.3 Dangerous Goods

Transport of Fuel by Road

If a pipeline was not available in the initial years of operation of the Second Sydney Airport, Jet A1 aviation fuel would need to be supplied by road, with the fuel most likely to be supplied from the Shell Clyde refinery near Parramatta. Approximately 2.0 to 2.5 million litres of Jet-A1 fuel, plus 30,000 to 35,000 litres of AvGas, would be needed daily to service an airport of 10 million passengers per year capacity.

Supplying this volume of Jet A1 fuel would require some 40 to 65 tanker movements per day, depending on whether they were 60,000 litre B-Doubles or 40,000 litre articulated tankers. Approximately one additional tanker movement per day would be required for AvGas, although this would be supplied directly from the Shell refinery at Geelong in Victoria, and AvGas tankers would use different routes than the Jet A1 tankers, for example, the Hume Highway.

One route nominated in *Technical Paper No. 13* for Jet A1 fuel transportation to the airport from Clyde Refinery (or the nearby Sydney Metropolitan Terminal) would be for tankers to proceed south along Silverwater Road, then go along the M4 Motorway, turn off onto Wallgrove Road and then proceed along Elizabeth Drive to the airport. A second possible transport route would be to use Parramatta Road and the Great Western Highway, rather than the M4 Motorway.

Background traffic levels forecast for 2006 for the roads on the two nominated routes range from a high of 173,000 (for the portion of the most easterly part of the M4 in the route) to a low of some 24,000 (for the Great Western Highway east of Wallgrove Road). Wallgrove Road is forecast to carry 46,000 vehicles per day in 2006, while Elizabeth Drive is forecast to carry approximately 30,000 vehicles per day in that year. Assuming that smaller tankers were used, a maximum of 65 tankers per day would result in approximately 24,000 fuel tanker movements per year to service the airport, in 2006. The contribution to all traffic from the fuel-laden vehicle movements is quite low, in the range of 0.02 to 0.37 percent of the existing traffic.

No specific heavy vehicle count was made on the route sectors, but generic heavy vehicle distribution based on Sydney traffic has shown some six percent of overall main road traffic to be in the four tonne-and-over class (PPK Environment & Infrastructure, in preparation). Thus the extra aviation fuel traffic associated with the Second Sydney Airport along the nominated roads would be of the order of 0.4 to five percent of heavy vehicle traffic.

Although specific data were also not available on dangerous goods movements or on the proportion of dangerous goods movements which were flammable liquid loads, it can be inferred from other surveys and studies in NSW and overseas that approximately one to two percent of heavy vehicle traffic is likely to carry dangerous goods. Of these vehicles, somewhere around 55 to 75 percent could be expected to carry Class 3 Flammable Liquid Loads (Roads and Traffic Authority, 1994). *Table 16.3* shows the potential increases in flammable goods traffic as a result of the transport of airport aviation fuel.

Table 16.3 Potential Increases in Flammable Goods Traffic Due to Aviation Fuel Tank

Route	Projected 2006 Traffic (Without Airport Fuel)	Estimated[1] Class 3 Flammable Goods Vehicles (Without Airport Fuel)	Estimated Class 3 Flammable Goods Vehicles (Including Airport Fuel)	Approx Increase in Class 3 Flammable Goods Vehicles Due to Airport Fuel[2] (percent)
	Vehicles Per Day			
M4	173,000	152	217	40
Great Western Highway	24,000	21	86	300
Wallgrove Road	46,000	40	105	160
Elizabeth Drive	30,000	26	91	250

Notes:
1. *Assuming two percent of heavy vehicles carry dangerous goods and 75 percent of dangerous goods vehicles carry Class 3 Flammable goods.*
2. *Assuming 65 vehicles per day.*

From the estimates shown in *Table 16.3*, it can be seen that the increase in flammable goods traffic is most significant for the least-busy segments of road. However, Elizabeth Drive is likely to be upgraded to a four-lane divided road by 2006, and the Western Sydney Orbital (which would be used instead of Wallgrove Road) is likely to be available in the early years of operation of the airport. These high capacity, motorway standard roads would reduce the traffic impact of additional fuel tankers on these routes to a minimum level.

There is a complex relationship between crash rates and a range of factors such as road configurations and geometry, intersections, traffic numbers and speeds. For example, while crash rates might increase with traffic congestion, the incidence of the relevant high-momentum crashes may go down due to lower speeds.

Generic data for accident rates per tanker kilometre for various overseas countries on urban roads range from a high of 7.7×10^{-6} in the United States, to a low of 0.5×10^{-6} for urban roads in the Netherlands. A dangerous goods truck crash rate of 0.6×10^{-6} per vehicle kilometre was derived for the M5 East Motorway (Roads and Traffic Authority, 1994) using actual data for the sections of the M5 Motorway then operating, with the highest truck crash rate (based on actual crash data) was 5×10^{-6} per vehicle kilometre for the worst section of suburban road identified. Overall crash frequencies were derived for the Great Western Highway and the M4 routes by applying these two rates.

In a worst-case, neither Elizabeth Drive not the Western Sydney Orbital would be upgraded by the time that the airport reached 10 million passengers per year capacity. In this situation, for the M4 route, there would be approximately 20 kilometres of road on which motorway crash rates would apply and 20 kilometres with urban road crash rates. Conversely, for the Great Western Highway route, there would be approximately 40 kilometres of roadway with an urban road crash rate.

Based on these rates and 65 movements per day of Jet-A1 fuel (24,000 per year) approximately three crashes per year could be expected over the whole of the M4 route, while on the Great Western Highway route, five crashes per year could occur. It would be likely that many of these crashes would be minor, that is, not leading to any release of fuel or to a fire. Furthermore, these crash rate estimates should be treated with caution, as, in addition to the generalised nature of the estimates used to derive them, there is some evidence that the more recent performance of fuel tankers has been substantially better than for general truck traffic and thus crash rates may be substantially better than the estimates suggest. Better control over the condition of tankers, improved driver training and attention to driver fatigue are among the factors believed to have been contributing to improved performance.

As there is only one AvGas tanker movement daily, compared with 65 Jet-A1 movements, and as this tanker would use a different route than the other tankers, it was considered appropriate to base consequence analysis on using Jet-A1 as the representative material. Jet-A1 is essentially a highly refined grade of kerosene. While it is a Class 3 flammable liquid, it is significantly less volatile than petrol and has a significantly higher flash point (greater than 38 degrees compared with approximately minus 43 degrees for petrol). Jet-A1 burns vigorously if ignited but is significantly harder to ignite at ambient temperatures, less likely to form an explosive mix in confined spaces and burns with a lower heat emission rate.

Essentially there are two types of incidents of concern:

- crash and spillage with or without ignition; and
- fire, involving the load without prior crash.

It should be recognised that not all crashes would result in loss of containment and even where there is a loss of containment, the fuel would not be ignited in all cases. Generally, a roll-over or relatively high momentum crash would be required for loss of containment. If a fire was to occur, the main hazard to people and property would be direct harm from flames and/or harm from radiant heat. The fire could be in the form of:

- tanker fire;
- a pool fire at or in the vicinity of the tanker; and
- a fire which flowed down drainage lines either burning as it went or collecting at a point some distance from the crash site and burning as a pool fire in that location.

The fire could impact on people in surrounding lands or on other road users. It is very difficult to assess the consequences of liquid fires which flow from the crash site as they vary markedly from case to case. However, the hazards associated with pool fires can be addressed by selection of representative scenarios.

For the assessment for the M5 East Motorway (Roads and Traffic Authority, 1994), after review of the road configurations and geometry it was considered that for a 40,000 litre tanker, a pool of about 47 by 19 metres was a reasonably conservative representative case. Using these pool dimensions and kerosene (instead of hexane, which was used as a representative Class 3 Flammable Liquid in the M5 Study), the consequence distance to the level which is considered to lead to fatality on prolonged exposure was found to be some 27 metres from the centre of the pool or 18 metres beyond the edge of the pool.

This representative worst-case incident footprint is not large and a greater part of the footprint would fall on the roadway. In some instances the footprint would extend into land on either side of the road. In most instances, however, there would be opportunities for individuals taking evasive action; that is, sheltering or moving away. Even with immediate ignition there would be a short period of time before the pool reached maximum size and the fire escalated to full intensity. With delayed ignition, the period would be even longer. The main fatality risk for such events would therefore be to other road users rather than to people on surrounding land.

Based on this analysis it is likely that the proposed transportation of aviation fuel in tankers would increase the risk of a truck crashing for all parts of the route due to the increased volume of dangerous goods traffic. The analysis suggests that use of the M4 Motorway would be preferable to the Great Western Highway because of comparison of crash rates for the M4 route (2.9) and the Great Western Highway route (5.1), as well as for reasons of greater separation from surrounding land and other road users. More detailed and comprehensive analysis would be required to confirm least-risk routes for road transport options. It should be noted that the use of a pipeline for the transport of fuel would be a lower risk option than for any of the road tanker options.

Dangerous Goods Other Than Fuel

Issues relating to storage and use of dangerous goods other than aircraft fuel, particularly compressed natural gas and liquefied petroleum gas, were raised in submissions on the Draft EIS. Compressed natural gas and liquefied petroleum gas could be used to power ground support fleet at the Second Sydney Airport even though current information indicates that this is not the case at Sydney Airport.

Compressed natural gas and liquefied petroleum gas are cleaner burning fuels than diesel or petroleum, however they are flammable gases. Therefore certain precautions would be required for the transportation, storage and handling of these gases to minimise the risk of explosion or fire.

Both gases are generally transported under pressure as a liquid in tankers and cylinders and can be stored on-site in purpose built above- or below-ground tank/s and/or cylinders.

Storage of dangerous goods at the airport is an occupational health and safety matter and therefore, under *Section 1.04* of the *Airports (Environment Protection) Regulations 1997*, issues regarding occupational health and safety would be regulated by State law.

The *NSW Dangerous Goods Act 1975* requires a licence to be held for the storage of certain quantities of dangerous goods. A licence would need to be obtained from NSW WorkCover Authority for the storage of the following quantities of liquefied petroleum gas and compressed natural gas at the airport:

- 300 kilograms of liquefied flammable gas, such as liquefied petroleum gas, when connected for use (for example, to a stove, heater);
- 150 kilograms of liquefied flammable gas not connected for use and not for sale (for example, reserve cylinders for later use, or cylinders for filling forklift cylinders);
- 25 kilograms of liquefied flammable gas kept for sale in containers not exceeding six kilograms of gas;
- 60 cubic metres of compressed flammable gas (for example, acetylene, hydrogen) that is, up to eight 'G' size cylinders of seven cubic metres each; and

- 2,500 kilograms of liquefied flammable gas kept outside a city or town and at least 30 metres from any public place or protected work, and kept for use on the premises.

A licence is not required for aerosols when classified as Class 2.1 or 2.2, or for any other quantity of liquefied flammable gas kept in disposable containers (that is, containers not exceeding one litre and not refillable).

There are currently two standards for the storage and handling of liquefied petroleum gas: the *Australian/New Zealand Standard 1596:1997 Storage and Handling of Liquefied Petroleum Gas* and the *Australian Standard 3961 - 1991 Liquefied Natural Gas - Storage and Handling*. Both standards specify the components and application of the system, including control of gas outflow, safety valves, piping and vaporises, design and installation of tanks, cylinder filling installations and systems, automotive filling installations, operations and fire safety.

The *NSW Dangerous Goods Act, 1975* also requires a licence to be obtained from the Environment Protection Authority, for the transport of certain quantities of flammable gases. Requirements for road transport of flammable gases are detailed in the *Australian Dangerous Goods Code - 6th Edition, 1998* and include:

- carrier accreditation;
- design and construction of vehicles;
- approval and maintenance of tank vehicles and bulk containers;
- insurance;
- marking of vehicles and containers;
- emergency procedure guides;
- safety equipment;
- stowage of dangerous goods;
- precautions during use of road vehicles;
- control of ignition sources;
- emergencies; and
- driver instruction.

The driver of a tanker transporting flammable gases must also hold a valid licence obtained from the Environment Protection Authority. Drivers must successfully complete an approved Bulk Dangerous Goods Driver Training course as part of their application for a licence.

Other dangerous goods that could be stored or used at the Second Sydney Airport would include lawn mower fuel, pesticides, detergents and cleaning agents. Information from Sydney Airport suggests that quantities stored would not be large and that any storage would be in accordance with *NSW Dangerous Goods Regulations*.

At Sydney Airport, there are also a number of underground fuel tanks for petrol and diesel, for motor vehicle and truck/machinery use respectively. Underground fuel tanks also service emergency power generation units. These could also exist at the Second Sydney Airport. The latest applicable NSW Standards would be applied to storage and handling of these fuels.

16.3.4 External Risk Factors

Bird and Bat Strike

As reported in the Draft EIS, there are no known defined regular significant bird or bat movements which might conflict with any of the runway orientations at Badgerys Creek and it was concluded that bird and bat strike hazards would not be significant. There are no significant differences between the three airport options in terms of bird and bat strike risks, although problems could occur in future if waste disposal facilities or water bodies that attract birds are established in the vicinity of the sites of the airport options. It should be noted that the stormwater detention basins described in *Chapter 13* of this Supplement would be designed to discourage birds.

Measures should be taken to ensure that putrescible waste disposal facilities are not established in the vicinity of the airport site. Water quality control and detention ponds associated with the airport stormwater management system would also be designed and sited so that they cannot support bird life. It should be noted that crash rates adopted for the Draft EIS aircraft crash risk modelling work already took into account external factors such as bird and bat strikes.

Adverse Meteorology

The likely prevalence of adverse meteorological conditions which would potentially affect aircraft operations at the Second Sydney Airport site at Badgerys Creek was investigated by the Bureau of Meteorology (1997) and was discussed in the Draft EIS and *Technical Paper No. 5*. Further discussion is contained in *Chapter 10* of this Supplement.

Seismic Activity

An assessment of the likely rate of seismic activity in Badgerys Creek area was made in the Draft EIS. The risk of earthquakes at the Badgerys Creek site is not different from any other part of Sydney. Design and construction of the Second Sydney Airport would be in accordance with earthquake standards appropriate to the area where the site is located.

Bushfires

A bushfire study undertaken as part of the Draft EIS showed that the risk of bushfires was relatively low in the area around the sites of the airport options. This is reported in *Technical Paper No. 10*. Air traffic control procedures associated with dealing with poor visibility around the airport for fog or heavy rain would also be appropriate for any large smoke plumes created by bushfires.

Potential Increase of Mid-Air Collisions

Concerns were expressed about the potential interaction of aircraft from Sydney Airport and the Second Sydney Airport and a consequent potential for an increase in mid-air collisions. *Chapter 20* of this Supplement describes the likely scenarios for air traffic if the Second Sydney Airport were to proceed. Air traffic procedures would be devised to separate air traffic for each airport as far as possible but there would still be a need for flight-paths to merge or cross. Minimum separation distances would be maintained and this would reduce the possibility of any mid-air collisions. This is discussed in more detail in *Chapter 20* of this Supplement.

16.3.5 Emergency Plans and Security Issues

All licensed airports are required to prepare an airport emergency plan to comply with *Civil Aviation Regulation 89(1)(b)*. These plans are prepared to a standard framework developed by the National Airport Emergency Planning Committee in consultation with a wide range of organisations. This framework is detailed in *Airport Emergency Planning* in Australia, which provides comprehensive guidance and reference information for Airport Emergency Committees and those who must write and maintain plans. The framework document is reviewed annually.

Management of the risk associated with major security-related incidents, such as criminal or terrorist activity, is undertaken through the development of appropriate response procedures. The Constitution vests responsibility for the resolution of criminal acts in State Governments, which in turn vest the responsibility in their police forces. When a criminal act involves politically motivated violence the Commonwealth has policy involvement which is outlined in the *National Anti-Terrorist Plan* (restricted document).

The airport lessee for the Second Sydney Airport would need to work with police and appropriate State and Commonwealth Departments to develop an emergency response plan appropriate to the design and location of the airport. This plan would deal with the contingencies arising from criminal or terrorist incidents.

In order to minimise the prospect of terrorist or criminal attack against civil aviation, the airport and major airlines operating at the airport would be required to draw up, and have approved, an airport and airline security program which outlines the method of dealing with matters such as access control, identity on the airport and passenger screening. These protective security measures are approved and inspected by the Department of Transport and Regional Services.

16.3.6 Operational Hazards and Risks

Collisions Between Aircraft on the Ground

In some submissions, it was pointed out that there was no consideration of aircraft collision on the ground. This issue has been assessed in *Section 16.3.1* of this Chapter.

Road Accidents

Some submissions claimed that the number of road accidents off-site would increase due to increased traffic to and from the airport. This issue is not within the scope of the EIS for the Second Sydney Airport, but would be addressed in the environmental assessment of any major road.

Electromagnetic Radiation

Discussion occurred in submissions of the effects of electro-magnetic radiation from radar towers. Levels of electro-magnetic radiation from these radar towers are unlikely to be harmful to people living in surrounding areas. This is because the distance from these towers to the nearest residence would be greater than 500 metres for all options.

16.3.7 Other Hazard and Risk Issues

Construction Hazards

Hazards to workers and the public associated with construction of the Second Sydney Airport would not be any different from those experienced on large construction sites for major infrastructure projects. Occupational health and safety issues and public safety would be considered during the construction planning stage.

Risks to Flora and Fauna

An assessment of the risks to flora and fauna has not been undertaken for this EIS. The NSW Department of Urban Affairs and Planning (Department of Planning, 1990b) suggests the following criteria for sensitive environmental areas relating to the potential effects of accidental emissions on the long-term viability of the ecosystem or any species within it:

- industrial developments should not be sited in proximity to sensitive, natural, environmental areas where the effects (consequences) of the more likely accidental emissions may threaten the long-term viability of the ecosystem or any species within it; and
- industrial developments should not be sited in proximity to sensitive, natural, environmental areas where the likelihood (probability) of impacts that may threaten the long-term viability of the ecosystem or any species within it is not substantially lower than the background level of threat to the ecosystem.

In regard to these criteria, insufficient scientific knowledge exists about the potential acute and chronic toxicity impacts on ecosystems or species. It could be assumed that if there is the potential to impact on human health during operation of the airport there might also be some potential for ecosystem impacts. However, determining a causal relationship between an airport's operation and any potential toxicological impacts on a particular species would be extremely problematic. The background level of threat to the ecosystem would also be difficult to assess.

Direct impacts of the airport on flora and fauna, and proposed measures for mitigating those impacts, are described in *Chapter 14* of this Supplement.

Health Effects

Psychological effects of hazards and risks on people's health are discussed in *Chapter 23* of this Supplement.

16.4 Overview of Hazards and Risks

Aircraft crash risk contours and individual fatality risk contours were developed for each of the airport options (Options A, B and C) and for each possible mode of operation of the airport (*Airport Operation 1, 2* and *3*) based on the Second Sydney Airport handling 10 million and 30 million passengers per year. The number of people who would be exposed to a fatality risk of more than one in one-million per year because of living within the various contours was also estimated.

Qualitative risk assessment was used to investigate other issues such as adverse meteorological conditions; bird and bat strike; supply, transport and storage of aircraft fuels and dangerous goods; contaminated sites; and bushfire risks. Guidelines published by the NSW Department of Urban Affairs and Planning suggest that the individual fatality risks from a hazardous facility should not exceed one in a one-million per year chance in residential areas (Department of Planning, 1990b).

When this criterion is applied to areas surrounding the proposed airport sites the estimated number of people who would be exposed to a fatality risk of greater than one in one-million per year chance is 2,500 for Options A and B, and 9,000 for Option C.

The maximum risk of fatalities for each of the airport options was calculated to range from 2.2 fatalities every one hundred years (for Option B, *Airport Operation 3*) to five fatalities every one hundred years (for Option C, *Airport Operation 2*). The maximum fatality risk for Option A would be 2.5 fatalities every hundred years, and this would be associated with the operating mode for *Airport Operation 1*.

Guidelines issued by the NSW Department of Urban Affairs and Planning (Department of Planning, 1990b) suggest that for the assessment of the safety of the location of a proposed development of a potentially hazardous nature, hospitals, schools, child-care facilities and aged care facilities should not be exposed to individual fatality risk levels in excess of 0.5 in one million chance of a fatality each year.

Individual fatality risk contours corresponding to 0.5 chances in one-million per year of a fatality were plotted for the airport operation mode with the highest societal risk and hospitals, child-care facilities and schools enclosed within the contours were identified for each airport option. The facilities contained within these contours are as follows:

- Option A: one child-care centre and four schools;
- Option B: two child-care facilities and two schools; and
- Option C: four child-care facilities and seven schools.

The likely impacts of aircraft crashes on Sydney Water infrastructure including Warragamba Dam gates; Lake Burragorang and catchment; the Sydney water supply pipeline; and the Prospect Reservoir complex would include interruption of services for up to 1.6 million users and potential contamination of water supplies. Widespread flooding could also result from crashes into critical sections of the Warragamba Dam walls. However the likely frequency of any of these events is of the order of one crash per 1,000 years per square kilometre, for the worst-case (Sydney Water supply pipeline with Option C), and of the order of one crash per 10,000 years per square kilometre for Warragamba Dam wall and Prospect Reservoir with Options A and B.

Other issues investigated included the risks and consequences of aircraft crashes into major electrical infrastructure. Although the level of risk to major facilities such as substations and transmission lines is very low, major interruption to electricity supplies would result from destruction of any of these facilities. The time taken to restore services and rebuild facilities would be dependent upon the physical extent and type of damage, and the availability of emergency and replacement equipment.

In the initial years of operation of the Second Sydney Airport, aviation fuel might need to be supplied by road, requiring up to 65 tanker movements per day for a 10 million passengers per year capacity airport. Increases in flammable goods traffic due to aviation fuel tankers would be most significant for roads with currently low traffic numbers, such as the Great Western Highway, Elizabeth Drive and Wallgrove Road. However, the use of alternative routes such as the M4 Motorway, possible construction of the Western Sydney Orbital and future upgrading of Elizabeth Drive would reduce traffic impacts of tanker movements to a minimum. Early construction of a pipeline for fuel transfer would reduce risks to road users.

Storage and use of dangerous goods other than aircraft fuel within the airport boundary, particularly compressed natural gas and liquefied petroleum gas was also investigated. Storage facilities would be constructed in accordance with the *Australia/New Zealand Standard 1596:1997 Storage and Handling of Liquefied Petroleum Gas* and the *Australian Standard 3961:1991 Liquefied Natural Gas - Storage and*

Handling and risks associated with them would not be significant. Information from Sydney Airport suggests that only minor quantities of other dangerous goods are stored at major airports.

In conclusion, hazards and risks associated with operation of the Second Sydney Airport would be consistent with levels of risks commonly experienced around other airports. The overall risk from operation of the Second Sydney Airport would be lower than the societal risk for Sydney Airport.

PART G

Social and Economic Impacts

Chapter 17

Aboriginal Cultural Heritage

Chapter 17
Aboriginal Cultural Heritage

17.1 Summary of the Draft Environmental Impact Statement

17.1.1 Aboriginal Cultural Heritage Field Survey Findings

Over 35 percent of the sites of the airport options was surveyed for the Aboriginal cultural heritage assessment. The effective survey coverage, taking into account vegetation and visibility, was approximately five percent. There were 110 recordings of Aboriginal sites made, comprising 58 open artefact scatters, eight scarred trees, 44 isolated finds and one potential archaeological deposit. These results were extrapolated to predict the number of sites expected to be found if a 100 percent surface survey was undertaken for each airport option. There were likely to be 72 surface sites and 47 isolated finds for Option A, 118 surface sites and 78 isolated finds for Option B and 126 surface sites and 79 isolated finds for Option C. Zones of archaeological potential were also defined by the area of minor and secondary creek corridors as shown on *Figure 17.1*.

17.1.2 Aboriginal Issues and Consultation

Consultation was undertaken with the Gandangara Local Aboriginal Land Council, the Darug Tribal Aboriginal Corporation, the Korewal Elouera Jerrungarugh Tribal Elders Aboriginal Corporation and the Campbelltown City Council Aboriginal Advisory Committee. The study area was valued by the local Aboriginal community both for the Aboriginal sites which survive there and for the natural environment. There was general opposition among the Aboriginal community to an airport either in western Sydney or at Badgerys Creek.

17.1.3 Aboriginal Cultural Heritage Impacts

Sixty-eight percent of the sites and isolated finds were considered to have low local significance, 30 percent to have moderate local significance and two percent to have high local significance. The collective value of Aboriginal archaeological resources within the sites of the airport options was considered to be low.

Option A would impact on 60 known (119 predicted) Aboriginal sites or isolated finds; Option B would impact on 85 known (196 predicted) sites or isolated finds; and Option C on 94 known (205 predicted) sites or isolated finds. With no mitigating measures in place, most of these archaeological resources would be destroyed by the construction of the Second Sydney Airport proposal. Potential impacts include erosion or siltation of sites downstream; adverse effects on scarred trees from changes in air quality; increased visual and noise impacts to the contextual landscape of Bents Basin, to the south of the proposed airport sites; and potential impacts on sites as a result of increased development of land adjacent to the airport sites.

The impact on Aboriginal cultural values was described by the Gandangara Local Aboriginal Land Council as a significant loss under all airport options.

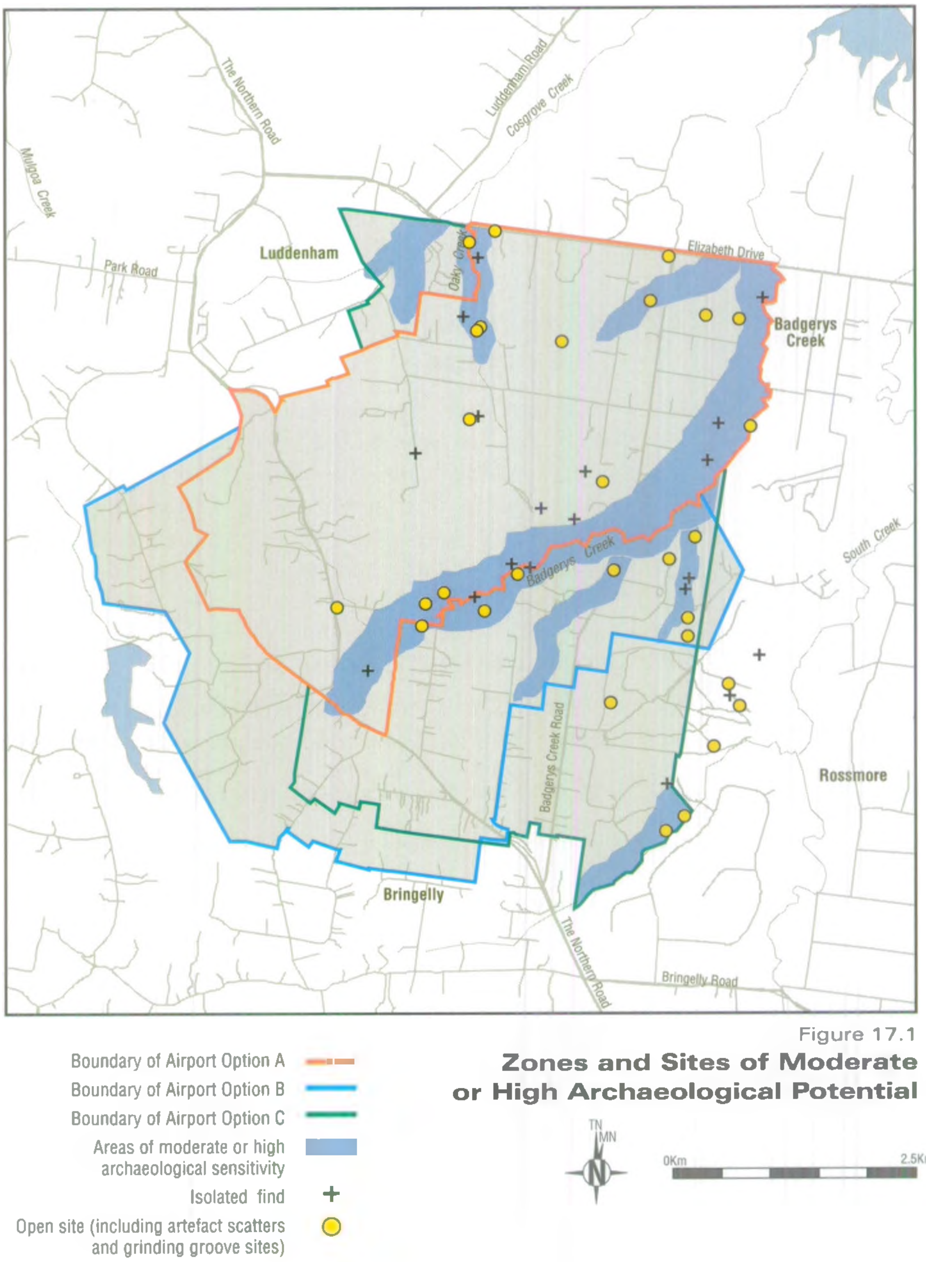


Figure 17.1
Zones and Sites of Moderate or High Archaeological Potential

Various management measures were proposed to mitigate impacts where possible, such as additional surface survey, subsurface testing, subsurface salvage, emergency salvage strategies to be implemented during construction. Monitoring would be undertaken during operation.

17.2 Summary of Aboriginal Cultural Heritage Issues

17.2.1 Issues Raised in Submissions

Cultural Heritage Context

Submissions including, among others, those from the Western Sydney Alliance and Mr Colin Gale, Chairman of the Darug Tribal Aboriginal Corporation, suggested that aspects of the cultural heritage context of Aboriginal resources were insufficiently described, such as the environmental context, the intangible evidence with regard to archaeological context, and Aboriginal views on history.

Aboriginal Consultation and Aboriginal Views

The main issue raised about the consultation undertaken with Aborigines was that Aboriginal views had not been adequately taken into account in the impact assessment and, specifically, that Aboriginal views of the cultural significance of the study area and the impacts of the Second Sydney Airport proposal were not addressed, or that their importance was down-played. On the other hand, the NSW State Government stated that a genuine effort to consult with Aboriginal people was demonstrated in the Draft EIS, however, little regard was considered to have been given to Aboriginal views on the proposal. In addition, the Aboriginal consultation program was criticised for only discussing issues with the major groups and the Local Aboriginal Land Councils, rather than with individuals who may have local knowledge.

Concerns were expressed in submissions that statements made by Aboriginal groups contained in *Technical Paper No. 11* were not included in the Draft EIS, such as the need for off-site impacts of infrastructure to be addressed.

Methodology and Scope of the Assessment

Issues raised in submissions relating to methodology and the scope of the assessment were wide ranging. There was concern expressed that detailed information contained in *Technical Paper No. 11* should have been included in the Draft EIS.

Submissions from the Western Sydney Alliance, other western Sydney councils and the National Parks Association of NSW, among others, suggested that the methodology for the overall cultural heritage assessment was inadequate. More specifically, this issue related to the comment that a proper cultural heritage impact study rather than an archaeological survey should have been undertaken to include the impacts on the spiritual, social and environmental context of the Aboriginal resources. Aspects of the field survey methodology on which there were comments included:

- the absence of sub-surface testing;
- the sampling strategy and survey coverage, in particular the question of why such a small percentage of the study area was surveyed and why potential archaeological deposits were not identified systematically;
- the appropriateness of using average surface site density;
- the lack of information regarding significant waterholes and bush foods;
- the inadequacy of using landforms to accurately predict the location and significance of sites and assumptions about landforms which were not supported by other evidence; and
- the need for a comprehensive assessment based on National Parks and Wildlife Service (1997c) guidelines.

The assessment criteria for significance and scale used to assess the significance and particularly the use of the Burra Charter were also considered to be inappropriate, as they did not take into account intangibles and cultural significance.

Existing Environment

The submission by the NSW State Government considered that the amount of evidence presented to comprehensively assess the significance of items was insufficient. Accordingly, the NSW State Government and others concluded that the significance of items might be higher than estimated. Relevant to the comments about methodology, the absence of assessment of the historic, aesthetic, scientific or social value of the archaeological resources was also noted.

Other issues relating to the description of the existing environment were that:

- an Aboriginal site of State significance currently listed on the NSW National Parks and Wildlife Service register was not acknowledged;
- the existing Native Title land claim was not addressed properly, neither were several other current Native Title claims addressed; and
- Aboriginal National Estate values were not assessed.

Aboriginal Cultural Heritage Impacts

Issues raised in submissions about the assessment of impacts on Aboriginal cultural heritage arose mostly from comments regarding the methodology and scope of the assessment. It was noted that the impacts of infrastructure corridors were not assessed. Also, it was considered that the cumulative impacts of the loss of Aboriginal archaeological items needed additional assessment.

It was considered in submissions that more thorough consideration of the indirect impacts on Aboriginal cultural heritage from the airport's operation should have been given, including consideration of those impacts resulting from noise, airborne pollutants, vibration, fuel fallout and traffic. Related to this concern were comments that impacts on Aboriginal sites in adjoining local government areas were not addressed.

Environmental Management

Improvements to the proposed environmental management measures for the Aboriginal cultural resource were considered necessary in submissions on the Draft EIS. Suggestions were made that options for site relocation should have been investigated and a test excavation program implemented. Other submissions raised the need for mitigation measures to ameliorate indirect impacts, as well as additional investigation as to the appropriateness of the proposed measures.

Clarification was also sought about the approvals process for destruction of Aboriginal sites and whether or not this was a Commonwealth or a State responsibility.

The absence of costings for the environmental management measures proposed was also an issue raised in submissions, including submissions from the Western Sydney Alliance and Campbelltown City Council.

17.2.2 Issues Raised by the Auditor

The Auditor commented that *Technical Paper No. 11*, although well written, had major flaws in logic, data, interpretation and presentation, including specifically problems in the field survey sampling strategy. The Auditor recommended that a program of test excavations was needed to provide data to further assess the significance of the sites of the airport options.

The Auditor concurred with the Draft EIS's conclusion that the scientific significance of the known and projected cultural heritage resources in the study area was low and would not have in itself prevented the development of an airport. The Auditor also considered that the heritage significance of known and unknown sites might have been higher than the Draft EIS estimates.

The Auditor also commented that a cultural heritage management plan would need to be prepared if the airport proposal was to proceed.

17.3 Response to Aboriginal Cultural Heritage Issues

17.3.1 Cultural Heritage Context

The Aboriginal cultural heritage context of the Badgerys Creek area is described in detail in Technical Paper No. 11, (Chapter 4) and summarised in Chapter 20 of the Draft EIS. The information provided included the statutory and environmental context of Badgerys Creek. Historical context included ethno-history, a review of tribal and cultural affiliations and an overview of local Aboriginal history including reference to missions, reserves and other settlements. The archaeological context of Badgerys Creek was described including its regional context, and previous investigations within the area. Predictive models and conclusions about the nature of the surviving archaeological resource within the area were based on this detailed data.

The information was collated from various sources, including previous studies and material provided by Aboriginal sources. This involved consultation undertaken to meet the aims of the Aboriginal cultural heritage study, which included identifying traditional and contemporary cultural values associated with the study area and incorporating local Aboriginal community involvement as an integral component of the study.

All relevant information available to the study team was incorporated into the contextual description of the sites of the airport options. Adequate information has been provided to gain an appropriate understanding of the cultural heritage context of the Badgerys Creek area for the purpose of describing and assessing the potential impacts of the Second Sydney Airport on Aboriginal cultural heritage.

17.3.2 Aboriginal Consultation and Aboriginal Views

Consultation Undertaken for the Draft EIS

Aboriginal consultation undertaken during the preparation of the Draft EIS is documented in detail in Section 3.6 of *Technical Paper No. 11* and summarised in Chapter 20 the Draft EIS.

Aboriginal views at the time of publication of the Draft EIS are documented in Appendix J of *Technical Paper No. 11* and are also summarised in the Draft EIS.

In the context of the cultural heritage assessment, a broad-ranging program of Aboriginal consultation was conducted during the preparation of the Draft EIS both with recognised groups and with numerous individuals. Consultation protocols were agreed with Aboriginal groups prior to the commencement of the consultation process. Aboriginal representatives also conducted consultation within their own communities with groups and individuals as they deemed appropriate. Aboriginal groups provided their own statements with regard to the proposal, archaeological sites and the significance of the sites and the land. Information presented or communicated to the consultants orally was documented by the archaeologists and anthropologist and presented in the Draft EIS and *Technical Paper No. 11* accordingly.

Much of the consultation work conducted by Aboriginal representatives in the process of compiling their reports and stated views is 'hidden' from readers of the Draft EIS because this work was conducted orally and within traditional modes of consultation. Defined standards and guidelines (National Parks and Wildlife Service, 1997c) apply to the manner in which the consultation conducted by the archaeologists and anthropologists was required to be documented. However, information collated by Aboriginal representatives can be documented and presented in any way which is deemed culturally appropriate by the relevant group or community. Therefore, by simply comparing 'amounts' of data rather than 'content', it might have appeared to some that less emphasis was placed on Aboriginal-derived data, although this was not the case.

The fact that there is an Aboriginal view which is distinct and different from European forms of cultural understanding and heritage assessment (such as can be demonstrated utilising an archaeological approach), is recognised and acknowledged by all heritage practitioners in Australia. For this reason, the significance assessment adopted in the Draft EIS made specific allowance for Aboriginal assessments of indigenous values. Only indigenous people can recognise and assess intangible values associated with the land and with specific places. These values are not always clearly defined by Aboriginal people (for any number of cultural reasons), however, they are alluded to in the reports provided in Appendix J of *Technical Paper No. 11*. The assessments of significance made by the Aboriginal groups after consultation within their local indigenous community reflected not only their views on the archaeological resource of the sites of the airport options, but also their consideration of the 'intangible' values of the place.

It was suggested in submissions that there was a bias toward an 'archaeological' methodology and assessment at the expense of an Aboriginal assessment of the area. This impression may again be partly related to the amount of data generated by the archaeological investigation when compared with data derived directly from Aboriginal sources.

Minimal information was available relevant to the archaeological resource of the sites of the airport options prior to the Draft EIS investigations. A large amount of research and survey coverage was required to address this shortfall. This resulted in an assessment which might have appeared to some to be more concerned with scientific significance and issues than Aboriginal significance and issues. Although archaeological methodology is primarily a European way of looking at cultural heritage and places, it is worth noting that the Aboriginal groups and individuals involved in the survey considered that the conduct of the archaeological assessment was a positive exercise and the data it generated was beneficial to both Aboriginal interests and Aboriginal values in the study area.

It is not unexpected that the amount of traditional Aboriginal knowledge remaining for the Badgerys Creek area is less than for other areas of Australia. The Cumberland Plain was settled by Europeans very quickly after colonisation, disruption to the fabric of Aboriginal social life was almost immediate and land use disturbance has continued for over 200 years. However, as documented in *Technical Paper No. 11* and the Draft EIS, traditional values are still relevant to this area.

Additional Consultation with Aboriginal Groups

Further consultation with Aboriginal groups was undertaken in September and October 1998 to review their opinions on the airport proposal, to discuss issues raised in public submissions and to address any other concerns these groups wished to have documented for this Supplement.

The Darug Tribal Aboriginal Corporation (incorporating the Darug Link Association Incorporated) was contacted by telephone on September 24, 1998. Mr Colin Gale, Corporation Chairman, indicated that he did not wish to speak to the consultants about the Second Sydney Airport proposal. Mr Gale also indicated that he was not happy with the way in which his views were documented in the Draft EIS and that he had problems with the Draft EIS as a whole, but would not elaborate on his views.

The Gandangara Local Aboriginal Land Council was contacted by telephone on September 25, 1998. A meeting with the Land Council Heritage Sub-Committee was held at Liverpool on 1 October, 1998. In attendance were Kerry Navin (project archaeologist), and Messrs Barry Gunther and Jamie Thomas (representing the Gandangara Local Aboriginal Land Council).

The Land Council representatives indicated that their community's views in opposition to the proposal had not changed since publication of the Draft EIS in December 1997. They indicated that they would amend the report which they provided for the Draft EIS to incorporate some additional recommendations in the event that an airport was built at Badgerys Creek. These included recommendations relating to Consents to Destroy, Aboriginal monitoring of earthworks, analysis of lithic material salvaged from the airport site and collection of flora from the proposed impact area. Mr Gunther and Mr Thomas stressed that land is spiritual and has value to Aboriginal people which is not reflected in the archaeology.

A brief discussion was also held with Mr Warren Carroll, Chairman, Gandangara Local Aboriginal Land Council about the proposal. The amended report from the Gandangara Local Aboriginal Land Council had not been received at the time of publication of this Supplement.

Mr Reuben Brown, Chairperson of the Korewal Elouera Jerrungarah Tribal Aboriginal Corporation, could not be contacted directly in the course of this additional consultation. Mr Brown has an unlisted telephone number and efforts to contact him through a third party were not successful.

Aboriginal Views on Cultural Significance and Impacts

Based on the additional consultation undertaken for this Supplement it is considered that Aboriginal views relevant to the proposal for a Second Sydney Airport at Badgerys Creek have not changed since compilation of the Draft EIS. Aboriginal groups are generally opposed to the construction of an airport at Badgerys Creek.

17.3.3 Methodology and Scope of the Assessment

Scope of the Assessment

A proper cultural heritage study rather than an archaeological survey should have been undertaken for the Draft EIS according to submissions on the Draft EIS. The Aboriginal cultural heritage study provided in full as *Technical Paper No. 11* was conducted with reference to the requirements of the NSW National Parks and Wildlife Service in relation to the recording and assessment of Aboriginal cultural heritage in NSW. The study was conducted by a team of over 20 experienced heritage professionals and was undertaken considering the spiritual, social and environmental context of the Aboriginal resources. Although such factors can be documented by archaeologists and anthropologists, the assessment of how relevant such factors are on the perceived significance of a place is generally the role of the local indigenous people. These issues were addressed to the extent deemed necessary and/or appropriate by local Aborigines.

Field Survey and Sampling Strategies

Comments were made in submissions regarding the applicability of the field survey and sampling methodology. The Auditor suggested that a probability sampling approach should have been adopted and that stratification of the sample should have been executed as part of the post-field analysis. The sample survey coverage within all proposed airport options was stratified according to landform unit divisions; the methodology followed standards recognised within the field of archaeology and complied with the most recent NSW National Parks and Wildlife Service guidelines (National Parks and Wildlife Service, 1997c).

The survey coverage achieved in the archaeological investigations was criticised as being either excessive or too small a proportion. The survey objective of at least 33 percent of each airport option was exceeded in all cases. In addition, the proportion of coverage achieved for the majority of individual landform unit divisions within each airport option was also in excess of 33 percent. These values were well above generally accepted archaeological sampling standards which typically range between five and 25 percent.

The criticism that the survey sample achieved was too small appeared to be derived from a misconception regarding archaeological sampling methodology. By its very nature, all archaeological survey involves various levels and degrees of sampling and a 100 percent surface coverage is only achievable or feasible for relatively small study areas, such as those less than one square kilometre. All archaeological surveys conducted in larger study areas invariably involve degrees of sampling, and as such are consistent with best practice and contemporary guidelines, such as those of the NSW National Parks and Wildlife Service (1997c). The total size of the sites of the airport options, approximately 2,900 hectares and the nature of its landforms made a 100 percent survey coverage of the study area for this proposal not achievable, even if it were assumed that greater than 33 percent coverage was desirable.

The decision not to systematically record individual open-context potential archaeological deposits (PADs) was also questioned in submissions to the Draft EIS. This decision was based on a determination that areas of potential deposit could more effectively be identified using a holistic small-scaled topographic approach, rather than a site specific one limited to actual survey coverage. Within areas of relative potential, the determination of individual PAD boundaries (as required by site specific recording) was often impossible and irrelevant given the objectives of PAD identification.

Submissions also considered the presentation of average surface site and isolated find densities in the Draft EIS to be misleading. It was felt that the use of the averaged data represented an attempt to downplay or obscure much higher density figures which were determined for specific landform units. These comments related to the broader question of how much data and detail should be provided in the Draft EIS of specialist areas of analysis. As described in Chapter 3 of the Draft EIS, an objective of the Draft EIS was to make it as useable to as broad an audience as possible. In the case of Aboriginal cultural heritage, a large amount of material from *Technical Paper No. 11* was presented in summary form in the Draft EIS, and in this regard, the use of overall averages was deemed to be an appropriate form of summary. Indeed, the very nature of an average provides an effective means of comparison within the context of a summary form of data. Despite the absence of much of the specific data in the Draft EIS, readers were consistently referred to Technical Paper No. 11 for more detail. In addition, those landform types which contained relatively high surface densities of recorded sites were specifically identified and illustrated in the Draft EIS in Figure 20.3 as zones of relative archaeological potential, as shown in Figure 17.1.

The limited amount of information regarding significant waterholes and bush food within the Draft EIS was also criticised in submissions. The information presented in the Draft EIS related directly to the scope of information provided during consultation with Aboriginal groups and the level of detail these groups considered appropriate for the assessment. Due to the generalised nature of these Aboriginal statements, it was not possible to conduct further field investigations regarding site specific variables.

It was stated in some submissions that the use of landform variation as a means of subdividing the sites of the airport options and providing an overall matrix for understanding the incidence and distribution of archaeological Aboriginal sites seemed to be inappropriate. It was further commented that landform may not provide a reliable framework for predicting the location and significance of sites. In particular, it was thought that evaluations regarding the disturbed nature of some landforms was not borne out by other evidence, notably remnant native vegetation. In fact, the correlation between landform variation and the incidence and type of Aboriginal archaeological sites is a well established and widely recognised phenomenon throughout the practice of Australian archaeology. This is reflected in the NSW National Parks and Wildlife Service guidelines (National Parks and Wildlife Service, 1997c) which specifically require that archaeological survey be structured around a primary subdivision of the study area according to landscape variables. The use of landform divisions within the Draft EIS investigation followed, and was consistent with, standard and best practice within Australian archaeology.

Several submissions considered that the limited presence of remnant native vegetation along sections of drainage line within the sites of the airport options meant that evaluations of the degree of landform disturbance should have been amended. In particular, it was suggested that the valley floors and alluvial sediments might have greater archaeological potential if the degree of ploughing and vegetation clearance had actually resulted in less disturbance than presented in the Draft EIS. Based on the observations of these remnant areas by the field survey teams, these conclusions are difficult to support. The remnant areas are mostly limited to the immediate banks of drainage lines and do not represent a major proportion of the identified zones of archaeological potential. The remnant areas are characterised by regrowth vegetation which has occurred since European land settlement. The vegetation structure and range of species are indicative of previous vegetation clearance, either partial or total, varying degrees of ploughing, and relatively continuous grazing. As such these remnants are not indicative of minimal land use impact.

In addition, it is reasonable to assume that widespread forest clearance and European agricultural practices would have significantly changed the hydrology and sediment regimes within the drainage lines of the sites of the airport options. These changes are likely to have changed the flow and erosion dynamics within the stream-beds to a significant extent. Prior to European land use, it is conceivable that Badgerys Creek and its tributaries was not as entrenched as it is today and may have been characterised by a chain-of-ponds type of flow with shallow banks and boggy and wetland peripheral areas. Such an environment would have meant that archaeological sites were more likely to be situated away from the actual stream-banks, on locally elevated ground closer to the valley toe slopes - areas which today are subject to repeated ploughing and grazing. Current streamline positions and forms may not be a reliable indicator of the valley floor environment prior to European settlement.

Sub-surface Testing

Archaeological field work was limited to surface surveys and the recording of surface archaeological features. No sub-surface excavation or testing was conducted for the Draft EIS. The absence of sub-surface testing was clearly identified as a limitation in the Draft EIS assessment (*Technical Paper No. 11*: p3-4). The reasons for the exclusion of sub-surface testing were as follows:

- sub-surface testing was not warranted given the available data from excavations carried out in adjacent and comparable environments; and
- sub-surface testing would have resulted in otherwise avoidable and irreversible damage (through excavation) to many archaeological sites located outside of the zone of impact.

The Auditor was critical of the Draft EIS methodology in relation to the absence of testing below the ground, that is, surface-based interpretations made all the other forms of data unreliable and uninterpretable. As a consequence, the Auditor considered that the Draft EIS conclusions were flawed in logic, data, interpretation and presentation.

A principal objective of cultural heritage management is the conservation of the cultural heritage resource and its preservation for future generations. There is, therefore, no rationale to justify the unnecessary impact to sites which would result from archaeological excavation in the context of this assessment.

It is considered that the placement of such critical importance on sub-surface data was not justified especially given the following considerations:

- the initial technical work for the Draft EIS involved a comparison of the Badgerys Creek and Holsworthy airport options. The adopted archaeological methodology must be assessed on this original framework, not just the assessment of the Badgerys Creek options. The conduct of systematic sub-surface testing within the Holsworthy impact areas would have more than doubled the scope of the whole project. Given the marked differences in the diversity, form and context of Aboriginal sites found at Badgerys Creek and Holsworthy, the conduct of a program of sub-surface testing was unlikely to provide additional avenues of assessment which would significantly modify the assessments based on surface features and potential; and
- all Aboriginal groups consulted had expressed the view that the assessment of Aboriginal sites should have involved minimal physical impact. Sub-surface testing at Badgerys Creek before a decision was made with regard to a preferred airport option would have resulted in the unnecessary destruction of sites.

Given the Draft EIS outcomes and the subsequent exclusion of the Holsworthy Military Area from further consideration, the decision not to conduct sub-surface testing as a component of the Draft EIS is considered to be justified. A large number of significant archaeological deposits within the (now excluded) Holsworthy study area were not needlessly impacted or disturbed by test pitting. This result was in keeping with local Aboriginal community concerns that impact to sites be kept to a minimum. It was also consistent with a principal objective of consulting archaeology, that is, the conservation of cultural heritage sites. The exclusion of sub-surface testing prevented impacts to a large number of significant sites within Holsworthy Military Area.

A detailed and comprehensive program of subsurface testing and salvage would be conducted within the preferred airport option (as recommended Section 9.2 of *Technical Paper No. 11*) in the context of the implementation of the environmental management plan for the proposal.

National Parks and Wildlife Service Guidelines

The NSW National Parks and Wildlife Service (1997c) released a working draft set of standards and guidelines to be applied to the Aboriginal cultural heritage components of EIS investigations in NSW in September 1997. Comments were made in submissions that the Draft EIS assessment should have been conducted according to the these guidelines. However, the Draft EIS investigations were completed prior to the drafting of these guidelines which were made available to consultants only after finalisation of *Technical Paper No. 11*. The Draft EIS investigation nevertheless complies with, and in many cases goes beyond, the National Parks and Wildlife Service guidelines which were current at the time of the conduct of the investigation.

The Guidelines are only applied by the National Parks and Wildlife Service to assessment work conducted under State legislation. The Draft EIS was conducted under Commonwealth legislation and was subject to the requirements and guidelines of the relevant Commonwealth agencies, rather than the State agencies.

Despite this, it is considered that both the Draft EIS and *Technical Paper No. 11* comply with, and effectively address, all issues and requirements which are specified in the NSW National Parks and Wildlife Service guidelines.

Assessment Criteria

Several submissions questioned the applicability of the Burra Charter in defining how the significance of cultural heritage places were assessed. They suggested that the methodology used in the Draft EIS ignored intangible and cultural values which could not be related to archaeological material evidence. Some suggested that the criteria used by the Australian Heritage Commission would have been more appropriate.

The Burra Charter is the most authoritative and recognised statement of heritage principles, objectives and methodology within Australia. All significance criteria used by State and Commonwealth agencies, including the Australian Heritage Commission, are derived from the Charter and its principles. The Charter's definition of cultural significance and its criteria for assessment are broad and all encompassing and certainly include intangible elements. The Charter allows for the assessment of heritage values which are outside of a strictly archaeological methodology. In fact, the *Illustrated Burra Charter* (Marquis-Kyle and Walker, 1992; p19) clearly states:

> *The theory on which the Charter is based is applicable to Aboriginal sites. Like other sites which have special value to present communities, it is essential that Aboriginal communities participate in studying them and making decisions. The Charter stresses the need to take account of all aspects of significance but does not provide an easy way to resolve conflicting interests once they have been identified. As ever, this must be done through careful thought and consultation.*

The perception, expressed in submissions, that heritage values derived from non-archaeological evidence were inadequately assessed or given less emphasis compared to archaeological sites can be explained by looking at the nature of the primary information and sources available for the Draft EIS. A large proportion of *Technical Paper No. 11* was taken up with the documentation and presentation of archaeological data and methodology. By comparison, the presentation of the results of Aboriginal consultation and contemporary cultural values relevant to the study area took up a smaller proportion. These proportions did not, however, provide a reliable measure of the importance or emphasis placed on these different components. They reflected the major differences in the nature of the evidence and the methods used in identification.

Archaeological investigation within the sites of the airport options was primarily concerned with the detection of material traces of past Aboriginal occupation. As a consequence, this involved a search for evidence and sites which were not specifically known or remembered within contemporary Aboriginal tradition or lore. Many of the sites recorded as a result of the archaeological survey are valued by Aboriginal people and might have included intangible elements and significance which fall outside of the scope and application of archaeology. The archaeological approach is by necessity centred on material evidence and requires considerable documentation from survey procedure through to artefact description and significance analysis.

By way of contrast, the identification and analysis of contemporary Aboriginal cultural values is centred on consultation within the Aboriginal community and the identification of remembered, contemporary and active belief and value systems. This is a methodology based on the intangible elements and may not necessarily relate to specific places or elements. It is dependent on the nature and scope of lore (both traditional and contemporary) which remains, and is considered appropriate to reveal in an EIS process. Throughout the Draft EIS, there was reliance on the actual words of the Aborigines to identify their own cultural values and beliefs regarding the sites of the airport options and the intangible (non-archaeological) values they contained. The succinctness of these reports and their brevity relative to the majority of the Draft EIS, obscured the level of activity on behalf of the Aboriginal study team who compiled them.

Unlike the site specific archaeological analysis, the Aboriginal presentation of cultural values was characteristically provided in general terms and according to broad concepts such as site types, ecological and landscape values, resource sites and bush foods. To maintain the integrity of these Aboriginal assessments, no attempt was made to reapply them to the archaeological scale of individual sites. For this reason, where no specific assessment of Aboriginal values was provided for individual archaeological sites, only the archaeological assessment was provided in the site-specific analysis. Aboriginal cultural values, as defined by the Aboriginal committees concerned, were then integrated into the analysis at a later and more generalised stage of the investigation.

17.3.4 Existing Environment

Survey Results

A total of 110 recordings were made during the Draft EIS field survey program for the sites of the airport options. One additional recording (Site B2, National Parks and Wildlife Service site number 45-5-517) was added to the Draft EIS database from a previous survey conducted by Lance (1984).

A total of 58 open artefact scatters, eight scarred trees, 44 isolated finds, and one open potential archaeological deposit were recorded during the field survey. Of these, 48 open artefact scatters, seven scarred trees, 41 isolated finds and one open potential archaeological deposit fell within the sites of the airport options.

Cultural Significance

The assessment of the significance of Aboriginal sites recorded for the sites of the airport options was based on the Burra Charter which defines cultural significance as "*aesthetic, historic, scientific or social value for past, present and future generations*" (Australia ICOMOS, 1997). The assessment of the cultural significance of a place is based on this definition but often varies in the precise criteria used according to the analytical discipline and the nature of the site, object or place. Each of the Aboriginal archaeological sites was assessed using five categories of significance:

- significance to contemporary Aboriginal people;
- scientific or archaeological significance;
- aesthetic value;
- representativeness; and
- value as an educational and/or recreational resource.

The criteria for assessment of all sites and isolated finds within Options A, B and C was presented in Chapter 5, *Technical Paper No. 11*, and the tabulations for such assessments were provided in Appendix I, *Technical Paper No. 11*.

Concerns were expressed about the lack of evidence presented in *Technical Paper No. 11*, with the implication that if there had there been more evidence then the significance of items might have been higher. Detailed information pertaining to Aboriginal sites (such as site location and contents) is generally not made available to the public and is not published in documents which are generally accessible to the public. This is a well-established protocol which ensures the optimal protection for Aboriginal sites, particularly those which are located in urban and readily identifiable contexts. Careful consideration was given as to the amount of data which could be included in *Technical Paper No. 11* without potentially compromising the security of a large suite of (relatively accessible) Aboriginal sites in western Sydney. Consequently, no detailed site descriptions were provided in the Technical Paper. However, the archaeologists and Aboriginal community had at their disposal all the available evidence relating to the sites located within the airport options and isolated finds and all significance assessments were based on that data.

Native Title

At the time of preparation of the Draft EIS there was one native title claim which had been lodged which included the sites of the airport options. Native Title Claim NC96/21 was lodged by Gordon Mitchell Wellington on 26 June, 1996 as a member of the 'Gundu-ngura'.

A search of National Native Title Tribunal listings was conducted in October 1998 to update information relevant to the Badgerys Creek area. This search indicated that application NC96/21 was rejected on April 28, 1997.

A Native Title Claim NC97/8 was lodged by Colin Rex Gale and Gordon Morton on 12 May, 1997 on behalf of the Darug Aboriginal people. The boundaries of this claim include the sites of the airport options. This claim had not been made when Native

Title searches of the Badgerys Creek area were made for the cultural heritage assessment in December 1996.

National Estate Values

The *Australian Heritage Commission Act 1975* established the Australian Heritage Commission as the Commonwealth Government's adviser on the protection of Australia's National Estate. The National Estate encompasses those places in the natural, historic or Aboriginal and Torres Strait Islander environments which the Commission considers should be conserved because of their 'aesthetic, historic, scientific or social significance or other special value for future generations as well as for the present community'.

There are no Aboriginal cultural heritage sites located within the sites of the airport options which would, on present indications, qualify for placement on the Register of the National Estate.

Prior to the field investigations, undertaken for the Draft EIS in 1996, a search of the National Parks and Wildlife Service register indicated that one Aboriginal site, National Parks and Wildlife Service Site No. 45-5-517, an artefact scatter comprising five visible artefacts, had been recorded for the area and listed on the register. A search of the register was conducted in December 1998 to ascertain if any sites of 'State' significance had been subsequently listed. None of the sites presently listed would be considered to be of State significance.

Because a site is listed on the NSW State register it does not follow that the site is of 'State' significance. All recorded Aboriginal sites and isolated finds, irrespective of their significance rating, are (or should be) listed on the NSW National Parks and Wildlife Service Register of Aboriginal Sites.

17.3.5 Aboriginal Cultural Heritage Impacts

Specific and Collective Values

All site specific assessments for the identified Aboriginal sites were based on known surface traits, together with estimates of sub-surface potential based on the surface recordings and the results of comparable sub-surface investigations elsewhere on the Cumberland Plain.

Ninety seven sites or isolated finds and one potential archaeological deposit were assessed. All recorded sites and features were considered to fall within a local context of significance only. Sixty eight percent were assessed as having low significance (67 locations), 30 percent as having moderate significance (29 locations), and two percent as having high significance.

The zones of archaeological potential identified within the minor and secondary drainage lines were considered to have mostly local significance. The surviving archaeological resource within the sites of the airport options were considered to have negligible collective value as a scientifically significant suite or complex of Aboriginal sites.

It was noted in submissions that the Gandangara Local Aboriginal Land Council's assessment of significance was prepared in response to the archaeological survey and it was commented that site specific values were not assessed by the Aboriginal community. However, Aboriginal communities, as a matter of course, consider both site specific values and broader context attributes (collective values) when presenting their views relative to proposed developments.

Again, this perception that significance is only driven by the tangible (archaeological) data is a product of the way in which information is required to be documented by heritage practitioners, as compared to the way in which indigenous people choose to present their views.

Indirect Impacts

Indirect impacts are defined as all consequential changes derived from a development which are not the result of the actual physical transformations associated with the proposed development which constitute the development's intended structures and actions.

The potential indirect impacts of the Second Sydney Airport on physical and Aboriginal cultural values were summarised in *Technical Paper No. 11*. It was considered that these would variously occur within a range of distances from the proposed airport site and/or its infrastructure and service corridors. The areal extent and severity of indirect impact would vary according to the nature of the processes involved. Impacts might also result from changes in the human environment, such as land use, perceptions of value and management practices.

The construction of access and service corridors might also have indirect contextual impacts, such as subdividing or truncating site complexes, degrading visual quality or diminishing the landscape integrity of a site.

A broad overview of potential indirect impacts was considered adequate to provide an indication of the types of effects on the cultural heritage resource which could be expected from a large scale development such as the proposed Second Sydney Airport.

Detailed assessments of the impacts of associated infrastructure development such as roads, railways and transmission lines were beyond the scope of the cultural heritage investigations conducted for the Draft EIS. These developments would be subject to separate and detailed studies as necessary under the State environmental impact assessment process.

Cumulative Impacts

Methodology and Regional Context

An assessment of the cumulative impacts on the existing or surviving Aboriginal archaeological cultural resource in the region surrounding the Second Sydney Airport has been undertaken for this Supplement and is contained in *Appendix* G. Cumulative impacts have been considered in terms of the incremental, collective or aggregate effect. The assessment aims to consider the potentially adverse effects of the proposal from a broad regional perspective, rather than as a localised impact only within the sites of the airport options. The cumulative impacts have been assessed using one of Buckley's (1994) approaches, that is, calculating the total predicted impacts of the proposal, including all cumulative components and comparing these with estimated baseline conditions prior to the development of the proposal. The first desirable baseline to be calculated therefore is the characterisation of an archaeological region in which the Second Sydney Airport proposal is contained.

Various approaches exist for determining suitable regional research boundaries. These include defining a boundary in terms of known language or cultural areas, drainage basins or other combinations of physical geography (O'Connell and Alan, 1995; Peterson, 1976). As the present level of understanding of the archaeological record at the sites of the airport options is centred on landscape based variables, it is considered that landform provides the most appropriate means of defining a regional context for the assessment of cumulative impacts. Thus, a physically defined region is the most appropriate approach, being consistent with the modelling of archaeological sites elsewhere within Australia where variation within Aboriginal sites has been found to be closely correlated with landform groups.

The Cumberland Plain is a consistently recognised and used regional category throughout the body of archaeological work that has been undertaken for the Sydney region (Byrne, 1994; Kohen, 1986; McDonald, 1997; McDonald and Rich, 1993; Smith, 1989a). This is the region in which the Second Sydney Airport proposal lies. However despite the quantity of work undertaken, as a region, the Cumberland Plain has not been consistently defined. As discussed in *Appendix* G, the northern lowland subdivision of the Cumberland Plain is the most relevant for the definition of a regional context for a cumulative impact assessment of this proposal. This section of the Cumberland Plain therefore effectively constitutes a region defined on a set of physical characteristics with reference to which the sites of the airport options may be considered.

Previous archaeological investigations have contributed significantly to an understanding of the Cumberland Plain regional resource, however, the nature of cultural resource management studies and the limited quantity of research based projects means that only a very small part of the region has been systematically surveyed. There are, however, several potential avenues for estimating cumulative impacts incurred by the proposal.

These approaches focus on the identification and quantification of land areas which by virtue of land use condition, or possession of specific environmental attributes have been identified in the course of previous regional studies as having the best potential for containing representative samples of the regional cultural heritage resource. The severity of non-Aboriginal land use impact has been found to directly correlate with the potential reduction of archaeological resources in the wider region. Landscape attributes, specifically stream course characteristics, have also been found to influence site location and density at a regional level. The identification of regionally applicable patterns or models of site occurrence based on known site records is also useful, but qualified by the very small proportion of lands surveyed in the Cumberland Plain and preliminary nature of current research models.

Cumulative impacts have therefore been assessed in three categories in relation to archaeologically sensitive land uses; in relation to archaeological potential indicated by stream order; and in relation to the known and predicted archaeological resource in the Cumberland Plain.

Cumulative Impact on Archaeologically Sensitive Land Uses

Areas of remnant Grey Box Woodland and River-flat Forest vegetation communities among open fields and along stream courses appear to represent the only areas with high potential for undisturbed (hence potentially significant) archaeological materials within the sites of the airport options. The major land use division for this assessment is therefore the distinction between these remnant wooded areas and the remaining area. The wooded areas are the focus for analysis to determine the potential cumulative loss of archaeological materials, compared to the known and surviving resource (baseline) of the Cumberland Plain.

The results of this analysis are described in more detail in *Appendix* G. The cumulative impact on archaeological sensitive land use categories is highest for Option B, having 3.4 square kilometres of high potential lands representing an additional 0.46 percent loss of the potential surviving regional resource and increasing regional cumulative loss to 47.1 percent. Following this is Option C, comprising 3.1 square kilometres of high potential lands representing an additional 0.43 percent loss of the potential surviving regional resource and increasing regional cumulative loss to 47.1 percent. The least cumulative impact is as a result of developing Option A, with two square kilometres of high potential lands representing an additional 0.28 percent loss of the potential surviving regional resource and increasing regional cumulative loss to 46.9 percent.

Cumulative Impact on Archaeological Potential Indicated by Stream Order

McDonald (1997) suggests that a direct relationship exists between archaeological potential and the character of drainage systems within an area. As stream order increases, so does its potential for association with more intense Aboriginal occupation leading to the formation of more complex, denser and potentially more significant (from a scientific perspective) archaeological sites. McDonald (1997) also predicted that creek junction or confluences, which she termed "nodes", come to represent activity foci and as a result the complexity of surrounding occupation activity (and hence archaeological evidence) increases.

Considering the range of annual precipitation in the Cumberland Plain region it was estimated that the junction of second and third order streams crossed a critical threshold in terms of provision of a reliable water supply (McDonald, 1997). Based on potential archaeological significance if the drainage regime at the sites of the airport options was in pristine condition (that is, pre European settlement), the cumulative impact in terms of the destruction of these entities would be greatest for Option B. Option C would result in the second greatest impacts, with Option A the least. This impact refers to the loss of potential archaeological resource associated with second and third or higher order steam nodes.

Taking into consideration the fact that a considerable number of nodes have been impacted by the construction of dams, the actual cumulative impact would be less. Accordingly, the cumulative impact of each of the airport options having regard to existing dams would be as follows:

- Option A would result in the destruction of 17 second order nodes (an additional seven percent cumulative impact) and four third or higher order nodes (an additional 2.5 percent cumulative impact);
- Option B would destroy 21 second order nodes (an additional eight percent cumulative impact) and two third or higher order nodes (an additional 1.8 percent cumulative impact); and
- Option C would destroy 23 second order nodes (an additional 9.5 percent cumulative impact) and two third or higher order nodes (an additional 0.6 percent cumulative impact).

Cumulative Impact on the Known and Predicted Archaeological Resource

A total of 654 Aboriginal archaeological sites have been recorded within the Cumberland Plain region (McDonald, 1997). The Draft EIS added 110 sites to the regional database, making a total of 764 sites in the Cumberland Plain region. It is difficult to equate sites recorded with concepts of surviving resource, however, because there are no consistent records maintained as to the survival of the resource after recording.

All airport options combined would result in the destruction of 96 archaeological sites, comprising seven scarred trees, 48 open artefact scatters and 41 isolated finds. Their destruction would constitute a cumulative impact of 12.56 percent of the known archaeological resource.

In terms of the known archaeological resource of the Cumberland Plain, Option A would result in the destruction of 7.8 percent (60 sites) of the known archaeological sites, 23 percent of known scarred trees, 3.9 percent of open artefact scatters and 7.8 percent of all lithic sites (inclusive of isolated finds). Option B would result in the destruction of 10.99 percent (84 sites) of the known archaeological sites, 32 percent of known scarred trees, 5.76 percent of open artefact scatters and 10.99 percent of all lithic sites (inclusive of isolated finds). While Option C would result in the destruction of 12.3 percent (94 sites) of the known archaeological sites, 32 percent of known scarred trees, 7.32 percent of open artefact scatters and 12.3 percent of all lithic sites (inclusive of isolated finds).

In contemplating the cumulative impacts in terms of the loss of the predicted archaeological resource relative to the region, Option A would result in the destruction of 14.3 percent of all sites, Option B would result in the destruction of 21.5 percent and Option C would result in the destruction of 23 percent of the predicted regional archaeological resource.

Summary of Assessed Cumulative Impacts

The cumulative impact of the proposal is, in most cases, proportional to the actual loss of the landform units involved, except where land use impacts have operated differentially between the airport options. Option A is consistently assessed as incurring the least cumulative impact. The differences between Options B and C are relatively minor overall and should be considered to result in similar levels of cumulative impact.

The actual and predicted cumulative impact results suggest that the development of any of the airport options would result in a significant impact to the archaeological resource of the Cumberland Plain. However, results which relate to known archaeological resources must been seen in their relative context. Overall, only a very small proportion of the Cumberland Plain has been subject to comprehensive field survey. It is crucial to note the low proportion of survey carried out in the Cumberland Plain region in comparison to known site numbers. For example, in 1989 when 386 Aboriginal archaeological sites were on record, it was calculated that these were the product of surveys covering a mere 0.5 percent of the regional area (McDonald, 1997). The current total of 764 sites represent a similarly proportional survey coverage. It is thus clear that the cumulative impact figures for the airport proposal are likely to be an exaggerated product of the minor extent of the regional survey coverage.

This highlights the need for a regional survey of the Cumberland Plain which would enable a more realistic approximation of the archaeological baseline.

Nevertheless, it is apparent that the analysis of the airport options suggests considerable cumulative impact on particular categories of archaeological resource in terms of site numbers destroyed. The loss of between five and seven scarred trees, for example, would reduce the regional resource by between 23 percent and 32 percent respectively. Such levels of cumulative impact may, however, be qualified by the acknowledgment that there is only a limited number of these site types on record which is most likely a product of the low levels of regional survey coverage, rather than rarity per se. *Technical Paper No. 11* also questioned the authenticity of some of the scarred trees, which if correct would also contribute to a reduced cumulative impact.

Mitigation of archaeological cumulative impacts may be approached from a perspective of regional trade-offs similar to those employed in physical environmental studies. For example, better conserved examples of the landforms and site complexes present at the sites of the airport options occur elsewhere within the Cumberland Plain region. A conservation agreement involving the identification and protection of such areas in exchange for destruction of the relatively degraded resource contained within the sites of the airport options could be considered as best practice and would also mitigate against anticipated future cumulative impacts.

17.3.6 Environmental Management

Statutory Framework

The *Aboriginal and Torres Strait Islander Protection Act 1984* provides for the protection of areas and objects which are of significance to Aboriginal people in accordance with Aboriginal tradition. The Act allows for Aborigines to apply to the Minister to seek protection for significant areas and objects. Under this Act, the Minister has broad powers to make a declaration should the Minister be satisfied that the area or object is a significant Aboriginal area or object and is under immediate threat of injury or desecration.

In addition, under the *Airports (Environment Protection) Regulations 1997* an environment strategy prepared for a leased airport is required to identify any sites of Aboriginal cultural heritage significance following consultation with any relevant Aboriginal community group or organisation and any relevant Commonwealth or State body. Further, the regulations require that the operator of an airport, that is, the airport lessee company as described in *Chapter 25* of this Supplement, must take all reasonable and practical measures to ensure that there are no adverse consequences for the existing cultural (including archaeological and anthropological) values of the local area or sites of Aboriginal cultural significance.

As a consequence, while the *National Parks and Wildlife Act 1974* (as amended) provides the primary basis for the legal protection and management of Aboriginal sites within NSW, this Act would not apply to the site of the Second Sydney Airport as described in *Chapter 25* and *Appendix* M of this Supplement.

Other Acts of relevance to the protection of Aboriginal cultural heritage include the *Australian Heritage Commission Act 1975* and the *Native Title Act 1993*.

Development of a Cultural Heritage Management Plan

Options for the mitigation of the potential impacts of constructing and operating the Second Sydney Airport on Aboriginal cultural heritage are limited because of the difficulty in permanently reserving a representative sample of the significant archaeological resource.

Impact mitigation strategies were provided in Chapter 20 of the Draft EIS and Chapter 9 of *Technical Paper No. 11*. These would be implemented in the context of the environmental management plan for construction of the airport. Comments relating to this were that the information provided was not specific enough and that the concept of a conservation action should be broadened into an archaeological management plan for airport construction.

The environmental management plan developed for the proposal would consider all potential impacts, would incorporate all of the measures outlined in the Draft EIS and *Technical Paper No. 11* and would be comprehensive and inclusive.

The Auditor commented that salvaged artefactual material would be more appropriately stored in a museum than, as suggested, with local Aboriginal communities. It is becoming common for NSW Aboriginal communities to have 'care and control' of artefactual material. This is a well recognised and well received way of repatriating cultural material to indigenous people.

It is not feasible to provide estimates of the costings involved in the implementation of the management strategies until a specific airport option has been selected and approval to proceed with the proposal granted.

Potential Management Measures

The selective salvage of physical materials and information prior to construction represents the best strategy available for mitigation of the impacts of the airport. Although it is acknowledged that salvage is an inferior alternative to in situ conservation of representative samples, selective salvage is a controlled form of destruction, incorporating the archaeological techniques of excavation, collection and data recording. Conservation, in contrast, maintains the full amenity for future research techniques and programs of inquiry.

Potential management measures are provided in detail in Chapter 9 of *Technical Paper No. 11* and in Chapter 20 of the Draft EIS. An overview of potential environmental management is described in *Chapter 25* of this Supplement and possible environmental management measures summarised in Appendix M.

17.4 Overview of Aboriginal Cultural Heritage

All proposed airport options contain a similar and limited range of surface archaeological resources. Field survey of over 35 percent of each airport option site resulted in a total of 110 recordings, comprising 58 open artefact scatters, eight scarred trees, 44 isolated finds and one potential archaeological deposit. Sixty sites or isolated finds are located in Option A, 84 sites or isolated finds in Option B and 94 sites or isolated finds in Option C.

All the recorded sites and features in the sites of the airport options are considered to fall within a local context of archaeological significance. The main determinant of this assessment is the upper catchment context and the widespread nature of these landforms on the Cumberland Plain. Option A would incur the least cumulative impact on the archaeological resource of the Cumberland Plain, with the differences between Options B and C relatively minor, but resulting in a greater level of cumulative impact than Option A. The cumulative impact of the airport on the Cumberland Plain is likely to be exaggerated due to the minor extent of regional survey coverage. Analysis does, however, suggest considerable cumulative impact in relation to particular categories of known archaeological resources, such as scarred trees.

The Aboriginal cultural heritage assessment of the Second Sydney Airport included a wide ranging program of Aboriginal consultation, an overview of the environmental, historical, archaeological and local Aboriginal history context of the area and a review of tribal and cultural affiliations. The consultation program provided Aboriginal groups and individuals with a forum to express their views about the cultural heritage assessment results and the impacts of the proposal.

The surviving archaeological resource within each of the options has low to minimal collective value as a scientifically-significant suite or complex of Aboriginal sites. However, all of the archaeological sites and the remaining natural environment of the sites of the airport options are valued by the local Aboriginal community for their cultural significance. The Gandangara Local Aboriginal Land Council is opposed to their destruction.

The archaeologically-significant resource is mostly situated subsurface (with the exception of some scarred trees), and within contexts which are already under threat from residential and commercial development. A program of subsurface testing in areas of defined archaeological potential would be undertaken prior to any on-site construction to accurately identify the nature and distribution of the subsurface archaeological resource. In the long term, archaeological salvage could have the advantage of recovering information that might otherwise be lost or never sought. The topographic spread of the potential resource is limited and it would be possible to develop a sampling strategy that at least fulfils contemporary research requirements.

The airport options would all involve a range of potential indirect, operational and cumulative impacts. Mitigation of adverse impacts would include further survey and recording, pre-construction monitoring, subsurface testing, large-scale salvage, development of management plans and subsequent monitoring of construction and operational phases of airport development.

Chapter 18

Non-Aboriginal Cultural Heritage

Chapter 18
Non-Aboriginal Cultural Heritage

18.1 Summary of the Draft Environmental Impact Statement

18.1.1 Existing Environment

Twenty-four non-Aboriginal cultural heritage items were identified within and adjacent to the boundaries of the three airport options. Of these, 14 were assessed as having local significance, nine of regional significance and one of State significance. Kelvin Park Homestead (item number B15) is listed on the Register of the National Estate and by the National Trust. Eleven of these 24 items are listed on the heritage schedule of Liverpool Council's *Draft Local Environmental Plan 1997*. Liverpool Local Environmental Plan has been gazetted since the study for the Draft EIS was undertaken.

Evidence of the environmental heritage significance of the sites of the airport options relates to:

- their association with the disposition of land ownership in the early years of the colony ('historic significance');
- the expansion of the colony into the rural hinterland prior to the crossing of the Blue Mountains ('historic and aesthetic significance');
- early 19th century 'gentleman farmer' housing and the buildings for a remote grazing property in the period ('historic, aesthetic and research significance');
- the form of the homesteads associated with small farming properties in the late 19th century and the development of service townships ('historic, aesthetic, research and social significance'); and
- the gradual decline in agricultural viability of the Cumberland Plain and the rise and fall of the wine and grape industry ('historic significance').

18.1.2 Non-Aboriginal Cultural Heritage Impacts

Airport Option A would result in the loss of 13 identified heritage items. Of these, five have regional significance and eight have local significance. One further item, The Northern Road, would be demolished within the airport boundary but would remain intact outside the boundary. Seven of these items are listed on the *Liverpool Draft Local Environmental Plan 1997*.

Option B would result in the loss of 15 items, five of regional significance and 10 of local significance. The Northern Road would also be demolished within the airport boundary. Eight of these items are listed on the *Liverpool Draft Local Environmental Plan 1997*.

Option C would result in the loss of 17 items, six of regional significance and 11 of local significance. The Northern Road would also be demolished within the airport boundary. Ten of these items are listed on the *Liverpool Draft Local Environmental Plan 1997*.

Measures for mitigating impacts on non-Aboriginal heritage items are available for all airport options. Potential measures are identified for each heritage item, including: protection during construction; investigating options for retention; further archaeological assessment; archaeological excavation; archival recording; test excavation; and relocation. Option A would result in the least impact on the identified heritage significance of the sites because fewer heritage items would be demolished. Heritage items capable of being retained and those items identified adjacent to the airport site would also be affected to some degree by operational impacts of the airport such as noise, vibration and visual impacts.

18.2 Summary of Non-Aboriginal Cultural Heritage Issues

18.2.1 Issues Raised in Submissions

Methodology and Scope of the Assessment

Submissions on the Draft EIS questioned whether or not a preliminary field survey was undertaken. Other submissions were critical of the inclusion of only those heritage items within and immediately adjacent to the airport boundaries. The need to assess the impacts on heritage items outside the airport sites in other local government areas was also expressed as a concern.

The Australian Heritage Commission raised natural and historic heritage issues, although these were not made as a formal submission on the Draft EIS. The natural heritage issues are addressed in *Chapters 12* and *14* of this Supplement. The main comment from the Commission about historic heritage was a request for the 23 heritage items (not including Kelvin Park Homestead, which is already listed) to be assessed with respect to National Estate values and whether or not any could qualify for inclusion on the Register of the National Estate.

Existing Environment

Submissions from Camden and Penrith City Councils commented that not all potentially affected heritage items were identified in the Draft EIS, particularly those existing outside the designated study area. Concern was also expressed in submissions that the Draft EIS did not fully describe the heritage resources on the sites of the airport options. Related to this were comments to the effect that the archaeological value of the study area needed to be more fully assessed in terms of its significance and the potential destruction of sub-surface items.

The collective or group value of the significance of the heritage items to be lost was also raised as an issue of concern in submissions on the Draft EIS. The lack of assessment relating to this issue was considered a shortcoming. In addition, it was considered the Draft EIS underestimated the heritage significance of items.

Non-Aboriginal Cultural Heritage Impacts

Submissions by the Western Sydney Alliance and National Trust of Australia (NSW), among others, expressed concern that the "true" or actual environmental impacts on the built and natural heritage could not be determined from the conclusions of the Draft EIS. The specific reasons for this were elaborated in several submissions as including the need to:

- clarify the number of heritage items destroyed for each airport option;

- clarify approvals required prior to the destruction of heritage items and the approvals required to monitor impacts on retained items and those in surrounding areas; and
- assess impacts on non-Aboriginal culture, particularly for future generations.

Comments relating to operational or indirect impacts were numerous and wide ranging. These included the need to assess the cumulative or combined impacts of the loss of a large number of non-Aboriginal heritage items, and the absence of assessment of the effects of noise, vibration, episodes of fuel venting and dumping and traffic on heritage items beyond the sites of the airport options.

Environmental Management

Submissions on the Draft EIS regarding non-Aboriginal cultural heritage focused comments on the environmental management of impacts. Generally, the issue raised most frequently concerned the preferred method of maximising protection for heritage items, which was considered to be unclear. It was also suggested that a comprehensive management policy would be needed prior to construction of the proposal. Various suggestions for improving management strategies included the need for:

- further assessment to develop appropriate management options for each individual item;
- more detailed research into and assessment of some items;
- potential relocation of items in the general region (especially for items within Badgerys Creek village and on Badgerys Creek) or assessment of other management measures that keep items intact (including in situ preservation and the creation of heritage enclaves within the airport site); and
- artefact collection.

Support was expressed by the NSW State Government for recommendation 8.5 in *Technical Paper No. 12* regarding the conservation of all items where possible and further investigation of alternative options for items currently identified for demolition. Another concern raised by the Western Sydney Alliance and the Western Sydney Regional Organisation of Councils, among others, was that the costs of management measures were not considered.

18.2.2 Issues Raised by the Auditor

The Auditor found that the methodology complied with best practice, the survey methodology was as thorough as appropriate and that the work was undertaken in a cost-effective manner. The Auditor also noted that *Technical Paper No. 12* achieved all of the objectives identified in the EIS Guidelines, although the information presented in Chapter 21 of the Draft EIS was limited.

18.3 Response to Non-Aboriginal Cultural Heritage Issues

18.3.1 Methodology and Scope of the Assessment

The methodology used for the assessment of non-Aboriginal heritage impacts is summarised in *Section 18.1.1*. One issue related to the methodology raised in submissions was the absence of a preliminary field survey. A field survey could be undertaken to assist in defining an appropriate study area and to assist in clarifying or refining the scope of work and detailed methodology for the assessment.

Site inspections were undertaken for the non-Aboriginal heritage assessment following the identification of heritage items and sites using primary and secondary research methods: the purpose of these site inspections was to research physical evidence and to verify historical research findings in respect of the identified heritage items and sites. In addition, existing heritage studies were examined and heritage listings reviewed.

It should be noted that the non-Aboriginal heritage assessment for this EIS was undertaken having regard to previous studies and investigations, including the *Liverpool Heritage Study* (Neustein and Associates, 1992). With the benefit of this background information a preliminary field survey would not normally be undertaken for the assessment of non-Aboriginal heritage. Such a survey would not necessarily improve the quality or the conclusions of the assessment. It is important to point out, however, that although assessments of this nature are systematic, it is possible that further research, changing levels of knowledge or perceptions of heritage significance may reveal items or sites not previously included.

Another comment raised in submissions was that heritage items were only identified within the sites of the airport options and immediately adjacent. Concern was expressed that the impacts on heritage items in other local government areas should have been assessed.

The study area for the assessment of non-Aboriginal heritage impacts was chosen to represent the area in which potential impacts of airport development on heritage items could be assessed with some certainty. This area mostly comprised the area of direct impact and the sites immediately adjacent to the proposed airport boundaries where indirect or operational impacts could be confidently assessed. The potential for indirect and operational impacts on heritage items that exist beyond the defined study area is discussed in *Section 18.3.3*.

Impacts on individual heritage items beyond the study area have not been assessed specifically because of the difficulty in identifying the exact nature and extent of these types of impacts without undertaking a comprehensive baseline study of the condition of the heritage items potentially affected. Also, there is insufficient evidence to justify the level of potential impacts from, for example, noise, vibration and fuel dumping, to assess the impacts for each heritage item and also the appropriate geographical boundary at which these impacts might or might not occur.

18.3.2 Existing Environment

Identified Heritage Items

The reasons for defining the study area for the assessment of impacts on non-Aboriginal cultural heritage as the boundaries of the three airport options and areas immediately adjacent to these boundaries were explained in *Section 18.3.1*. All potentially affected heritage items within these areas have been described and assessed in accordance with the *Australia ICOMOS Charter for the Conservation of Places of Cultural Significance* (the Burra Charter) (Australia ICOMOS, 1987), and with the guidelines contained within the *NSW Heritage Manual* (Department of Urban Affairs and Planning and NSW Heritage Office, 1996). The use of these two guidelines are considered best practice for non-Aboriginal heritage assessment in NSW.

All of the identified sites have been described in detail in the site inventory forms contained in Appendix B of *Technical Paper No. 12* and their descriptions and significance summarised in Chapter 5 of *Technical Paper No. 12* and Chapter 21 of the Draft EIS.

Assessment of Significance

The non-Aboriginal cultural heritage resource includes the fabric and physical evidence of non-Aboriginal human activity. This fabric includes buildings and structures, works, relics, archaeological deposits and other features that provide physical evidence of the history of non-Aboriginal human occupation within the study area. Cultural heritage also includes intangible aspects of a place, how it is valued by the community and the response that the place evokes from the community.

The study area includes a range of sites with archaeological research potential. The study area is also likely to contain a range of archaeological features which may yield information about expansion of the colony from its earliest centres into rural hinterlands, early road systems, agricultural activities practised in the area and the people employed in these developments, evidence which is unavailable from other sites or other resources.

The significance of each of the identified heritage items was assessed using the *NSW Heritage Manual* criteria. For each item an inventory form containing an assessment of significance in both tabular and written format was prepared which indicated the level of significance as being either local, regional or State. Items previously identified by heritage agencies or the local council were reassessed against the *NSW Heritage Manual* criteria. The assessment undertaken for this EIS was generally consistent with the significance assessment undertaken by these heritage bodies.

Collective Value

Section 21.3.2 of the Draft EIS (and Chapter 5 of *Technical Paper No. 12*) presents an assessment of the significance of the study area in terms of its collective or group value. Analysis of the tangible and intangible evidence of the Badgerys Creek area in terms of the major phases of historical activity found the area to have historic, aesthetic, research and social significance. The collective or group value of the items identified provides:

- evidence of its association with the disposition of land ownership in the early years of the colony and the events leading up to and following the 'Rum Rebellion', a seminal event in the history of the colonial administration of NSW ('historic significance');
- evidence of the expansion of the colony from its early centres into the rural hinterland prior to the crossing of the Blue Mountains, of the first road routes through the district, and of the type of agriculture and people employed in these developments ('historic and aesthetic significance');
- evidence of early 19th century 'gentleman farmer' residential housing and the form and extent of building necessary for the operation of a remote grazing property in the period ('historic, aesthetic and research significance');
- evidence of the form and materials of the homesteads and outbuildings associated with small farming properties in the late 19th century and the development of small townships that service these communities ('historic, aesthetic, research and social significance'); and
- evidence of the gradual decline in the agricultural viability of the Cumberland Plain, the rise and fall of the wine and grape industry and the development of alternative uses for former pastoral land associated with 20th century technology ('historic significance').

The study area has the potential to provide archaeological evidence that contributes significant information about small scale semi-rural establishments and industries associated with early settlements in outlying areas of Sydney. This resource is likely to contribute to a greater understanding of the region's historic development. Other sites beyond the study area boundaries are likely to contain comparative information about early agricultural activities in the region. However, within the study area, no other former inn or significant early road sites are known to survive, though to confirm this would require further research, which is outside the scope of this Supplement.

Potential for Sub-surface Heritage Items

The study area includes a number of sites of historical archaeological significance. Material remains of non-Aboriginal activities and occupation are present in a number of forms, such as vineyards, settlement walls, irrigation channels, domestic and commercial structures and roads. Non-Aboriginal artefact scatters, relating to single events or processes, are also present, as are stratified accumulations of cultural material in contexts such as sub-floor deposits, wells, rubbish pits and cesspits. Where stratified accumulations exist undisturbed by later events, they have extremely high scientific value.

The archaeological resource is finite and fragile. Features relating to the earliest period of non-Aboriginal occupation in the area are rare but have, in some cases, been disturbed by later activities and occupations. Sites which are likely to contain undisturbed features are, therefore, considered to be of considerable heritage value.

Within the inventory of heritage items identified in the study area at least three known or potential non-Aboriginal archaeological sites have been identified. These are the Lawson's Inn site, The Northern Road and the Anchau Vineyard site. On the basis of available information those sites which are likely to contain archaeological features have been identified as heritage items.

The heritage resources within the study area include a diverse range of elements. While some evidence, such as the range of buildings across the study area, is readily available, much is concealed or buried and is impossible to assess in a specific manner without detailed, individual site-specific research and physical examination. The study area contains areas of historical archaeological potential, especially in relation to evidence of the development of non-Aboriginal occupation in the area.

Archaeological resources are irreplaceable. They have the potential to contribute to our knowledge of early history with information that is unavailable from other sources such as historical documentation. It is, therefore, important that archaeological resources are adequately investigated and recorded, particularly in circumstances where they are to be destroyed as part of the development of a site.

National Estate Values

The assessment of heritage significance undertaken for the Draft EIS was based on the procedures for the assessment of significance outlined in the *NSW Heritage Manual* (Department of Urban Affairs and Planning and NSW Heritage Office, 1996). Section 3.1 of *Technical Paper No. 12* presents the methodology and approach for significance assessment and discusses alternative methodologies utilised by other heritage agencies. Particular note was made of the methodology used by the Australian Heritage Commission for evaluation of proposed entries for the Register of the National Estate. Table 3.1 in *Technical Paper No. 12* compares the assessment criteria of the NSW and the Commonwealth heritage assessment systems.

In response to a particular comment from the Australian Heritage Commission, the 23 heritage items identified in the field survey have each been re-evaluated in terms of the eight assessment criteria (National Estate values) used by the Commission and a broad assessment of the degree of heritage significance under these criteria has been made. This final assessment is made as a judgement as to whether the overall significance of the item is sufficient to meet the threshold for inclusion on the Register of the National Estate. This judgement is intended to be indicative only and any decision about the inclusion of any item onto the Register is make by the Australian Heritage Commission.

There are eight National Estate assessment criteria specified by the Australian Heritage Commission. Four of these criteria have further sub-criteria, which identify more specific attributes relevant to natural, Aboriginal, cultural and landscape values. In the following list, only those sub-criteria which are relevant to the assessment of non-Aboriginal and non-natural landscape values are noted. The eight criteria are:

- Criterion A: Importance in the course, or pattern, of Australia's natural or cultural history

  A.4: *Importance for association with events, developments, or cultural phases which have had a significant role in the human occupation and evolution of the nation, State, region or community;*

- Criterion B: Possession of uncommon, rare or endangered aspects of Australia's natural or cultural history

  B.2: *Importance in demonstrating a distinctive way of life, custom, process, land-use, function or design no longer practised, in danger of being lost or of exceptional interest;*

- Criterion C: Potential to yield information that will contribute to an understanding of Australia's natural or cultural history

  C.2: *Importance for information contributing to a wider understanding of the history of human occupation of Australia;*

- Criterion D: Importance in demonstrating the principle characteristics of:

  - a class of Australia's natural or cultural places; or
  - a class of Australia's natural or cultural environments.

  D.2 *Importance in demonstrating the principal characteristics of the range of human activities in the Australian environment (including way of life, philosophy, custom, process, land-use, function, design or technique);*

- Criterion E: Importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;

- Criterion F: Importance in demonstrating a high degree of creative or technical achievement of a particular period;

- Criterion G: Strong or special associations with a particular community or cultural group for social, cultural or spiritual reasons; and

- Criterion H: Special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.

Table 18.1 lists the heritage items identified in the study area, provides the degree of significance previously assessed under the NSW criteria, provides a list of the National Estate criteria that each item satisfies and then presents a summary of the item's current status under the relevant heritage management authorities.

Table 18.1 Evaluation of Heritage Items Against National Estate Values/Criteria

Name of Item	No.	NSW Criteria (Level of Significance)	National Estate Criteria	National Estate Register Entry	National Estate Register Suitability	NSW Heritage Council Orders	Liverpool LEP Schedule	National Trust Register
Luddenham Public School	B1	Local	A4, D2, G1	No	No	No	Yes	No
Dairy shed	B2	Local	A4, B2, D2	No	No	No	No	No
Luddenham Uniting Church, Cemetery and Progress Hall	B3	Regional	A4, D2, F1, G1	No	Yes	No	Penrith - Yes	No
Site of Lawsons Inn	B4	Regional	A4, C2	No	Yes	No	Yes	No
Luddenham Anglican Church and Cemetery (St James's)	B5	Regional	A4, D2, F1, G1	No	Yes	No	Penrith - Yes	No
Anchau Vineyard Site	B6	Local	A4, C2	No	No	No	No	No
Vicary's Vineyard -Original Homestead	B7	Regional	A4, D2	No	Yes	No	Yes	No
Vicary's Vineyard - The Winery Building	B8	Regional	A4, D2	No	Yes	No	Yes	No
Vicary's Vineyard - The Woolshed	B9	Local	A4, D2	No	No	No	Yes	No
Vicary's Vineyard - The Shearers Quarters	B10	Regional	A4, D2	No	Yes	No	Yes	No
'Evergreen' House	B11	Local	A4, D2, E1	No	No	No	Yes	No
"Mount Pleasant" Homestead	B12	Local	A4, D2, E1	No	No	No	Yes	No
Two Elevated Water Tanks	B13	Local	A4, D2	No	No	No	Yes	No
OTC Bringelly Remote Receiving Station	B14	Regional	A4, B2, E1	No	Yes	No	Yes	No
Kelvin Park Homestead	B15	State	A4, D2, E1, F1, H1	Yes	Yes	No	Yes	Yes
'Braeburn' Homestead	B16	Local	A4, D2, E1	No	No	No	Yes	No
Former Badgerys Creek Butchery	B17	Local	A4, D2	No	No	No	No	No
St. John's Anglican Church Site and Cemetery	B18	Local	A4, D2, F1, G1	No	No	No	Yes	No
Badgerys Creek Uniting Church Site and Cemetery	B19	Local	A4, D2, F1, G1	No	No	Yes	No	No
Farm Cottage	B20	Local	A4, D2	No	No	No	No	No
Group of Farm Outbuildings	B21	Local	A4, D2	No	No	No	Yes	No
Bridge over Badgerys Creek	B22	Local	A4, D2	No	No	No	Yes	No
Original Badgerys Creek Public School Buildings	B23	Regional	A4, D2, E1	No	Yes	No	Yes	No
The Northern Road	B24	Regional	A4, D2, H1	No	Yes	No	Penrith - Yes	No

Of the 24 items identified in *Table 18.1* only one is currently on the Register of the National Estate (Item B15 - Kelvin Park Homestead). This item is assessed as having a State level of cultural significance under the *NSW Heritage Manual* criteria. Under all airport options the Kelvin Park Homestead, which is listed on the Register of the National Estate, would be retained and protected during construction to prevent avoidable or irreversible impacts on the Homestead's significance. A dilapidation survey would initially be undertaken to determine the current condition of the Homestead and regular monitoring undertaken.

No stated minimum standard of cultural significance exists for entry on the Register of the National Estate. The Australian Heritage Commission Assessments Committee is the determining authority for decisions relating to entry on the Register; however, in practice, items of a regional level of cultural significance would generally qualify for inclusion on the Register. Another nine items are identified in the assessment undertaken for this Supplement as having sufficient cultural significance to warrant entry onto the Register of the National Estate. These nine items are all assessed as having at least regional level of cultural significance (under the *NSW Heritage Manual* criteria) and, in this regard, could be considered for entry onto the Register of the National Estate.

All of these nine items are currently recognised as heritage items in the respective local environmental plans for the local government area within which they are located (either Liverpool or Penrith). Item 24 - The Northern Road runs through both local council areas. This item is listed in the *Penrith Local Environmental Plan No. 201 - Rural Lands* but is not affected by the airport proposal within this council area. It is unlisted in the *Liverpool Local Environmental Plan 1997*, although in this council area it is affected, in part, by the proposal.

18.3.3 Non-Aboriginal Cultural Heritage Impacts

Construction Impacts

Clarification was sought in several submissions about the number of heritage items that would be destroyed under each airport option. For Option A, all of the items identified within the boundaries of this option would be destroyed. This is 13 items in total, five of which are assessed as having regional significance and eight of local significance. Part of The Northern Road would also be destroyed where it traverses the area contained within Option A. For Option B, all of the 15 heritage items identified within the boundaries of this option would be destroyed. This comprises five items assessed as having regional significance and 10 as having local significance. Similarly to Option A, that portion of The Northern Road that is contained within the area of Option B would also be destroyed. For Option C all of the 17 heritage items identified within the boundaries of this option would be destroyed, including six assessed as having regional significance and 11 as having local significance. The Northern Road where it is contained within the area of Option C would also be destroyed.

In total there were 24 non-Aboriginal heritage items identified within the combined boundaries of the three airport options sites and immediately adjacent to these boundaries. When considering the individual airport option areas there is no scope to retain items, meaning that for Option A, 13 out of the 24 items identified within the study area would be destroyed, for Option B, 15 out of the 24 items identified within the study area would be destroyed and for Option C, 17 out of the 24 items identified would be destroyed.

Some submissions also sought clarification of the approvals required prior to the destruction of these heritage items and the approvals required to monitor impacts on retained items and those in surrounding areas. This issue is addressed in *Section 18.3.4*.

The need to assess impacts on non-Aboriginal cultural heritage, particularly for future generations, was raised in some submissions. Each of the airport options would result in the loss of the historic, aesthetic, social and technical/research values of the individual heritage items which contribute to the heritage significance of the Badgerys Creek study area. These impacts mainly relate to the loss of evidence of aspects of the area's history and, hence, heritage significance, in particular:

- evidence of the expansion of the colony from its earliest centres into the rural hinterland, prior to crossing the Blue Mountains;
- evidence of the form and materials of the homesteads and outbuildings associated with small farming properties in the late 19th Century and the development of small townships that serviced these communities; and
- evidence of the gradual decline in the agricultural viability of the Cumberland Plain and the rise and fall of the grape and wine industries.

Options B and C would result in the loss of virtually all evidence of these aspects, although for Option A the evidence contained in individual heritage items lost through this option's implementation would remain. A reference to future generations is consistent with a key ecologically sustainable development principle of inter-generational equity. Additional assessment has been undertaken for this Supplement to determine the cumulative impacts of the development of the Second Sydney Airport on the non-Aboriginal heritage significance in the Liverpool local government area. It should be noted that a social impact assessment was undertaken for the Draft EIS and was presented in Chapter 25 of the Draft EIS as well as in *Technical Paper No. 2*. Further assessment of social impacts undertaken for this Supplement and is presented in *Chapter 24*.

Indirect Impacts

Operation of the proposed Second Sydney Airport could result in some indirect impacts on non-Aboriginal heritage items located outside of the sites of the airport options. This was discussed in Chapter 6 of *Technical Paper No. 12* and also in Chapter 21 of the Draft EIS and included impacts such as construction noise, aircraft overflight noise impacts, vibration impacts and impacts on the ambience and historic setting of heritage items including potential visual impacts. It was noted in the Draft EIS that the magnitude of these potential impacts could not be accurately assessed at the time of its preparation. As discussed in *Section 18.3.1*, these impacts on individual heritage items outside of the study area cannot be assessed specifically at this stage because of the difficulty in identifying the exact nature and magnitude of these impacts. Other reasons for not quantifying these indirect impacts are also discussed in *Section 18.3.1*.

Impacts on the Heritage Values of the Blue Mountains National Park

The land proposed for World Heritage listing within the Greater Blue Mountains area lies within National Parks or State Reserves. This area has been nominated for a World Heritage listing due to its importance in terms of biological diversity, landscape heritage values and Aboriginal heritage values. The nomination does not specifically relate to its value in terms of non-Aboriginal heritage and as such the impacts on the natural heritage values of the Blue Mountains National Park are addressed in *Chapters 14* and *21* of this Supplement.

Cumulative Impacts

The cumulative impact of the development of the Second Sydney Airport on the heritage of the Liverpool local government area would result primarily from the demolition of heritage items. The extent of the impact would vary depending on the airport option.

Option C would have the greatest impact, resulting in the loss of 17 heritage items identified. In general terms, the demolition of these heritage items would reduce the physical evidence relating to the nature and course of the historic development of the Liverpool area and would almost completely remove the physical evidence of the historic development of the Badgerys Creek area. This evidence relates to the form, materials, layouts and locations of the large and small farming properties of the late nineteenth century and their associated local townships. The items which contribute to the evidence of small farming properties of the late nineteenth century are Evergreen Homestead (Item B11), Mount Pleasant Homestead (Item B12), the site of Braeburn Homestead (Item B16), the Farm Cottage (Item B20) and the Farm Outbuildings (Item B21). The items which contribute to the evidence of local townships are the Badgerys Creek Public School (Item B23), the former Badgerys Creek butchery (Item B17), and the two church sites and cemeteries, St John's Anglican (Item B18) and the Uniting Church (Item B19).

In particular, there would be a loss of evidence of the rise and fall of the viticulture industry in the Cumberland Plains arising from the removal of the Vicary's Winery and its associated buildings (Items B7 to B10) and the remnant evidence of Anchau's Vineyard (Item B6). There would be some loss of evidence of the growth and expansion of the early colony westwards, through the loss of the site of Lawson's Inn (Item B4) and the effect on the route of The Northern Road (Item B24).

The loss of heritage items that provide direct evidence of the historic development of the Badgerys Creek area cannot be replaced or compensated for by reference to other sites and places in the Liverpool local government area. In this regard, though, these items are not dissimilar to a range of similar buildings and structures located in other small townships in the vicinity, such as Rossmore, Bringelly, Denham Court, Greendale and Kemps Creek. Beyond the Liverpool local government area, townships such as Mulgoa, Regentville and Narellan have many similarities in their historic development to Badgerys Creek and the buildings, structures and landscapes of these townships echo the form, materials and period of those at Badgerys Creek. The heritage schedule of the *Liverpool Local Environmental Plan 1997* lists local church cemeteries at Denham Court (Item No. 23), Greendale (Item No. 45) and Rossmore (Item No. 24). Cemeteries at St James Anglican Church and Luddenham Uniting Church are similar to those at Badgerys Creek, though these are not currently recognised in the Plan's schedule. Local public schools at Luddenham (Item No. 101) and at Bringelly (Item No. 102) are also comparable to the school identified at Badgerys Creek.

Small homesteads are also listed in the *Liverpool Local Environmental Plan 1997*, notably Bellfield Farm (Item No. 82), at Rossmore, and several of the larger estates contain a range of buildings which reproduce the features of the small establishments, such as the outbuildings attached to Cecil Hills Farm (Item No. 32) and Kelvin Park (Item No. 56). A late 19th century rural homestead, 'The Homestead' at Chipping Norton (Item No. 22) also provides evidence which is relevant to the structures in the Badgerys Creek area.

There are no other known archaeological sites listed in the *Liverpool Local Environmental Plan, 1997* which would provide comparisons to the site of Lawson's Inn, as the site of a similar establishment noted at Bents Basin (Item No. 5) is regarded as already disturbed. The archaeological survey of the Lawson's Inn site prior to construction of the proposal would recover the majority of the available information.

Evidence of viticulture in the Cumberland Plain provided by the Vicary's and Anchau sites is also not represented by other sites listed in *Liverpool Local Environmental Plan, 1997*. However, the large estates which once existed throughout the western plains are variously associated with this industry and 'Camden Park' at Menangle, 'Gledswood' at Narellan and 'Leeholme' at Luddenham were all early vineyard and winery sites which are regionally relevant to the Liverpool local government area. The remains of the large and famous Minchinbury Winery exist approximately 10 kilometres north-east of Badgerys Creek in the Blacktown Council area.

In general terms, the cumulative impact of the Second Sydney Airport proposal on the heritage of the Liverpool local government area would not be severe. There are comparable sites for most of the heritage items which are proposed to be demolished in other nearby areas or spread throughout the region. There are no items affected by the proposal which are of high significance and for which the major heritage values would be irreplaceable. There would be a near complete loss of the physical evidence of the historic development of Badgerys Creek itself. However, this place is representative of a number of similar places in the area, whose evidence would remain accessible.

18.3.4 Environmental Management

Statutory Framework

Heritage items may be protected by Commonwealth and State legislation and by local environmental planning instruments. As noted in *Chapter 25* of this Supplement, the operation of the *Airports Act, 1996* and of the *Airports (Environment Protection) Regulations, 1997* mean that State legislation and local statutory planning instruments would not generally apply to the construction and operation of the Second Sydney Airport. The principal Commonwealth legislation relevant to non-Aboriginal cultural heritage is the *Australian Heritage Commission Act 1975*. The *NSW Heritage Act 1977* and the *NSW Public Health Act 1991* are outlined below as the procedures set out in these Acts would provide guidance to the protection of relics and relocation of cemeteries.

Australian Heritage Commission Act, 1975

The *Australian Heritage Commission Act, 1975* provides for the creation of the Register of the National Estate. This Register is a national list of Australia's natural, historic and cultural heritage. It alerts planners, decision makers, researchers and the community at large to the heritage value of these places.

The Register lists items which, in the opinion of the Australian Heritage Commission, fall within the following definition:

> *Components of the natural environment or the cultural environment of Australia that have aesthetic, historic, scientific or social significance, or other special value for future generations, as well as for the present community.*

Listing in the Register of the National Estate imposes no legal restrictions on private or State owners or organisations. *Section 30* of the Act requires Commonwealth departments and agencies, to consult with the Commission prior to carrying out any work which would impact on the heritage value of a place on the Register. A department or agency may not take any action which adversely affects a place on the Register if there is an alternative which is 'prudent' and 'feasible'. Where an action is unavoidable the department or agency is obliged to take all reasonable measures to minimise the adverse effect of their action.

There is one property adjacent to the study area which is listed on the Register of the National Estate. This is Kelvin Park (Item B15), located immediately adjacent to but beyond the boundaries of Option C.

Heritage Act, 1977

The *NSW Heritage Act, 1977* includes various provisions for protecting identified items of environmental heritage. These include:

- Interim Conservation Orders;
- Permanent Conservation Orders;
- *Section 130* Orders;
- *Section 136* Orders; and
- Relics provisions.

The *Heritage Act* affords automatic statutory protection to 'relics' which form part of archaeological deposits. The Act defines a 'relic' as:

> *any deposit, object or material evidence relating to the settlement of the area that comprises New South Wales, not being Aboriginal settlement and which is 50 or more years old.*

Sections 139 to 145 of the Act prevent the excavation or disturbance of land for the purpose of discovering, exposing or moving a relic, except in accordance with an Excavation Permit issued by the Heritage Council of NSW. This would include relocation of cemetery headstones and associated elements as discussed below.

There are no items within the study area currently protected by conservation instruments under the *NSW Heritage Act*. The relics provisions apply in all cases where excavation of historic cultural material, older than 50 years, is proposed.

While the *NSW Heritage Act* does not bind the Commonwealth, it is intended that archaeological actions would, nevertheless, follow the procedures set out in the Act and its related guidelines.

Legislation for Relocation of Cemeteries

All of the airport options would require the relocation of St John's Anglican Cemetery (Item B18) and Badgerys Creek Methodist Cemetery (Item B19).

The human remains and headstones within these cemeteries are covered by the definition of a 'relic' in the *Heritage Act*. Relocation of the cemetery headstones and human remains would, therefore, require issue of excavation permits under *Section 140* of the *Heritage Act*. Such permits may be issued subject to current 'standard' conditions, which include requirements for reporting, storage of excavated material and cessation of work if any Aboriginal relics are uncovered or disturbed.

Current procedures for evaluation of excavation permit applications require the preparation of an archaeological assessment that considers the overall heritage value of the site and, in particular, its scientific research significance, together with a research design – a set of questions posed within an overall research framework, which ensures that information recovered from archaeological investigation contributes to contemporary research theory – and excavation methodology.

NSW Public Health Act 1991 and Public Health Regulation 1991

While the Commonwealth is not bound by State legislation, the proposed relocation of these two cemeteries would need to occur in a manner consistent with the relevant provisions of the *NSW Public Health Act 1991* and *Public Health Regulation 1991*.

The *Public Health Act* provides regulations regarding matters such as the disposal of human remains and issues relating to infectious diseases and associated matters, including exhumation. More specific requirements are set out in the *Public Health Regulation*. *Clause 36* provides that a person must not exhume the remains of a body unless the exhumation of those remains has been:

a) ordered by a coroner; or

b) approved by the Director-General.

An application for exhumation for remains must be made under *Clause 37* of the Regulation which indicates that the application can only be made by:

a) an executor of the Estate of the dead person;

b) the nearest surviving relative; or

c) if there is no such person available, a person who, in the opinion of the Director-General, is a proper person in all the circumstances.

While it may be feasible to ascertain the executor and/or nearest surviving relatives for a number of the deceased persons, the nature of cemetery relocation is such that an appropriate officer from the proponent who has a supervising and management role, could make application as a 'proper person'. However, there is potential for further complication if a 'nearest surviving relative' were to be located.

Clause 37(1) of the Regulation requires that an application is accompanied by:

a) the certified copy of the death certificate in relation to the dead person;

b a statutory declaration as to the relationship of the applicant to the dead person or still born child and the dead person's wishes, if any, requiring disposal of his or her body (so far as any wishes are known to the applicant); and

c) a fee of $200.

There are a number of recent precedents in NSW which suggest that it is feasible to make a single application covering the exhumation of an entire cemetery.

Subject to the determination of the Director-General, it may or may not be feasible to waive requirement (a) of *Clause 37(1)*, particularly if it is unclear whether all death certificates are available. In relation to requirement (b) of *Clause 37(1)*, previous practice has required the relevant project officer to make a statutory declaration indicating the circumstances surrounding the application and including the following information, where available:

- the location of the remains within the cemetery land;

- the role of the Heritage Council and any other statutory bodies involved in the proposal;
- the views of any relatives, where known;
- the reasons why the exhumation is necessary; and
- details of the proposed relocation of the remains.

In accordance with *Clause 39* of the Regulation, an environmental health officer, from the NSW Department of Health, must be present as exhumation occurs. In other similar circumstances it has been normal practice for an environmental health officer to visit the site occasionally during the course of the exhumation.

Local Environmental Planning Instruments

The *Liverpool Local Environmental Plan 1997* administered by Liverpool Council, has been gazetted since the preparation of the Draft EIS which incorporates heritage provisions, a schedule of heritage items and a schedule of potential archaeological sites. There are 11 items within or immediately adjacent to the sites of the airport options which are identified in the heritage schedule. These are:

- the Overseas Telecommunications Commission site group, including Remote Receiving Station and staff housing;
- water tanks in Badgerys Creek Road;
- St John's Anglican Church Group including church and cemetery, Badgerys Creek;
- Mount Pleasant Homestead, Bringelly;
- road bridge, Pitt Street, Badgerys Creek;
- Badgerys Creek Public School;
- Vicary's Winery Group, including wool shed, slab horse shed, land area, main house (and garden), The Northern Road Luddenham;
- Lawsons Inn site, The Northern Road, Luddenham (the Thistle site);
- Luddenham Public School;
- Bringelly Public School Group, including School House and former Headmaster's residence; and
- the Kelvin Park Group, including site landscaping, homestead, kitchen wing, servant's quarters, coach house, slat barns (two), and other works/relics (located adjacent to the site of the proposed Option C).

The impacts of the airport options on these items, as well as other items identified have been assessed in the Draft EIS and *Technical Paper No. 12*.

The National Trust

The National Trust of Australia (NSW) has assembled a comprehensive register of heritage items and conservation areas through the assessment work of its expert committees. Although it holds no legal status, the Trust's register is considered to be an authoritative guide to heritage significance and the Trust acts as an effective lobby group for heritage conservation.

There is only one item which is located immediately adjacent to the site of airport Option C which is classified by the National Trust. This is Kelvin Park at Bringelly (Item B15).

Management Measures

Archaeological Assessment and Management

Proposed mitigation measures to be implemented in relation to potential non-Aboriginal archaeological resources within the sites of the airport options are presented below. These measures aim to reduce the impact of the proposal on archaeological resources. They are intended to provide a general strategy for impact mitigation. Further assessment of impacts and identification of specific measures would be required prior to construction, during the detailed design stage.

The research and evaluation completed as part of the Draft EIS has identified a number of heritage items, including archaeological sites, within the study area. However, the precise nature and extent of archaeological features and the appropriate level of investigation and recording has not been determined.

If the Second Sydney Airport proposal proceeds, each archaeological or potential archaeological site would be the subject of a detailed archaeological assessment, prepared so as to:

- define the probable nature and extent of archaeological resources;
- assess its significance in detail;
- determine the most appropriate archaeological management procedures; and
- define the boundaries for archaeological management procedures.

Should the archaeological assessment recommend archaeological excavation where sub-surface deposits may be disturbed then the following procedures would be adhered to:

- application for an excavation permit under *Section 140* of the *NSW Heritage Act* would be made to the Heritage Council of NSW. The application would include the research design, results of site-specific assessments and an indicative work program. It should be reiterated that the Commonwealth is not bound by this requirement however;
- excavation and/or monitoring by an archaeologist of all site disturbance on the basis of recommendations contained within the archaeological assessment; and
- contractor and subcontractor training regarding both statutory and procedural requirements for management of archaeological resources.

Cemetery Relocation

The proposed relocation of the St Johns Anglican Cemetery Site and the Badgerys Creek Methodist Cemetery would occur following the issue of permits required by the Heritage Council of NSW and the Director-General of the NSW Department of Health, unless the Commonwealth elects to proceed on the basis that it is not bound by State laws.

In addition to, and in conjunction with these legal requirements, specific management measures for the relocation of the cemeteries would be developed, having regard to best practice conservation planning processes and relevant non-statutory guidelines. The processes would be undertaken in accordance with the relevant requirements and guidelines of:

- the *Australia ICOMOS Charter for the Conservation of Places of Cultural Significance* (the Burra Charter) (Australia ICOMOS, 1987);

- *The Conservation Plan* (Kerr, 1996);
- *Cemeteries: Guidelines for their Care and Conservation*, (Department of Planning and Heritage Council of NSW, 1992); and
- *Skeletal Remains, Guidelines for the Management of Human Skeletal Remains under the Heritage Act 1977* (Heritage Council of NSW, 1998).

The processes set out in these guidelines involves further site specific investigation of the values, issues and associated people for each cemetery site. These investigations are necessary to determine site specific requirements. However, in summary, the following steps would be undertaken:

- site specific research regarding the history of each cemetery and the individuals buried therein;
- assessment of the significance of each site, in accordance with the *Skeletal Remains Guidelines* and the *NSW Heritage Manual*;
- consultation with relatives of the deceased. The consultation process should include genealogical research and public advertisement. Any aspects of social significance which arise from the consultation should be fed back into the significance assessment;
- identification of other relevant constraints and issues;
- preparation of a Conservation Policy, consistent with the relevant guidelines of the Burra Charter;
- preparation of an archaeological assessment and research design, as the methodological basis for archaeological excavation;
- identification of appropriate new locations and designs, consistent with the conservation policy;
- application for an excavation permit under *Section 140* of the *NSW Heritage Act*;
- application for an exhumation permit under *Section 37* of the *NSW Public Health Regulation*;
- archaeological excavation and exhumation, in accordance with the above; and
- reinterment of remains and re-location of headstones and associated growth furniture, in accordance with the agreed design.

Management of National Estate Values

Each of the heritage items and sites that are affected by the proposed airport options have been identified as having National Estate values. These values are expressed in relation to eight principal criteria that are set out in the *Australian Heritage Commission Act, 1975*. *Table 18.1* identifies the particular values associated with each item.

Adequate management of National Estate values requires compliance by Commonwealth agencies with the procedures set out in the *Australian Heritage Commission Act 1975* and a process of best practice conservation decision making, consistent with contemporary guidelines (the non-Aboriginal cultural heritage environmental management proposals already documented as part of the Draft EIS are consistent with this approach).

In accordance with the requirements of *Section 30* of the *Australian Heritage Commission Act*, proposals for demolition, relocation or any other activity which may have an adverse impact on items on the Register of the National Estate, (or, in this case, assessed as having National Estate values) should be referred to the Australian Heritage Commission. Further, such actions should only proceed where it is established that there are no alternatives which are "prudent" and "feasible".

Fulfilment of these requirements, and compliance with the principles of the Burra Charter, suggest that the specific actions to be taken in relation to each item with National Estate values should follow a process comprising:

- site specific research and assessment of significance;
- understanding of significance and other relevant issues;
- consideration of alternatives;
- development of appropriate policies and strategies; and
- implementation of management strategies so as to maximise retention of significance.

As already established in the Draft EIS, items with National Estate values would be retained and conserved wherever possible. So as to ensure that this occurs, each item would be subject to a site specific evaluation, including preparation of a "heritage impact statement" which identifies all "prudent" and "feasible" alternatives. Only in cases where there are no such alternatives would demolition or relocation occur.

Consistent with 'best practice' conservation, protection would be provided to those items with National Estate values that are retained and conserved. This protection would be provided in two ways:

- establishment of procedures and protocols that prevent inadvertent physical damage to individual items; and
- installation of physical protective methods, (barriers, earth covering or fences, as appropriate), consistent with the significance of each item.

All three airport options, A, B and C, involve both demolition and relocation of identified heritage items with National Estate values. While specific proposals are identified for each item in the Draft EIS, these would be subject to site specific evaluation, prior to construction commencing.

In relation to the specific National Estate values set out in the *Australian Heritage Commission Act*, the following general approach would be taken for items which are not able to be retained and conserved:

- Criterion A: Importance in the Course, or Pattern, of Australia's Natural or Cultural History;
    - archival recording; and
    - relocation is considered inappropriate for such items, unless proposed in relation to other values;
- Criterion B: Possession of Uncommon, Rare or Endangered Aspects of Australia's Natural or Cultural History;[
    - archival recording;

- Criterion C: Potential to Yield Information that Will Contribute to an Understanding of Australia's Natural or Cultural History
  - archaeological assessment;
  - test excavation; and/or
  - archaeological excavation;
- Criterion D: Importance in Demonstrating the Principle Characteristics of a Class of Australia's Natural or Cultural Places; or a Class of Australia's Natural or Cultural Environments;
  - archival recording;
- Criterion E: Importance in Exhibiting Particular Aesthetic Characteristics Valued by a Community or Cultural Group;
  - archival recording; and
  - in the case of cemeteries, relocation;
- Criterion F: Importance in Demonstrating a High Degree of Creative or Technical Achievement of a Particular Period;
  - archival recording;
- Criterion G: Strong or Special Associations with a Particular Community or Cultural Group for Social, Cultural or Spiritual Reasons;
  - relocation; and
- Criterion H: Special Association with the Life or Works of a Person, or Group of Persons, of Importance in Australia's Natural or Cultural History;
  - archival recording.

Specific Management for Archaeological Resources

Proposed management measures for each of the airport options is presented in Table 21.2 of the Draft EIS. The following contains specific management measures for each item of archaeological potential identified within the study area, with the view to mitigating the impact of the proposal.

Generally, the preferred option for management of identified heritage items including archaeological sites, is conservation in situ; that is, the site should remain undisturbed by any activity, including archaeological excavation. This option retains the historic resource for future generations and provides the opportunity for more highly developed conservation techniques and management strategies to be implemented in the future. Therefore, where particular sites are assessed as having potential for retention, a mitigation recommendation has been made that these sites be the subject of detailed investigation during the design development stage with the aim of retaining the item in question.

Archaeological assessment is proposed for all sites identified as having archaeological potential as a precursor to other management procedures. This would ensure, inter alia, that the extent of archaeological management for any given site is defined in detail.

Archaeological assessment and excavation are proposed for items assessed as having high archaeological potential or as having rare representation within the study area. For example, archaeological excavation of the Anchau Vineyard site is proposed as this site is considered likely to reveal information about the local wine growing industry and its resources as well as the domestic lifestyle that existed within that community.

The site of Lawson's Inn is also proposed for archaeological assessment and test trenching as the site represents an important stopping place on the early Northern Road. From as early as c.1830, its presence influenced the siting and layout of the later subdivision of Luddenham town. It is also proposed that archaeological investigation be undertaken on The Northern Road itself which played an integral part in the historic development of the surrounding region.

Test trenching is proposed for sites where the amount of retrievable information likely to be gained from below ground remains is as yet unknown. A site specific archaeological assessment prior to test trenching would assist in determining the boundary of the area to be investigated as well as a more detailed search of historic records than has so far been possible. Test excavation would enable the archaeologist to determine whether the site merits any further archaeological action.

Initially, archaeological monitoring is not proposed for any of the sites within the study area. However, it is likely that some of the sites which undergo test excavation would not warrant a full archaeological excavation and, in these cases, archaeological monitoring of the site is considered an adequate mitigation measures.

Archival recording has generally been proposed in relation to buildings and other standing structures which are to be demolished. These would be managed in accordance with the standard procedures outlined in the Draft EIS and *Technical Paper No. 12* (Chapter 8). Archaeological sites would be fully recorded both graphically and photographically at the time of excavation, test trenching or monitoring.

Management Measures for Heritage Items Close to the Site and Within the Airport Options

One of the reasons for retaining and conserving places of cultural significance is that they contain information that drawings, photographs or film of the item cannot capture and retain. However, skillfully a place is filmed or however evocatively it may be described, it is not possible to replace the physical properties or evoke the experience of the actual place.

Several submissions provided suggestions to improve management strategies for non-Aboriginal cultural heritage; one was the potential relocation of items from the sites of the airport options to the general region or assessment of management measures that could keep items intact in the form of a 'heritage enclave' within the preferred airport site. Several identified heritage items that would be destroyed within either Option A, B or C could feasibly be relocated to another site outside of the site of the airport option. The most relevant of these would be item No. B23, the original Badgerys Creek Public School building. If there was community support for relocating items from within the airport site to another suitable site close by, this would be acceptable. However in heritage terms, relocating items to another site does not mitigate the heritage impacts on those items. The significance of the items identified lies in their place and surroundings rather than in the activities that take place within them. Therefore, the suggestion that relocation of items to outside of the proposed airport site is feasible does not achieve mitigation in terms of heritage impacts.

The suggestion to create a 'heritage enclave' within the site of the airport is not practical or achievable for this proposal. The identified non-Aboriginal heritage items within the airport options are located in various places on the sites and, given the master plans proposed for each of the options, it would not be feasible to retain those items in their existing locations. Relocating these items to a single specially designated enclave situated within the airport site would also detract from the significance of the items and remove them from their existing context.

Every effort would, therefore, be made in the detailed design process for the Second Sydney Airport proposal to retain as much fabric and physical evidence of heritage items as possible. Care would also be taken to protect heritage items during the construction stage. This might involve the boarding up of buildings or using hoardings to isolate items from activities which might be damaging. It is also proposed that a dilapidation survey of retained items be undertaken prior to commencement or construction, to allow their condition to be regularly monitored during construction of the airport and, ideally, when the airport is operational.

The latter management measure would also be applied to items close to the boundary but outside the airport sites as it is recognised that these may be affected by both construction as well as operational impacts. One such item is Kelvin Park, which is of State heritage significance and protected by a permanent conservation order under the *NSW Heritage Act*. This property would be the subject of a detailed inspection (subject to access being made available) and dilapidation survey to determine its current condition and to enable subsequent monitoring of construction and operational impacts to be undertaken.

Options to mitigate visual impacts of the airport, such as the security fence, airport structures and spill light would be investigated. This may involve the planting of trees adjacent to the site boundary and/or selection of a screen fence. It is recognised that the retention of an appropriate visual setting is a major conservation objective and consideration would, therefore, be given to this issue in the final planning and detailed design of the airport as also discussed in Chapter 21 of the Draft EIS.

Another issue raised in several submissions was that the cost of management measures were not considered in the Draft EIS. Costs for management measures described in both the Draft EIS and this Supplement could only be established based on a defined conservation strategy which further assesses the status of each non-Aboriginal heritage item to be affected by the proposal and the most appropriate management options for each item. This would be dependent on which airport option is selected and thus which items are potentially affected. As this is not known at this stage, it is considered inappropriate to undertake this exercise in the framework of this EIS.

18.4 Overview of Non-Aboriginal Cultural Heritage

The methodology for the assessment of non-Aboriginal cultural heritage was based on best practice, using the *Australia ICOMOS Charter for the Conservation of Places of Cultural Significance* (the Burra Charter) (Australia ICOMOS, 1987)) and the *NSW Heritage Manual*. Heritage items were identified and assessed in accordance with these guidelines and consultation with heritage organisations was undertaken. Several positive comments were made about the scope and manner in which the study was undertaken and the fact that it has complied with all of the objectives identified in the EIS Guidelines. Justification of the study area boundaries is based on the area of direct impact of the airport proposal, given that it is difficult to estimate the magnitude and extent of indirect impacts for heritage items that exist beyond the proposed airport boundaries.

All items of heritage value within the sites of the airport options have been identified, as well as some items immediately adjacent to the boundaries of the three airport options. In total there were 24 non-Aboriginal cultural heritage items identified with 14 assessed as having local significance, nine of regional significance and one of State significance. Eleven of the items identified are listed in the *Liverpool Local Environmental Plan 1997*. The collective value of this group of identified heritage items has been assessed to have historic, aesthetic, research and social significance as defined under the *NSW Heritage Manual* criteria.

The study area includes a number of sites of historical archaeological significance. Within the inventory of heritage items identified at least three known or potential non-Aboriginal archaeological sites have been identified. These are the Lawsons Inn site, The Northern Road and the Anchau Vineyard site. It is impossible, however, to assess these in a specific manner without detailed, individual site specific research and physical examinations. Management measures to achieve this are described below.

Airport Options A, B and C would result in the loss of 13, 15 and 17 identified non-Aboriginal heritage items respectively. Without implementing any management measures, all of these heritage items would be lost resulting in the loss of the various aspects of heritage significance as identified. Each option would result, to varying extents, in the partial loss of The Northern Road, an item identified as having regional significance. Some aspects of the heritage significance identified could, however, be retained if Option A was the preferred airport option as this option allows the retention of some items that have a heritage significance that would be lost if Options B or C were chosen as the preferred option.

Twenty-three of the heritage items identified in the survey have been re-evaluated in terms of the eight assessment criteria (National Estate values) used by the Australian Heritage Commission and a judgement made as to whether the overall significance of the item is sufficient to meet the threshold for entry onto the Register of the National Estate. It was found that nine items were identified as having sufficient cultural significance to warrant entry onto the National Estate Register. These items are all assessed as having at least a regional level of significance (under the *NSW Heritage Manual* criteria) and could be included on the Register.

The statutory framework that is relevant to non-Aboriginal cultural heritage issues for the Second Sydney Airport includes the *Australian Heritage Commission Act 1975*, the *NSW Heritage Act 1977* and other State legislation relevant to the relocation of cemeteries. All of the airport options would require the relocation of St Johns Anglican Cemetery and Badgerys Creek Methodist Cemetery. Relocation of cemetery headstones and human remains would require issue of excavation permits under *Section 140* of the *NSW Heritage Act*. The relocation would need to occur in accordance with the relevant provisions of the *NSW Public Health Act 1991* and *Public Health Regulation 1991*. Although the Commonwealth is not bound by this legislation it would proceed on the basis that these Acts are relevant to its activities. In addition to these legal requirements, specific management measures for the relocation of the cemeteries would be developed having regard to best practice conservation planning processes and relevant non-statutory guidelines.

Each of the heritage items and sites which are affected by the proposed airport options have been identified as having National Estate values. Management of these items and sites requires compliance with the procedures set out in the *Australian Heritage Commission Act 1975* and the process of best practice conservation decision making. As such the proposal to destroy some of these items depending on which airport option is preferred would be referred to the Australian Heritage Commission. These items would be subject to a site specific evaluation including preparation of a heritage impact statement which identifies all prudent and feasible alternatives.

Archaeological assessment is proposed for all sites identified as having archaeological potential as a precursor to other management procedures. Archaeological assessment and excavation is proposed for items assessed as having high archaeological potential or as having rare representation within the study area, for example the Anchau Vineyard site. The site of Lawsons Inn is also proposed for archaeological assessment and test trenching as well as an additional archaeological investigation to be undertaken on The Northern Road.

Chapter 19

Land Transport

Chapter 19
Land Transport

19.1 Summary of the Draft Environmental Impact Statement

The Draft EIS reviewed travel demand associated with the proposed Second Sydney Airport. Traffic impacts were assessed and required road network improvements identified. Options for providing public transport links to the airport site were reviewed. It was estimated that in 2016 up to 139,000 people would travel daily to and from the airport by car, truck, taxi, bus or train. This would be equivalent to between 66,000 and 77,000 daily airport-related road vehicle trips, depending on whether or not a rail link is provided.

Potential road and rail access to the airport sites is shown in *Figure 19.1*.

Two alternative routes were considered for a rail link connecting the airport to the metropolitan network at Glenfield on the East Hills and Main Southern lines. One corridor passed through Edmondson Park and Bringelly while the other corridor was routed via Edmondson Park and Rossmore. The rail link would be at ground level, except through the airport, where it was expected to be in a tunnel. It was estimated that in 2016 the rail link to the Sydney Second Airport could carry about 36,000 passengers per day, 60 percent of which would be travellers moving to and from the airport with the remaining trips associated with urban development of the rail corridor. Travel time by rail was estimated to be 48 minutes to the Sydney central business district and 33 minutes to Parramatta. It was expected that the new airport would be serviced by express bus and coach services operating to and from regional centres not serviced by rail, and that these services would be supported by appropriate bus priority measures on the surrounding road system. Overall, public transport mode share for travel to and from the airport in 2016 was expected to be 26 percent without a rail link and 35 percent with a link.

Based on traffic modelling for each of the three airport options, Elizabeth Drive, The Northern Road, Bringelly Road and Luddenham Road would need to be upgraded to provide adequate road access to the airport by 2006. This was in addition to road upgrades required for background traffic demand. Travel times by road to and from the Sydney CBD in the morning peak were estimated to be 74 and 60 minutes respectively, while the journey to Parramatta was estimated to be 42 minutes. As part of the development of the airport site, it was anticipated that Badgerys Creek Road would close.

During the construction of the airport, there would be a significant increase in truck traffic on roads around the airport, with up to 900 trucks per day during the peak construction period. Additionally, there would be 3,800 vehicle trips per day to the airport site by construction workers. During the construction phase, there would be some deterioration in service levels on The Northern Road, Elizabeth Drive and Bringelly Road before these roads are upgraded. There would also be road diversions and closures, as well as some road upgrades.

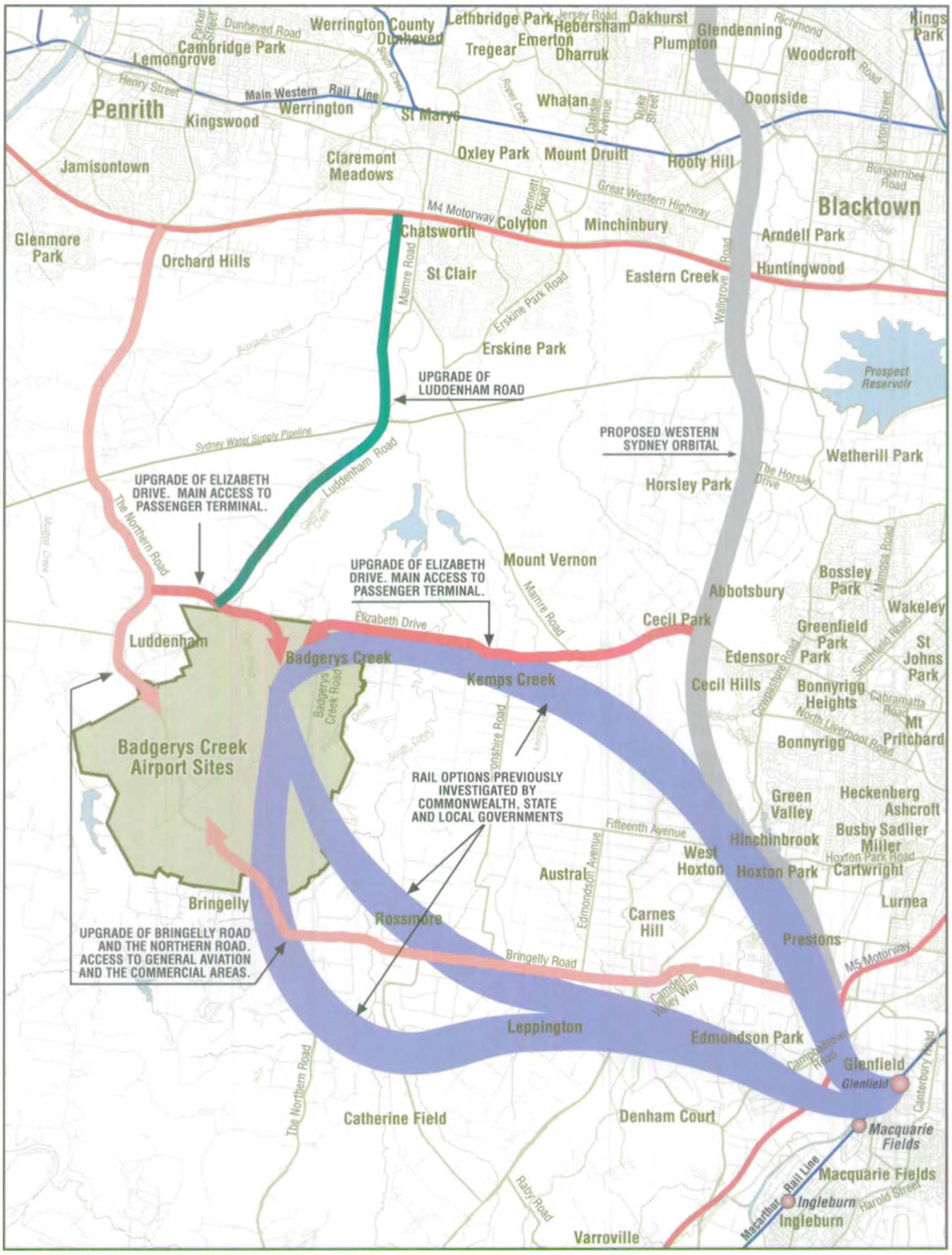


Figure 19.1

Potential Road and Rail Access to Badgerys Creek Airport Sites

Note: Access corridors are indicative only and not drawn to scale.

19.2 Summary of Land Transport Issues

19.2.1 Issues Raised in Submissions

Land Transport Demand

A broad variety of transport issues were raised in submissions on the Draft EIS. Submissions, including those from the Western Sydney Alliance, the Total Environment Centre, NRMA Limited and the University of Western Sydney, expressed concern about the travel forecast methodology and in some cases expressed the opinion that the total forecast of vehicle trips generated by the Second Sydney Airport was underestimated. These concerns were also related to the issue of a possible increase in road congestion in the airport region and a possible deterioration of the level of service on many of the region's roads. Communities Against an Airport in Western Sydney considered that forecast traffic volumes on access roads to the airport should have been shown in the Draft EIS.

In its submission on the Draft EIS, the NSW Government commented that the recommended road improvements associated with the Second Sydney Airport were based on unconstrained traffic growth, which was contrary to the NSW Government's policy of constraining growth in vehicle kilometres travelled in the greater Sydney region. Based on this policy, the submission indicated that there was an over-estimation of the amount of road upgrading required to service both background traffic and airport traffic. This concern was also raised by the Western Sydney Alliance. It was indicated that there was a need for the Draft EIS to recognise the implementation of a metropolitan demand management strategy which would slow traffic growth and reduce private car use and emissions. The airport rail link and bus priority measures were seen as an essential part of this program.

Concerns were also raised in submissions from the Total Environment Centre, NRMA Limited and the NSW Government that the proposed road improvements outlined in the Draft EIS were inadequate having regard to the likely traffic increases expected in the region due to other developments. Examples given include the development of the ADI site at St Marys and its potential impact on The Northern Road. The methodology was also considered to be inadequate because there would be a need to upgrade further transport links in western Sydney having regard to the expected industrial development associated with the airport's operation. Submissions on the Draft EIS considered this issue to have been inadequately addressed.

In addition, clarification of freight and business trip numbers assumed in the model was also requested in submissions.

Public Transport

Non-Rail Public Transport

Concerns were raised in submissions that in an area which was remote from the established road and rail systems there would be a significant dependence on private vehicle use in accessing the airport. NRMA Limited indicated that measures should have been identified to optimise public transport use, such as dedicated busways or bus priority measures on all major airport access roads. These, it was argued, should apply equally to local, regional and airport bus services. Bus priority measures were seen in submissions to be a essential component of traffic demand management in the region.

To demonstrate the effectiveness of the proposed airport bus service, it was requested that the EIS show travel times to key centres throughout Sydney, including the Sydney central business district and Sydney Airport.

Proposed Rail Link and Options

While a rail corridor to the Second Sydney Airport was identified in the Draft EIS, submissions indicated that the EIS should go further and present details of the benefits that would be derived from the airport rail link and make a definitive recommendation for its construction. Although details of the project timing were called for, most submissions on this issue considered the provision of a rail link at the commencement of airport operations mandatory. It was also considered that the funding and delivery of the rail link should be the responsibility of the Commonwealth.

The NSW Government and Liverpool City Council raised concerns about the implications of an airport rail link to the wider Sydney rail network. Assessment of the implications of the possible need for additional rolling stock, network improvements and operational costs, as well as addressing the way in which airport rail services would interact with the existing CityRail commuter services were requested.

Concerns were also raised in submissions over the location of the rail link through rural and environmentally-sensitive land and the failure of the Draft EIS to consider the effects of providing rail access on road access for existing residents. The submission from Liverpool City Council recommended that the airport rail link be collocated in the Western Sydney Orbital road corridor where its environmental impact could be significantly lower.

Submissions from the Total Environment Centre, Fairfield City Council and the NSW Government were concerned that the urban development supporting the rail link was inappropriate, variously because the associated population forecasts were under-estimated or because such development within the South Creek Valley was inappropriate and inconsistent with current Government policy.

Road Transport

Traffic Identification and Segmentation

Further clarification was sought by the Western Sydney Alliance and other western Sydney councils concerning the mode split assumptions adopted. The NSW Government requested that details of passenger origins and destinations be shown.

Impacts of Construction Traffic

Submissions from the Western Sydney Alliance expressed concern that construction traffic was not treated adequately, with insufficient information on road upgrading works required to cope with construction traffic, and management measures to counter the impacts of construction traffic on the region's arterial roads not identified.

Funding of Road Infrastructure

The funding of road access infrastructure was raised as an issue of concern in submissions from the NSW Teachers Federation, the Western Sydney Alliance and the NSW Government, amongst others. In some cases it was suggested that the transport infrastructure costs were under-stated, while others expressed concern that no allocation of responsibility for the provision of funding for the road infrastructure identified in the Draft EIS was provided. Consequently, it was suggested in submissions that there was significant doubt over the delivery of the support infrastructure to the extent that, without Commonwealth Government funding commitments, the proposed airport was not viable.

Emergency Vehicle Access and the Transport of Jet Fuel

Submissions from the Western Sydney Alliance, Campbelltown City Council and other councils in western Sydney expressed concern about the implications of road safety associated with the transport of jet fuel by road tankers. This issue was considered to have been inadequately addressed in the Draft EIS. In addition, Communities Against an Airport in Western Sydney, and others, were concerned that emergency vehicle access routes were not identified.

19.2.2 Issues Raised by the Auditor

The Auditor concluded that the overall analysis of land transport impacts of the proposal in the Draft EIS was of a high standard and employed appropriate methodology. The Auditor did, however, identify the following specific areas of concern:

- traffic control measures at major intersections on the construction access routes were not addressed;
- travel times and conditions to all regional centres in Sydney were not specified, and there was no comparison between the scenarios with and without road improvements;
- non-employment related trips associated with airport-related activity centres were not specifically reported and it was unclear how they were included in traffic projections;
- traffic volumes on airport access roads were not provided;
- there was no indication on how sensitive conclusions made with respect to bus patronage were to changes in assumptions; and
- emergency vehicle access was not discussed in sufficient detail.

Additionally, the Auditor raised issues with respect to the assessment of rail link options to the airport. In particular, consideration should have been given to operation of airport rail services by organisations other than CityRail, such as airlines or groups of airlines. Third-party operations would have implications for the viability of the rail link as, for example, the third-party may be able to absorb costs into airfares.

19.3 Scope of Response to Land Transport Issues

Summary information related to road transport travel forecasts and mode shares as well as construction traffic were presented in the Draft EIS. Modelling data and outcomes were presented in detail in *Technical Paper No. 13*. In responding to transport issues raised in submissions the following additional information has been assembled and analysis undertaken:

- new modelling related to road transport demand based on current NSW Government demand management policies;

- provision of additional information regarding airport trip origins and destinations and trips generated by airport-induced business, industry and freight movements;
- provision of additional information and analysis of public transport issues, including bus and rail patronage and measures to encourage public transport use;
- discussion of the rail network implications of developing a rail link to the airport;
- analysis of the implications of closing Badgerys Creek Road and its impact on Devonshire Road; and
- calculation of travel times by bus/coach, rail and car to key regional centres.

19.4 Traffic Forecasts and Demand Management

19.4.1 Travel Demand Issues

Submissions raised a number of issues regarding travel demand assumptions used in the Draft EIS. These included the claim that total vehicle trip generation was underestimated and that further information should be provided on passenger origins and destinations, freight and business trips and airport induced industrial traffic. Other submissions expressed concern about: existing traffic congestion in western Sydney; the inadequacy of rail services to the proposed airport in western Sydney generally; the likelihood that additional regional traffic would exacerbate existing traffic problems; and that without significant improvements to public transport services there would be increased private car use resulting in a deterioration of the regional environment.

An explanation of the methodology used to establish land transport demand generated by the Second Sydney Airport was contained in *Technical Paper No. 13*. A summary of this methodology is provided in *Appendix H1* of this Supplement.

The assessment of traffic impacts of the Second Sydney Airport involved, initially, estimating future background (non-airport) traffic levels and likely road improvements in western Sydney required to accommodate them. Daily vehicle trips likely to be generated by the Second Sydney Airport were then added to the background volumes and additional required road network improvements identified.

Some submissions on the Draft EIS questioned assumptions made regarding background and airport traffic forecasts and suggested traffic levels were underestimated. Others claimed that the predicted impact of demand management measures on constraining vehicular trips was not considered, leading to an overestimation of traffic levels. These issues are discussed below.

19.4.2 Demand Management Policy

The NSW Government has recently released its 25-year air quality management plan, *Action for Air* (Environment Protection Authority, 1998a), and *Action for Transport 2010: An Integrated Transport Plan for the Sydney Region*, (Department of Transport, 1998). These documents outline the NSW Government's adoption of targets for reducing car use in the Sydney region (as measured by total vehicle kilometres travelled). Historically, car use has increased at a faster rate than population increase. The first target is to halt this growth in vehicle kilometres travelled per person by 2011. The second target is to halt the increase in total vehicle kilometres travelled by 2021. To achieve these targets, the NSW Government has adopted a set of actions, including:

- maintaining current land use policies of urban consolidation and development of regional centres with high levels of public transport access;
- promoting increased public transport use through development of new corridors and expansion of existing infrastructure; and
- encouraging cycling and walking for short trips.

19.4.3 Draft EIS Traffic Forecasts

Background (non-airport) vehicle trips were modelled for the Draft EIS, based on land use forecasts consistent with the existing policies of urban consolidation and development of regional and sub-regional centres. Total trips between different parts of Sydney were split between car and public transport modes using a choice model that largely reflects current mode choice behaviour. Thus, the resulting car trip forecasts used in the Draft EIS corresponded largely to a continuance of current levels of car use.

Traffic levels adopted in the Draft EIS corresponded to the 'most likely' or 'mid-range' scenarios for future car use. While the forecasts did allow for a major shift from car to public transport use, they did allow for some slowing in the current trend of increased car use per person.

As part of the preparation of this Supplement, additional modelling was undertaken to examine the impacts of constrained growth in vehicle kilometres travelled on conclusions made in the Draft EIS with regard to required road network improvements for background traffic and airport traffic.

19.4.4 Demand Management Impacts on Traffic Forecasts and Road Network Improvements

Action for Air states that achievement of the 2021 target for constraining car vehicle use in the Greater Sydney region would require a reduction in total vehicle kilometres travelled of nine percent in the decade 2011 to 2021. Travel patterns in Sydney are such that peak, weekday travel provides the best opportunity for implementing demand management measures. The majority of trips during weekday peak periods are between home and work, and a major focus of NSW Government land use and transport strategies has been on developing a more efficient and sustainable pattern of commuter travel demand. Sydney's public transport system is most effective in providing an alternative to private vehicle use by commuters. Conversely, non-work travel patterns during weekday off-peak periods and weekends are more dispersed and public transport is less attractive as an alternative mode. For these reasons, it is argued that achievement of the target reduction in total vehicle kilometres travelled of nine percent would require a higher reduction in weekday peak period vehicle kilometres travelled. Accordingly, a reduction of 20 percent for weekday peak period trips was modelled as described in *Appendix H2* of this Supplement.

In the Draft EIS, vehicle trips likely to be generated by a Second Sydney Airport at Badgerys Creek were estimated based on a predicted strong use of bus and rail services by airport employees, passengers and visitors. As discussed in the next section, the bus and rail patronage assumed for airport trips was consistent with some level of demand management and was also consistent with actions identified for achieving the target for reducing total vehicle kilometres travelled. For this reason no change in airport vehicles trips was modelled.

The following road network improvements would no longer be required to cater for growth in background traffic with successful implementation of demand management measures:

- widening of Camden Valley Way to four lanes by 2006;
- establishing a four lane route parallel to South Western Freeway between Campbelltown and Glenfield by 2006; and
- upgrading the Western Sydney Orbital from four to six lanes by 2016.

The modelling demonstrates that the remaining road network improvements identified in the Draft EIS to accommodate airport traffic would still be required. However, if background traffic levels are less as a result of travel demand management measures, resulting congestion and pollution levels in peak periods would be less, as would travel times.

The impact of airport traffic assuming a reduction in total vehicle kilometres travelled is also described in *Appendix H2*. The substantial road network improvements identified in the Draft EIS would still be required, with the exception of the upgrading to four lanes of The Northern Road between Elizabeth Drive and the M4 Motorway. The upgrading of Devonshire Road has also been included. The reasons for this inclusion are outlined in *Section 19.6.4* of this Chapter.

19.4.5 Airport Trip Origins and Destinations

The impact of the Second Sydney Airport on Sydney's transport system (both road and public transport) would depend not only on total daily trips generated by the airport but from where the trips originate and to where they are going. This would apply to both employees as well as passengers and casual visitors. In the Draft EIS, information about trips to and from Sydney Airport was used to build a general airport trip distribution model. This model was then applied to a Second Sydney Airport located at Badgerys Creek to predict origins and destinations of airport trips. The resulting distribution of trips takes into account the distribution of population across the Sydney region as well as varying levels of accessibility to the airport. A summary of employee and passenger origins and destinations is provided in *Table 19.1*. Employees would be more likely to come from locations in western Sydney close to the airport while passenger demand would be spread more evenly across the Sydney region.

19.4.6 Trips Generated by Freight Movements, Business and Airport Induced Industry

Freight movements are expected to be generated by airport-related activity within the airport site and could be generated by both airport-related and ancillary activity in the surrounding area. A more detailed description of these activities and their potential location was provided in *Technical Paper No. 13*.

Tables 19.2 and *19.3* show employment growth and associated vehicle trips expected as a result of the development of the Second Sydney Airport at Badgerys Creek. *Air Traffic Forecast 2* corresponds to a staged development by 2006 (10 million passengers annually) while *Air Traffic Forecast 3* represents full development by 2016 (30 million passengers annually). Vehicle trips were calculated from predicted employment levels based on estimates of person trips and vehicle occupancies; this was described in more detail in *Technical Paper No. 13*.

Table 19.1 Origins and Destinations of Trips to and From the Second Sydney Airport in 2016

Sydney Statistical Region	Percentage Distribution			Two Way Person Trips		
	Passengers and Meeters/Greeters		Employees	Passengers and Meeters/Greeters		Employees
	International	Domestic		International	Domestic	
Blacktown-Baulkham Hills	8.4	15.3	10.9	6,972	5,661	2,017
Fairfield- Liverpool	3.1	8.2	19.2	2,573	3,034	3,553
Outer Western Sydney	4.1	7.8	7.7	3,403	2,886	1,425
Camden-Campbelltown	1.8	5.3	7.9	1,494	1,961	1,462
Blue Mountains	0.6	1.2	1.5	478	427	271
Outer Northern Sydney	4.9	4.2	2.5	4,067	1,554	463
Outer Southern Sydney	3.3	4.0	4.5	2,739	1,480	834
Eastern Suburbs	3.7	0.3	3.3	3,071	111	612
Inner Sydney	26.2	24.3	3.6	21,746	8,991	668
Lower Northern Sydney	12.0	6.5	4.9	9,960	2,405	908
Northern Beaches	4.8	2.6	3.0	3,984	962	556
Hornsby-Ku-ring-gai	4.7	3.6	3.9	3,901	1,332	722
Inner Western Sydney	4.3	1.8	3.2	3,569	666	592
Canterbury-Bankstown	5.3	4.0	7.9	4,399	1,480	1,462
St George-Sutherland	6.6	2.9	8.3	5,478	1,073	1,536
Central Western Sydney	6.2	8.0	7.7	5,146	2,960	1,426
Total Greater Sydney	**100%**	**100%**	**100%**	**82,980**	**36,983**	**18,507**

Source: PPK Environment & Infrastructure Pty Ltd, 1997a

Table 19.2 Airport-Related Employment Forecast

	Employment Forecasts					
	2006[1]			2016[2]		
	On-site	Off-site	Total	On-site	Off-site	Total
Airport-related	10,700	5,100	**15,800**	35,270	12,990	**48,260**
Ancillary facilities		6,100	**6,100**		18,630	**18,630**
	10,700	**11,200**	**21,900**	**35,270**	**31,620**	**66,890**

Notes:
1. *Air Traffic Forecast 2 has been selected to represent a situation equivalent to Stage 1 airport development, that is, 10 million air passengers and 16,000 employees at the Second Sydney Airport in 2006.*
2. *Air Traffic Forecast 3 has been selected to represent a situation equivalent to master plan airport development, that is, 30 million air passengers and 48,000 employees at the Second Sydney Airport in 2016.*

Table 19.3 Daily Airport-Related Employee Vehicle Trips (Two-Way)

	2006[1]			2016[2]		
	On-site	Off-site	Total	On-site	Off-site	Total
Airport-related	4,810	2,290	**7,100**	13,500	4,980	**18,510**
Ancillary facilities		2,740	**2,740**		7,140	**7,140**
Total	4,810	5,030	**9,840**	**13,530**	12,120	**26,650**

Notes: 1. *Air Traffic Forecast 2 has been selected to represent a situation equivalent to Stage 1 airport development, that is, 10 million air passengers and 16,000 employees at the Second Sydney Airport in 2006.*
2. *Air Traffic Forecast 3 has been selected to represent a situation equivalent to master plan airport development, that is, 30 million air passengers and 48,000 employees at the Second Sydney Airport in 2016.*

Truck movements associated with airport-related and airport-induced industry have been estimated, based on a ratio of truck trips to employee vehicle trips at Sydney Airport (Masson and Wilson, 1996) of around 11 percent. The resulting daily truck movements are shown in *Table 19.4.*

Table 19.4 Daily Estimated Truck Movements (Two-Way) Generated by the Airport

	2006[1]			2016[2]		
	On-site	Off-site	Total	On-site	Off-site	Total
Airport-related	530	250	**780**	1,490	550	**2,040**
Ancillary facilities		300	**300**		790	**790**
Total	**530**	**550**	**1,080**	**1,490**	**1,340**	**2,830**

Notes: 1. *Air Traffic Forecast 2 has been selected to represent a situation equivalent to Stage 1 airport development, that is, 10 million air passengers and 16,000 employees at the Second Sydney Airport in 2006.*
2. *Air Traffic Forecast 3 has been selected to represent a situation equivalent to master plan airport development, that is, 30 million air passengers and 48,000 employees at the Second Sydney Airport in 2016.*

19.5 Public Transport Issues

19.5.1 Public Transport Patronage

The Draft EIS identified the provision of a high level of public transport (bus and rail) infrastructure and services as an important component of the Second Sydney Airport. Investigations were carried out into what would be the most likely form that bus and rail services would take and what levels of use would result. *Table 19.5* summarises the estimated mode share for employees and passengers to the Second Sydney Airport with and without a rail link. The choices of modes for airport trips, primarily between car, bus and rail, are important factors in determining the traffic impacts of the Second Sydney Airport. A number of submissions on the Draft EIS expressed concerns about assumptions made regarding the provision of public transport as well as the accuracy of mode share estimates and the sensitivity of these estimates to different levels of public transport provision.

Table 19.5 Forecast Travel Mode Split to Second Sydney Airport

Mode of Travel	Employees		International[1]		Domestic[1]	
	No Rail	Rail	No Rail	Rail	No Rail	Rail
Car drivers	85%	72%	28%	25%	33%	30%
Car passengers	8%	5%	46%	40%	31%	28%
Taxis	2%	1%	15%	12%	28%	22%
Bus	5%	2%	5%	2%	6%	3%
Coaches	0%	0%	6%	6%	2%	2%
Rail	0%	20%	0%	15%	0%	15%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Note: 1. Includes passengers and meeters/greeters

Assumptions About Rail Travel

The following assumptions were made for future rail travel to the Second Sydney Airport:

- a new rail link would be constructed between the airport and the existing Main Southern Line at Glenfield;
- sufficient connections would be made with the existing rail network to enable trains to transfer between the airport rail link and the Main Southern and East Hills Lines;
- rail services would run to/from the airport at least every 15 minutes during peak operating hours of the airport;
- direct, limited stop services would be available to major destinations including Sydney Central Business District, Parramatta and Sydney Airport;
- rail fares would be set so as to encourage use of rail; and
- some restrictions would exist on car parking at the airport for employees as well as passengers to constrain vehicle use.

These assumptions were largely consistent with the level of rail services to be provided at Sydney Airport by the New Southern Railway. For this reason, mode share predictions for the Second Sydney Airport were based on predictions for travel to Sydney Airport on completion of the New Southern Railway. As shown in *Table 19.5*, the expected rail mode share for the Second Sydney Airport is in the range 15 to 20 percent for employees and passengers.

If the actual level of rail infrastructure and services to the Second Sydney Airport is less than that assumed above, the resulting rail mode share might be less than predicted in the Draft EIS. For example, if all rail passengers travelling to and from the airport are required to change trains at Glenfield then rail would become less attractive as a mode for airport travel. Quantification of the likely impacts on patronage of different levels of service provision would be an important consideration in a more detailed future study of the airport rail link. Further discussion of strategic operational issues associated with provision of a rail link to the airport is contained in *Chapter 7* of this Supplement.

The traffic impacts of proceeding with the airport without the development of a rail link was modelled for this Supplement. The detailed results of this modelling are contained in *Appendix H3*. Mode shares without a rail link were estimated during the

Draft EIS process and are shown in *Table 19.5*. There is a predicted increase in bus and taxi use but it is assumed that most of the people that would have used rail would use a car instead in the absence of a rail link. The modelling indicates that the increased car use predicted on the surrounding road network would increase traffic levels by five to 10 percent over the with rail scenario. However, no additional road network improvements were identified as being required. Congestion levels and their impact on pollution would increase as would road travel times.

Assumptions About Bus Travel

The assumptions made in the Draft EIS regarding demands for travel by bus and coach to and from the Second Sydney Airport were based on the aim of providing adequate priority for buses and coaches over other road traffic. The intention of transit priority measures is to provide competitive travel times for buses and coaches, and to make them attractive alternatives to the private car.

The details of these priority measures – locations, measures and the like – must wait until options for airport access by all modes are determined in consultation with State and local government. However, the strategy framework would be for bus and coach routes to make use of existing and presently proposed facilities (such as the Parramatta to Liverpool Transitway) where possible, with new measures or facilities provided to meet targets for bus travel times or average speeds. Along the routes, these could include bus lanes, queue bypasses at traffic signals, or signal pre-emption and co-ordination. Other measures to maximise attractiveness of bus and coach services would include provision of direct routes, location of bus and coach terminals close to airport entrances and exits and exclusive bus and coach circulation within the airport precinct. Possible improvements to the bus network to service the airport are shown in *Figure 19.2*.

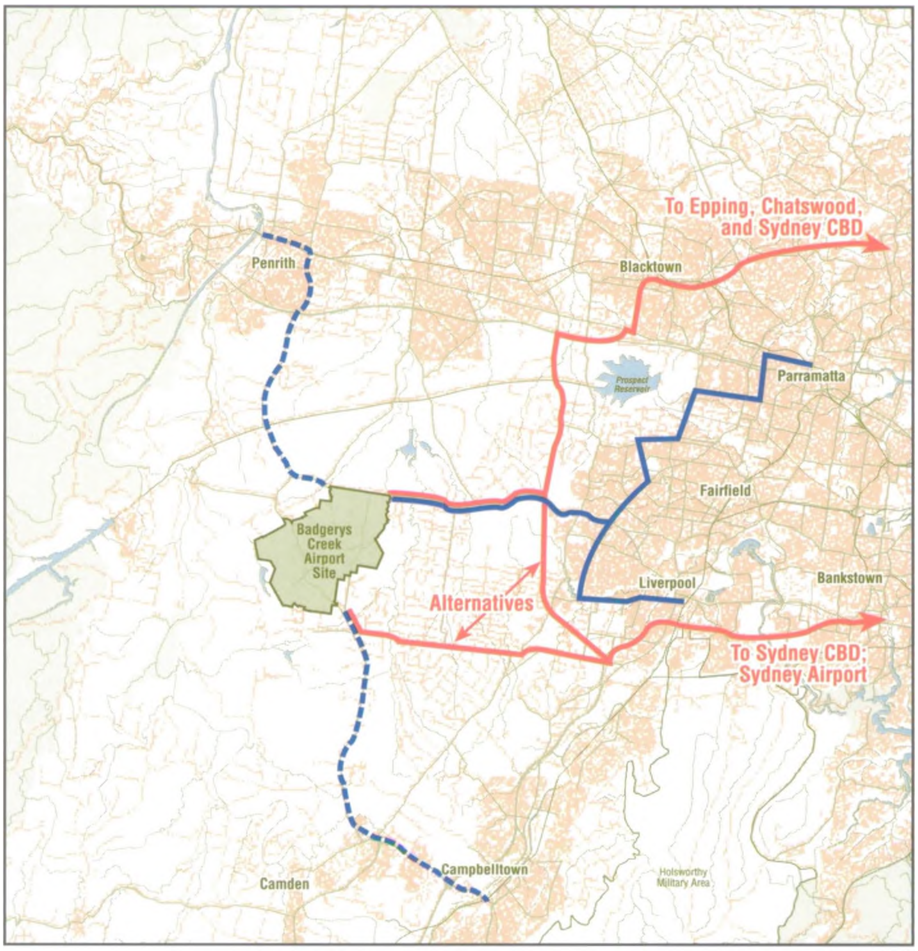
Table 19.5 indicates that predicted bus patronage for travel to and from the Second Sydney Airport is low, at around two to three percent when a rail link is provided. If the assumptions described above were not provided it is likely that bus patronage, and to a lesser extent rail, patronage would be less. However, any change in bus patronage would have only a minor impact on vehicle traffic levels as the predicted mode share for bus is low.

19.5.2 Measures to Encourage Use of Public Transport

A number of measures could be introduced to encourage the use of public transport to travel to and from the airport. Apart from measures already discussed, such as the provision of direct, high speed, high frequency rail services, more innovative measures being applied at airports overseas may be applicable. These include:

- specially designed airport trains that incorporate features such as increased luggage storage, more comfortable seating and interactive tourist information;
- passenger and baggage check-in facilities at major rail stations;
- high level of real-time rail service information at the airport and major stations;
- high levels of security on trains outside peak periods; and
- use of advanced, integrated ticketing technology.

Factors such as ride comfort, security and information provision are likely to be very important to prospective rail users to the airport. Similar arrangements could be implemented on regional bus services.



Main bus links to airport (utilises Liverpool-Parramatta Bus Transitway route)

Secondary bus links

Express bus services

Figure 19.2
Possible Improvements to the Bus Network

TN

0Km 10Km

Bus operational strategies would need to be integrated with rail strategies for the airport, but measures intended to encourage bus travel to and from the airport would include:

- bus and coach routes that are based on likely destinations of passengers and which maximise travel opportunities. These could include connections with the rail network (bus-rail interchanges) to facilitate travel to a range of destinations; direct bus services to destinations where multi-modal travel may not be possible or would not offer a travel time benefit; routes connecting employment and industrial areas to residential areas; and routes making use of high speed roads or bus priority facilities;

- bus routes as direct as possible, to reduce travel times;
- high frequency bus services, to minimise waiting times;
- buses with sufficient capacity for expected passenger demand and space for luggage as well as high degrees of comfort and accessibility. A range of bus types may be required for specific operational requirements;
- high quality transport information for passengers, including real-time information at bus stops;
- integrated electronic ticket systems; and
- passenger and baggage check-in at key interchanges.

In addition, public transport use could be encouraged by managing vehicle demand through measures such as:

- limiting car parking supply for employees;
- appropriate pricing of short and long stay parking;
- adopting employee-based schemes such as ride-sharing or van-pooling;
- providing real-time information on likely travel times by road; and
- imposing variable or static road user charges on access links to the airport.

Such a range of public transport and vehicle demand management measures could be integrated into an overall transport strategy for the airport. High levels of information about all transport options would ensure a more efficient use of different modes as well as increasing user benefits.

19.5.3 Rail Operational Issues

Scope of the Analysis

Issues regarding strategies for the provision of a rail link to the airport and urban development that may be associated with the rail link are addressed in *Chapter 7* of this Supplement. The Auditor and submissions raised a number of issues regarding the potential operation of such a rail link including rolling stock requirements, rail network constraints and potential involvement of the private sector in its operation.

The focus of the Draft EIS was on identifying potential corridors for the rail link, the type of rail services that would operate to the airport and expected mode shares for rail travel. The assumptions made about future rail service to the airport are discussed in *Section 19.5.2*. It was concluded that actual rail mode share would be different if assumed service levels were not achieved, or if additional measures were introduced to encourage use of public transport.

In the Draft EIS, it was assumed that a rail link would be constructed between the Second Sydney Airport at Badgerys Creek and the existing Glenfield station on the Main Southern Line. Connections to three existing rail lines would be feasible; these include:

- the extension of East Hills Line to meet airport rail link at Glenfield allowing direct services from Second Sydney Airport to Sydney Airport and the City;
- the connection to Main Southern Line north of Glenfield allowing direct services to Liverpool, Parramatta and Blacktown; and
- the connection to Main Southern Line south of Glenfield allowing direct services to Campbelltown, Southern Highlands and Canberra.

A rail link would have important operational implications for the wider Sydney rail network, depending on:

- the nature of rail link infrastructure, including existence of direct links to the East Hills and Main Southern Lines;
- the organisation responsible for operating airport rail services;
- the nature of rail services including service frequency, destinations and stopping patterns for example;
- the type of rolling stock used; and
- the fare structure and ticketing system.

It is outside the scope of the EIS to investigate operational impacts of the rail link but rather to identify the issues that would need to be considered in future assessment of the rail link.

Operation of the Rail Link

Previous NSW and Commonwealth Government land use planning for the sub-region surrounding the Second Sydney Airport examined the potential for residential development in the South Creek area and industrial and commercial development south of St Marys. As a result, options for a number of rail routes between Glenfield and the Second Sydney Airport, through various sectors of South Creek, were examined. A potential extension of these corridors from the airport to St Marys was also considered to be a long-term possibility.

The broad objectives of these investigations was to develop appropriate rail connections which:

- catered for a range of rail travel demands to broaden the patronage base of any new railway;
- take advantage of the strategic travel opportunities created by connections to the suburban rail network to maximise rail travel opportunities to the airport; and
- provide a direct connection between Sydney's Central Business District, Sydney Airport, Parramatta and the Second Sydney Airport to access the major air travel markets of Sydney and service interlining air passengers.

At the time of these investigations it was considered that airport rail services would probably be entirely provided by CityRail's suburban train services. Consequently, the prospect of third-party providers offering specific airport access rail services was not considered, although this now presents the prospect of more attractive airport-access-specific rail services.

Under the recent restructuring of rail authorities in NSW, ownership and maintenance of rail infrastructure has been separated from service provision. In this new environment, the operation of rail services is open to any organisation under a regime of track access charges. The NSW Government, as evidenced by its development of the New Southern Railway, and the proposed Bondi Beach and Parramatta-Chatswood Rail Links, is likely to continue to actively seek private sector participation in the construction and operation of new rail lines.

An opportunity would exist for a separate group, such as an airline consortium, to contribute to the financing and operation of the airport rail link. An overseas equivalent is the provision of competing Connex Outer-Suburban and Gatwick Express premium services between central London and London's Gatwick Airport.

Private sector involvement in the operation of the airport rail link would strongly influence the type of trains and services operated. Opportunities would exist for investing in high levels of service and competitive pricing to attract passengers to the Second Sydney Airport. Specially designed trains could be used to cater for the special needs of airport passengers and visitors.

Rail Services

Certain minimum levels of service would have to be offered irrespective of how the rail services would actually be provided. In strategic terms, connection of the Second Sydney Airport to Sydney's rail network would require at least two routes to be offered, namely:

- Second Sydney Airport–Glenfield–Sydney Airport–City; and
- Second Sydney Airport–Glenfield–Parramatta.

The previously considered Second Sydney Airport–St Marys–Parramatta service would only provide direct access to the Blacktown–Penrith corridor, which could equally be serviced by regional bus services.

The Second Sydney Airport–Glenfield–Sydney Airport–City route would jointly cater for interlining travellers and employee and traveller movements from Sydney and the northern, eastern and southern suburbs. The Second Sydney Airport–Glenfield–Parramatta route would cater for employee and traveller movements from Parramatta and the north-western, western and south-western suburbs. The following connections or interchanges would be required to service these demands:

- At Glenfield:
  - for local travel to Campbelltown/Macarthur and the Southern Highlands;
  - for local travel north to Liverpool, Fairfield, Granville and Regents Park;
  - for local travel east to East Hills, Riverwood and Kingsgrove;
- At Wolli Creek:
  - for local travel south to Hurstville, Sutherland, Cronulla and the South Coast;
  - for local travel north to Sydenham;
- At Sydney Airport to the Domestic and International Terminals for interlining travellers;
- At Sydney Central:
  - for direct access to the City Circle;
  - for local travel east to Bondi Junction;
  - for local travel north to North Sydney, Chatswood and Hornsby;
- At Liverpool/Cabramatta for direct access to these sub-regional centres; and
- At Parramatta:
  - for local travel east to Granville, Lidcombe, Strathfield and Burwood;
  - for local travel west to Blacktown, Riverstone, St Marys and Penrith.

The Second Sydney Airport–Parramatta service would be likely to be an extension of the Cumberland service currently running between St Marys–Parramatta–Liverpool–Glenfield–Campbelltown. A limited stop service would be desirable, at least between Glenfield and Parramatta where it overlaps with a number of current services.

To ensure attractive travel times for rail services, the Second Sydney Airport–Sydney Airport–Sydney service would probably need to be a new express service overlayed on the existing structure of all stops East Hills–City via Sydney Airport and limited stops Campbelltown–City via Sydney Airport services.

Frequencies on both the above services would need to be attractive for passengers. Minimum levels of services should be four trains per hour for each service over much of the working day. Multi-unit train operation would give the potential train operator flexibility in adjusting train sizes to match passenger demands. Eight car suburban trains can typically accommodate between 900 and 960 passengers. The premium service trains such as on the Second Sydney Airport–Sydney Airport–City route, could have less capacity which would have to be closely managed.

Capacity Issues

The ability to run airport rail services onto the East Hills and Main Southern Lines would depend on available capacity on these lines particularly during the weekday peak periods where CityRail services carry large numbers of commuters from the south-west to Sydney and Parramatta central business districts and other destinations on the rail network. The recent opening of the Harris Park Y-link has allowed direct services to operate between Campbelltown and Parramatta on the Cumberland Line. The recently released *Parramatta Draft Regional Environmental Plan* (Department of Urban Affairs and Planning, 1998d) promotes Parramatta's role as Sydney's second central business district, with strong growth in employment and commercial opportunities supported by high public transport accessibility. Demand for rail travel between the south-west and Parramatta is likely to grow. Sustained population growth in the south-west area, and the opening of the New Southern Railway, will also ensure that demand for travel from the south-west to the Sydney Central Business District and Sydney Airport on the East Hills Line will be high.

There would be a direct relationship between travel times, line capacity and the choice of operator for Second Sydney Airport rail services.

It would be likely that the Second Sydney Airport–Parramatta route would be operated by CityRail as an extension of its existing Cumberland service. Significant line capacity issues between Glenfield and Parramatta are unlikely. However, the Liverpool to Cabramatta section has existing capacity issues and may need augmentation in the future as part of a general program to jointly expedite passenger and freight train movements.

The Second Sydney Airport–Sydney Airport–City route would create a greater number of operational issues. The opening of the New Southern Railway with grade separation at the Illawarra Line, and the proposed track quadruplication works between Turrella and Riverwood, will increase capacity on the East Hills Line. However, should combined suburban services and the airport service exceed 12 trains per hour in either direction, quadruplication south-west of Riverwood may need to be considered to maintain performance. This capacity issue also arises with the potential use of the East Hills Line for upgraded longer distance services, such as a very high speed train between Sydney and Canberra.

Any significant growth in the number of trains using the East Hills Line, either from the Second Sydney Airport or non-suburban services such as an upgraded Sydney to Canberra service, might create capacity issues within the City rail system. For example, provision of a new Central Sydney terminus may need to be considered for an upgraded Sydney to Canberra service. Increasing capacity on the City Circle through the development of a new railway through central Sydney, such as the Metro-West Line, has been the subject of preliminary investigation by authorities over a number of years.

It is apparent that the operation of airport rail services would be in an environment of constrained capacity during the weekday morning and afternoon peak periods. The opening of the New Southern Railway with grade separation at the Illawarra Line, and the proposed track amplification works between Turrella and Riverwood, will increase capacity on the East Hills Line. A more detailed assessment of the operational scenarios for the expanded East Hills Line would determine achievable service frequencies and running times for airport rail services. The ability to run fast, limited stops services on the East Hills Line and other rail lines would be dependant on available train paths; express services place more demand on track capacity than slower, stopping services.

As well as considering rail infrastructure constraints, it would also be important to investigate impacts of train loadings on the operation of airport rail services. For example, in the afternoon peak passengers travelling to Second Sydney Airport might have to compete with commuters returning to the south-west region of Sydney.

The opportunity would exist for a third-party operator to provide premium quality rolling-stock which would have the potential to reduce travel times. Such travel time improvements would be dependent on the maintenance of appropriate line capacity. The third-party operator could offer distinctive, easily-policed, capacity-controlled services to meet the interlining requirements between Sydney Airport and the Second Sydney Airport. Such third-party operations would, however, not preclude the provision of suburban train access to the Second Sydney Airport and with that the facilitation of access to the majority of the existing suburban rail network.

19.6 Road Impacts

19.6.1 Traffic Volumes

The Auditor's Report requested that expected traffic volumes on access roads to the airport site be presented to determine the capacity requirements on these roads. Future traffic volumes for the two proposed airport access roads to the airport, off Elizabeth Drive and The Northern Road, were reported in the first two rows of Table 22.8 of the Draft EIS.

19.6.2 Construction Traffic

Information obtained from the Second Sydney Airport Planners (1997a) was used to establish the likely traffic generation resulting from construction activity, particularly those caused by heavy vehicles. The expected time frame for the construction of each airport option was described in the Draft EIS. Night work was included as part of construction planning.

Construction traffic would mainly consist of workforce vehicles (up to 3,800 vehicles per day) and heavy vehicles (up to 900 vehicles per day) carrying quarry products and building materials.

Figure 19.3 details the principal routes to be used by construction traffic. Expected construction traffic volumes, during the morning and afternoon peak hourly period along these routes are included in *Table H4.1* of *Appendix H4*.

Traffic volumes along The Northern Road and Elizabeth Drive would experience the largest increase as a result of construction traffic. The section of The Northern Road between Elizabeth Drive and Adams Road, the possible route to the airport site during construction, would need to be widened to a four-lane carriageway. While other approach roads, such as Bringelly Road and Wallgrove Road, would also be affected by construction traffic, they would continue to operate at acceptable levels of service.

Twelve intersections were identified for impact analysis of construction traffic on the local road network; their locations and existing traffic control are included as *Table H4.2* of *Appendix H4*.

The traffic volumes likely to be generated by construction activities associated with the Second Sydney Airport were assigned to the intersections. The intersections were then assessed using the intersection analysis program INTANAL V3.15. The average delays of vehicles, which represent the main parameter for the assessment of intersections, are summarised in *Table H4.2* of *Appendix H4* for the following scenarios:

- base case condition;
- with peak Stage 1 construction activities; and
- at peak master plan construction activities.

Figure 19.3 illustrates the existing traffic management measures, in addition to the anticipated measures that need to be installed to cope with the impact of the volume of construction traffic. The existing unsignalised intersections of Elizabeth Drive with Devonshire Road, of Bringelly Road with Cowpasture Road and Camden Valley Way, and The Northern Road with the access to site assumed at Adams Road would require the following treatments:

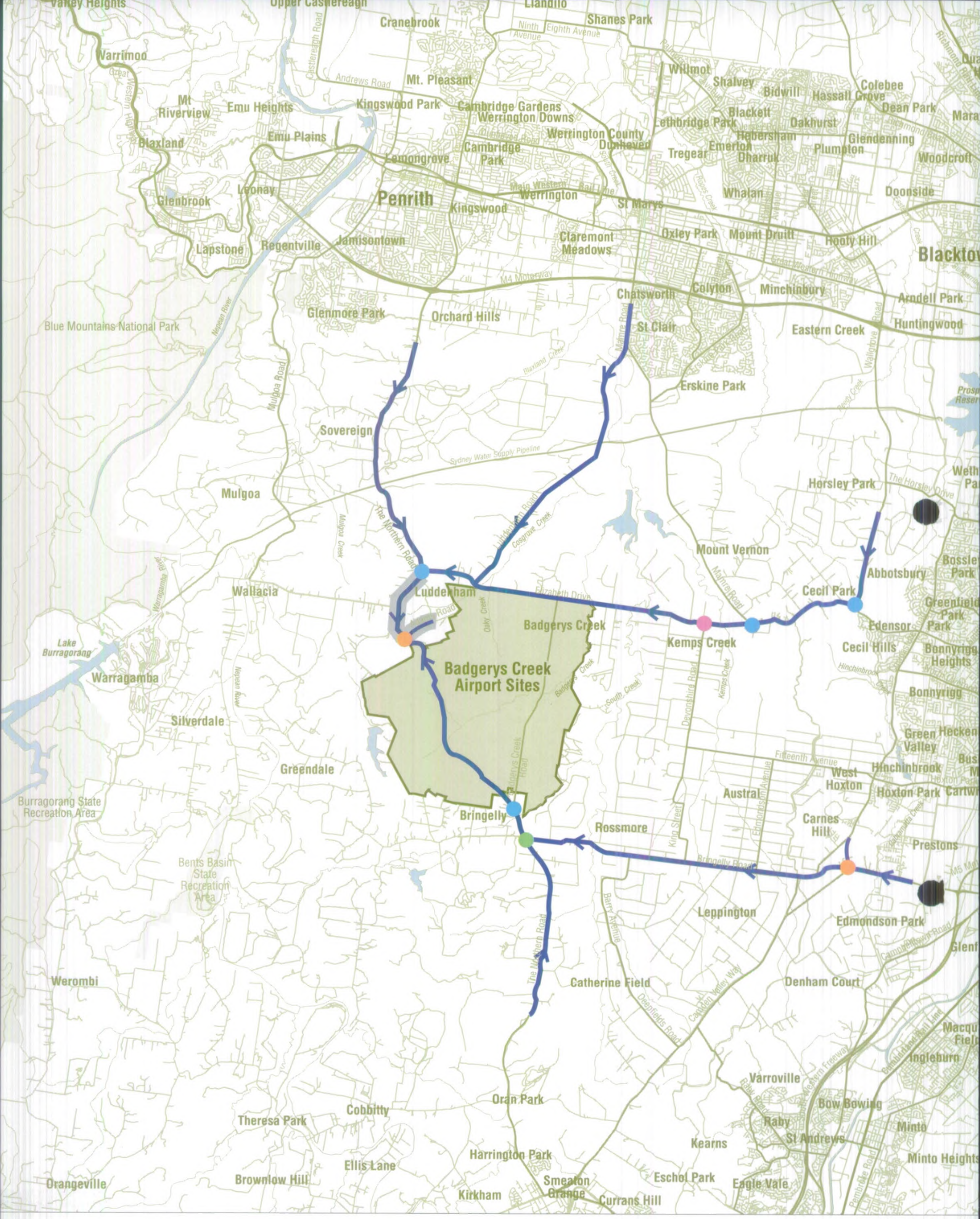
- intersection widening and improvements for right-turning traffic at the intersection of Elizabeth Drive and Devonshire Road;
- installation of traffic signals at the intersections of Bringelly Road with Cowpasture Road and Camden Valley Way (the NSW Roads and Traffic Authority presently propose to merge these intersections to form one signalised intersection); and
- installation of traffic signals at The Northern Road-Adams Road intersection, providing access to the airport site.

All other intersections are estimated to continue to operate at satisfactory levels of service.

19.6.3 Road Improvements

The Auditor suggested that future road improvements required without the Second Sydney Airport should be illustrated, so that they might be seen in context. The Draft EIS described these road improvements in Section 22.4.

Some submissions suggested that identified road network improvements without an airport were overestimated in the Draft EIS. *Section 19.4* of this Chapter discusses the likely impact of demand management measures intended to constrain future car use.



Roundabout

Signalised

Proposed Widening and improvements

Proposed signalisation

Upgrade to four lanes

Approach routes

Figure 19.3

Construction Traffic Approach Routes and Traffic Control at Major Intersections

Also discussed in *Section 19.4* is the overall accuracy of traffic forecasting in the Draft EIS. Further modelling, assuming a reduction in total vehicle kilometres travelled, suggests that while resulting traffic levels and congestion on the road network would decrease, the majority of road network improvements identified in the Draft EIS would still be required.

Also raised was the issue of traffic congestion in western Sydney resulting from construction of the Second Sydney Airport, and the suggestion that road network improvements identified for airport traffic were inadequate. It was concluded in the Draft EIS that without substantial improvements to the current road network in the vicinity of Badgerys Creek, severe congestion would occur. Road network improvements were identified that would be sufficient to provide a reasonable level of service to airport and background traffic (with a reasonable level of service being that under which traffic levels are within roadway capacity and delays are not excessive). Even with such improvements some congestion would still occur during peak periods but at a level consistent with that experienced in other parts of urban Sydney.

19.6.4 Impact of Closure of Badgerys Creek Road on Devonshire Road

The Draft EIS assumed that construction of the Second Sydney Airport under any option would require the closure of Badgerys Creek Road as a link between The Northern Road and Elizabeth Drive. The NSW Government and Liverpool City Council raised the impacts of such a closure as an issue; NRMA Limited was also concerned with the impacts on traffic volumes and safety on Devonshire Road. In response to these issues, further investigations were conducted into the impact of establishing a replacement road link for Badgerys Creek Road adjacent to the airport site.

Traffic model runs were conducted with three scenarios:

- 2016 background traffic without airport and Badgerys Creek Road open;
- 2016 background traffic with airport and no alternative through route for Badgerys Creek Road; and
- 2016 background traffic with airport and alternative route established.

Modelled traffic volumes and predicted level of service for Badgerys Creek Road, Devonshire Road and Northern Road with and without a replacement road link for Badgerys Creek Road are shown in *Table 19.6*. If a replacement link for Badgerys Creek Road was provided, traffic volumes on The Northern Road and Devonshire Road would be between 15 and 20 percent less than if no replacement link were provided.

Devonshire Road and King Street serve as a connecting route between Elizabeth Drive and Bringelly Road and both roads are of a two-lane rural road standard. The King Street portion of the route is not of a standard suitable for carrying high volumes of traffic; the road alignment in some locations is poor with tight corners and narrow pavement. The current standard of both Devonshire Road and King Street is considered inadequate to safely carry predicted traffic volumes associated with the Second Sydney Airport, regardless of whether a replacement road link for Badgerys Creek Road is provided. Low-cost, isolated remedial measures are unlikely to be sufficient to adequately address all safety issues. Thus, it is most likely that the full route between Elizabeth Drive and Bringelly Road would require upgrading to four-

Table 19.6 Modelled Traffic Volumes and Level of Service (LOS)[1] on Badgerys Creek Road (or Alternative Road) Devonshire Road and The Northern Road (Airport Option C in 2016)

	AM Peak		PM Peak		Daily Traffic Volume
Section Scenario	Volume[2]	Level of Service	Volume[2]	Level of Service	
Badgerys Creek Road (or Alternative Link) between Elizabeth Drive and The Northern Road					
Without Second Sydney Airport	389	A	370	A	4,580
With Second Sydney Airport and no alternative route	-	-	-	-	-
With Second Sydney Airport and alternative route established	731	A	750	A	8,607
Devonshire Road - Elizabeth Drive to Fifteenth Street					
Without Second Sydney Airport	494	A	484	A	5,690
With Second Sydney Airport and no alternative route	1,032	D	1,102	D	11,890
With Second Sydney Airport and alternative route established	894	C	884	C	10,300
Devonshire Road - Fifteenth Street to Bringelly Road via King Street					
Without Second Sydney Airport	395	A	397	A	4,550
With Second Sydney Airport and no alternative route	761	B	772	B	8,760
With Second Sydney Airport and alternative route established	572	A	577	A	6,600
The Northern Road South of Elizabeth Drive					
Without Second Sydney Airport	751	A	800	A	8,620
With Second Sydney Airport and no alternative route	925	C	884	C	10,620
With Second Sydney Airport and alternative route established	748	A	714	A	8,590
The Northern Road between Bringelly Road and Badgerys Creek Road					
Without Second Sydney Airport	1,544	F	1,503	F	18,670
With Second Sydney Airport and no alternative route	3,176	F	2,793	F	38,400
With Second Sydney Airport and alternative route established	3,592	F	3,257	F	43,430

Notes: 1. Level of Service is discussed in detail in Technical Paper No. 13.
2. Vehicles per hour.

lane standard with substantial realignment between Fifteenth Avenue and Bringelly Road. Furthermore, the establishment of a replacement link for Badgerys Creek Road would provide limited benefits to traffic in the vicinity of the airport and would not be justified.

19.6.5 Transport of Fuel by Road

Details of the routes likely to be used for the transport of aircraft fuel to the Second Sydney Airport in the period prior to the commissioning of a fuel pipeline to the airport site and the hazards and risks associated with the fuel transportation are detailed in *Chapter 16* of this Supplement.

19.6.6 Emergency Vehicle Access Routes

Emergency vehicle access routes have not been specifically assessed at this stage of the airport planning process. Nevertheless, there are key elements of the emergency vehicles route considerations which would not be affected. It is assumed that, where required, emergency vehicles would be primarily drawn from the Penrith, Blacktown, Parramatta and Liverpool areas. If additional vehicles are required they would most probably be drawn from the Fairfield, Campbelltown and Camden areas.

Priority evacuation routes would most probably be established leading to the nearest major hospital, which would indicate that Penrith would have the highest priority. The most likely routes to and from the airport sites for emergency vehicles would be:

- Penrith — by way of Luddenham Road, the M4 Motorway and beyond;

  or by way of The Northern Road, the M4 Motorway and beyond;
- Blacktown — by way of Elizabeth Drive, the Western Sydney Orbital, the M4 Motorway and beyond;
- Parramatta — by way of Elizabeth Drive, the Western Sydney Orbital, the M4 Motorway and beyond; and
- Liverpool — by way of Elizabeth Drive; or

  by way of Elizabeth Drive, the Western Sydney Orbital, the M5 Motorway, Hume Highway and beyond; or

  by way of The Northern Road, Bringelly Road, Camden Valley Way, the M5 Motorway, Hume Highway and beyond.

All of these routes would provide an acceptable level of service for emergency vehicles provided the road network improvements identified in the Draft EIS were implemented.

19.7 Other Transport Issues

19.7.1 Travel Times

The Draft EIS included travel times for road and rail transport between the Second Sydney Airport and the Sydney and Parramatta business districts. The EIS Guidelines also required travel times to Penrith, Liverpool and other regional centres. Additionally, submissions on the Draft EIS requested bus travel times.

Estimated morning peak travel times by road, rail and bus between the Second Sydney Airport and a range of key centres in 2016 are summarised in *Table 19.7*. All

Table 19.7 Comparative Travel Times (Road, Rail, Bus) from Second Sydney Airport to Nominated Centres (2016 AM Peak)

Centre	Road Travel Time (minutes): Base Case (No Reduction in VKT[2]) From Airport	Base Case (No Reduction in VKT[2]) To Airport	20 Percent Reduction in VKT[2] From Airport	20 Percent Reduction in VKT[2] To Airport	Bus/Rail Travel Time[3] (minutes) Options A and B	Bus/Rail Travel Time[3] (minutes) Option C
Sydney CBD	74[1]	60[1]	62	57	48[1]	45[1]
Parramatta CBD	42[1]	38[1]	36	37	33[1]	30[1]
Sydney Airport	59	50	48	48	41	38
Blacktown	35	35	30	32	43	40
Campbelltown	28	25	25	24	30	27
Liverpool	21	23	20	22	22	19
Penrith	13	14	13	13	26[4]	26[4]
Camden	18	20	18	18	36[4]	36[4]
Castle Hill	42	47	38	44	48[5]	45[5]

Notes:
1. *Reported in Draft EIS.*
2. *VKT means vehicle kilometres travelled. Refer Section 19.4.4 of this Chapter.*
3. *Reported times to all centres except Penrith, Camden and Castle Hill assume direct rail services.*
4. *Travel times assume direct bus route between Second Sydney Airport and both Penrith and Camden via The Northern Road.*
5. *Travel time assumes rail to Parramatta and bus or light rail to Castle Hill.*

road travel times are for the morning peak and have been estimated from the results of the traffic model based on predicted levels of service on the major motorways and arterial roads. The base case scenario is that used in the Draft EIS without specific consideration of a major shift in car use. The second scenario, assuming a 20 percent reduction in total vehicle kilometres travelled in the Sydney region, corresponds with a demand management scenario discussed in *Section 19.4*. Travel times with substantial demand management in place are predicted to be less, although the amount of difference varies with destinations.

All of the road travel times shown in *Table 19.7* assume that road network improvements identified in the Draft EIS would be implemented. Without such improvements, congestion and resulting delay would be extreme, to such an extent that no estimations have been made of likely travel times to each centre.

The assumptions made about rail infrastructure and services from the airport were outlined in *Section 19.5.3* of this Chapter. With regard to travel times, the important assumptions were:

- direct, limited stops services would operate to the Sydney central business district and Sydney Airport via Glenfield and the East Hills Lines;
- direct, limited stops services would operate to Liverpool, Parramatta and Blacktown via Glenfield and the Main South Line with transfers required for travel to Penrith; and
- passengers travelling to Campbelltown would be required to transfer at Glenfield.

19.7.2 Funding of Transport Infrastructure

The issue of the cost and funding of off-airport road infrastructure was raised in submissions on the Draft EIS. Also, the issue of the relative remoteness of the airport region and the requirement for increased government funding for public transport has been raised in submissions. These issues are discussed in *Chapter 22* of this Supplement.

The opinion was expressed in submissions that construction of the Western Sydney Orbital road is independently justifiable, and should be developed separately from any decision related to the construction of the Second Sydney Airport. This is not an issue for consideration in this EIS. However, it should be noted that the Draft EIS, in Section 22.4, indicated that, as a result of traffic modelling of the airport region background traffic, there was a need for the Western Sydney Orbital to be built between the M5 Motorway and the M4 Motorway as a four-lane motorway/divided road by 2006. For this reason the cost of the Western Sydney Orbital was not included in the estimated access costs for the Second Sydney Airport contained in Table 24.1 of the Draft EIS. The NSW Roads and Traffic Authority is currently finalising the EIS for the Western Sydney Orbital proposal.

19.8 Overview of Land Transport

A major centre of activity such as the Second Sydney Airport would significantly affect Sydney's public transport systems and the road network during both construction and operation. Extensive traffic modelling was carried out for the Draft EIS and this Supplement to quantify the extent of these impacts. Key aspects of the traffic modelling were:

- the traffic model included the whole of metropolitan Sydney;
- land use scenarios and a possible future Sydney road network were used to arrive at a range of future road travel estimates in terms of vehicle trips between specific origin and destination zones;
- forecast trips were assigned to their quickest route through the road network. This process produced forecast traffic volumes and travel speeds;
- the implications of the general growth in traffic levels resulting from increased urban development without the development of the airport were assessed. Background growth in traffic levels would place enormous demands on the existing road network;
- the predictions of the airport traffic impacts on surrounding motorways were based on future traffic models developed for the years 2006 and 2016. The 2016 model assumed that the Second Sydney Airport would reach its operating limit of 30 million passengers per year; and
- a strong and viable rail service was assumed for each airport option.

During the peak construction period for the Second Sydney Airport there would be about 900 trucks a day travelling to and from the airport site and up to 3,800 vehicle trips a day by construction workers. *Table 19.8* provides a comparison of predicted construction traffic volumes with existing traffic levels. Traffic volumes along The Northern Road and Elizabeth Drive would experience the highest increase as a result of construction traffic. It is expected that along the two-lane section of Elizabeth Drive the level of service would deteriorate. The section of The Northern Road between Elizabeth Drive and Adams Road, which is the possible access to the airport site during construction, would need to be widened to four-lanes. While other approach roads such as Bringelly Road and Wallgrove Road would also carry construction traffic, they would continue to operate at acceptable levels of service.

Table 19.8 Daily Construction Traffic (Two-Way)[1] for Airport Options

Major Approach Roads	Daily Traffic Volumes			
	Existing Traffic[2]	Construction Traffic	Total During Construction	Increase
Bringelly Road, east of The Northern Road	5,000	950	5,950	19%
Elizabeth Drive, east of The Northern Road	5,500	2,490	7,900	45%
The Northern Road, south of Elizabeth Drive	8,600	3,290	11,890	38%

Notes: 1. In equivalent passenger car units. Assumes construction to master plan stage.
2. From Roads and Traffic Authority and commissioned counts.

Figure 19.3 illustrates the existing traffic management measures, in addition to the measures that would need to be installed to accommodate the estimated volume of construction traffic. The following intersection treatments would be required:

- intersection widening and improvements for right-turning traffic at intersection of Elizabeth Drive and Devonshire Road;
- installation of traffic signals at the intersections of Bringelly Road with Cowpasture Road and Camden Valley Way; and
- installation of traffic signals at The Northern Road/Adams Road intersection, providing access to the airport site.

Before the transport impacts of the operation of the Second Sydney Airport could be assessed, it was necessary to obtain an understanding of how Sydney's transport would operate without a second airport. Modelling road traffic patterns without a Second Sydney Airport allowed a distinction to be made between background traffic conditions and additional traffic associated with a particular airport option.

Modelling showed that a number of road improvements would be needed to accommodate background traffic growth. The most significant of these improvements included:

- Western Sydney Orbital, potentially constructed in stages;
- Wallgrove Road as a four-lane divided road, but potentially replaced by the Western Sydney Orbital;
- Cowpasture Road widened to four-lanes;
- M2 Motorway extended to Richmond Road as a first stage and then to Stoney Creek Road as a second stage;
- Werrington Arterial;
- widening of parts of the South-Western Freeway and the M5 Motorway;
- Camden Valley Way widened to four-lanes;
- parts of Brooks Road widened to four-lanes;
- route between Glenfield and Campbelltown upgraded to four-lanes;
- Elizabeth Drive widened to four-lanes between Cowpasture Road and Cabramatta Road; and
- Prospect Arterial built to two-lanes between the Great Western Highway and The Horsley Drive.

It is estimated that in 2016 up to 139,000 people would travel to and from the airport by car, truck, taxi, bus or train each day. This would result in between 66,000 and 77,000 vehicle trips to and from the airport each day. The lower figure assumes that a rail line would be built while the higher figure has been calculated to assess transport impacts if no rail line is provided. The forecast mode of travel to and from the Second Sydney Airport, with and without rail, is shown in *Table 19.9*.

Table 19.9 Forecast Daily Person Trips To and From the Second Sydney Airport in 2016[1]

Mode of Travel	Employees	International[2]	Domestic[2]	Total
Without Rail				
Car drivers	15,700	23,300	12,200	51,200
Car passengers	1,500	38,200	11,500	51,200
Taxis	400	12,500	10,400	23,300
Bus	900	4,200	2,200	7,300
Coaches	0	5,000	700	5,700
Rail	0	0	0	0
Total	**18,500**	**83,200**	**37,000**	**138,700**
With Rail				
Car drivers	13,300	20,800	11,100	45,200
Car passengers	900	33,200	10,400	44,500
Taxis	200	10,000	8,100	18,300
Bus	400	1,700	1,100	3,200
Coaches	0	5,000	700	5,700
Rail	3,700	12,500	5,600	21,800
Total	**18,500**	**83,200**	**37,000**	**138,700**

Note: 1. Based on Air Traffic Forecast 3
2. Includes air passengers and meeters/greeters. For every two international passengers, there would be a meeter and greeter trip to and from the airport, while for every four domestic air travellers, a meeter or greeter trip is generated.

Modelling indicates that the following main routes would be used by traffic accessing the airport site:

- Mamre Road/Luddenham Road/Elizabeth Drive or the Western Sydney Orbital and Elizabeth Drive from the north;
- The Northern Road or Mulgoa Road from the north-west;
- M5 Motorway/Western Sydney Orbital/Elizabeth Drive from the east; and
- South-Western Freeway/Bringelly Road/The Northern Road from the south-east.

Table 19.10 provides estimates of future traffic volumes on key approach roads to the Second Sydney Airport.

A number of intersections near the airport sites would need to be upgraded in the future, as a result of airport activities. These upgradings would include the provision of traffic signals or grade separated junctions.

Substantial improvements to the road network surrounding the airport sites would be required to achieve satisfactory access to the airport and to maintain an acceptable levels of service to existing land uses in the vicinity. The minimum improvements

Table 19.10 Future Traffic Volumes[1] on Key Approach Roads to Second Sydney Airport (Average Daily Traffic)

Location	Without Airport 2006	With Airport (Forecast 2) 2006	Percentage Increase	Without Airport 2016	With Airport (Forecast 3) 2016	Percentage Increase
Airport Entrance (Elizabeth Drive)	n/a	24,600	n/a	n/a	61,400	n/a
Airport Entrance (The Northern Road)	n/a	8,800	n/a	n/a	20,200	n/a
Bringelly Road west of Cowpasture Road	23,200	29,200	26%	18,700	31,800	70%
Elizabeth Drive west of Wallgrove Road	23,200	30,200	30%	20,300	37,400	84%
Elizabeth Drive west of Mamre Road	14,000	26,600	90%	17,500	43,600	149%
Luddenham Road north of Elizabeth Drive	7,100	24,500	245%	4,600	55,000	1,100%
M4 Motorway east of Wallgrove Road	128,000	141,600	11%	131,200	160,000	22%
Mamre Road south of M4 Motorway	33,600	46,800	39%	26,800	68,600	156%
The Northern Road north of Bringelly Road	17,900	29,000	62%	18,700	47,800	156%
M5 Motorway east of Moorebank Avenue	n/a	n/a	n/a	85,400	88,000	3%
Western Sydney Orbital south of M4 Motorway	37,800	37,800	0%	70,900	75,400	6%

Note: 1. Figures rounded to nearest 100

required, in addition to those previously identified in the Draft EIS, to cater for background traffic growth include:

- establishment of a direct access route from the airport site to the M4 Motorway of four-lane divided carriageway standard, by 2006. This could connect with the M4 Motorway at either Mamre Road or at the site of the future Werrington Arterial (connecting the M2 Motorway to the M4 Motorway) to the west of Mamre Road;
- upgrade of Elizabeth Drive between The Northern Road and Wallgrove Road to four-lane divided carriageway standard by 2006, and six lanes by 2016;
- relocation and upgrade of The Northern Road north of Bringelly Road to the M4 Motorway to provide a four-lane carriageway by 2006;
- upgrade of Bringelly Road between The Northern Road and its junction with Camden Valley Way to four-lanes, by 2006; and
- provision of appropriate traffic controls at critical intersections.

Estimates of travel times by road, rail and bus between the Second Sydney Airport and a range of key centres in 2016 are summarised in *Table 19.11*. Road travel times would be lower than those estimated should the NSW Government achieve its objectives of significantly reducing vehicle kilometres travelled per capita by road within the Sydney metropolitan area over the next 20 years.

Alternatives for providing rail access to an airport at Badgerys Creek have been the subject of investigation by the NSW and Commonwealth Governments over recent years. The rail connection would likely link the airport to the Cumberland and East Hills Rail Lines at Glenfield. Detailed route selection, feasibility, operational and environmental impact assessment studies would need to be carried out prior to a decision being made on the development of the rail link.

The NSW Government has adopted a strategy for reducing road transport demand over the next 20 years. Additional traffic modelling undertaken for this Supplement indicates that the achievement of the NSW Government's aim of a significant

Table 19.11 Comparative Travel Times (Road, Rail, Bus) from Second Sydney Airport to Nominated Centres (2016 AM Peak)

Centre	Road Travel Time (minutes)				Bus/Rail Travel Time[3] (minutes)	
	Base Case		20 Percent Reduction in VKT[2]			
	From Airport	To Airport	From Airport	To Airport	Options A and B	Option C
Sydney CBD	74[1]	60[1]	62	57	48[1]	45[1]
Parramatta CBD	42[1]	38[1]	36	37	33[1]	30[1]
Sydney Airport	59	50	48	48	41	38
Blacktown	35	35	30	32	43	40
Campbelltown	28	25	25	24	30	27
Liverpool	21	23	20	22	22	19
Penrith	13	14	13	13	26[4]	26[4]
Camden	18	20	18	18	36[4]	36[4]
Castle Hill	42	47	38	44	45[5]	45[5]

Notes:
1. *Reported in Draft EIS.*
2. *VKT means vehicle kilometres travelled. Refer Section 19.4.4 of this Chapter.*
3. *Reported times to all centres except Penrith, Camden and Castle Hill assume direct rail services.*
4. *Travel times assume direct bus route between Second Sydney Airport and both Penrith and Camden via The Northern Road.*
5. *Travel time assumes rail to Parramatta and bus or light rail to Castle Hill.*

reduction in vehicle kilometres travelled would not significantly alter the conclusions of the Draft EIS in regard to road improvements required to accommodate both background traffic and traffic generated by the airport.

Nevertheless, a range of measures could be put in place to increase the percentage of public transport trips to and from the airport. These measures could include establishing bus priority measures on major road links to the airport.

Chapter 20

Aviation

Chapter 20
Aviation

20.1 Summary of the Draft Environmental Impact Statement

Chapter 8 of the Draft EIS outlined the purpose of the airport planning process. It included airspace management and airport operating scenarios. The various elements of airspace were described, as well as the legislative powers of Airservices Australia, the Department of Defence and the Civil Aviation Safety Authority.

The Chapter included a description of the factors to be taken into consideration by air traffic controllers in their selection of runways for use at airports. It also discussed airport operating scenarios, which are based on the rules and practices currently in use.

Chapter 8 addressed how the efficient management of airspace in the Sydney basin would be influenced by the location of the Second Sydney Airport in relation to Sydney Airport and other aerodromes, and by the runway orientation at Badgerys Creek. It concluded that management of airspace in the Sydney basin would be more effectively and efficiently carried out if the parallel runways at the Second Sydney Airport were in the same general direction as the parallel runways at Sydney Airport.

Chapter 9 of the Draft EIS described the three airport options under consideration. It included a description of the preliminary flight paths and flight zones for each runway and operating scenarios for each of the three options. The Chapter identified that the main consideration when designing the preliminary flight paths was air traffic management, particularly how the flight paths would interact with aircraft operating to or from Sydney Airport.

Chapter 15 of the Draft EIS summarised the air quality study documented in *Technical Paper No. 6*. It included reference to fuel dumping and fuel venting.

Chapter 22 of the Draft EIS outlined the potential transport impacts. For the aviation component, each option would have various impacts on the operations at other airports in the Sydney basin and the surrounding airspace. The Chapter identified the potential closure and/or reduction in activity at some secondary airports, the loss of much of the general aviation training area, impacts on sporting aviation, and the impact on the Department of Defence facility at Orchard Hills.

20.2 Summary of Issues Related to Aviation

20.2.1 Issues Raised in Submissions

The Draft EIS attracted a number of comments about the interaction between Sydney Airport and the proposed Second Sydney Airport. Some submissions argued that this interaction had not been analysed in sufficient detail, while other submissions asserted that the interaction was not as critical as described in the Draft EIS. The submissions cited multi-airport environments, such as London and New York, where it was considered that air traffic was denser than at Sydney, yet not as complex as was envisaged for the Sydney basin. Some also claimed that if multi-airport operations can function effectively and efficiently in London and New York, then Sydney could easily cope with Options A or B rather than Option C.

Other submissions claimed that the Draft EIS did not make clear the advantages of Option C over Options A and B, or the implications of Options A and B in relation to operations at Sydney Airport.

Some submissions contested the claim in the Draft EIS that the final flight paths for the second airport would need to be consistent with the operating arrangements brought about by the *Long Term Operating Plan for Sydney (Kingsford Smith) Airport and Associated Airspace* (Airservices Australia, 1996). The grounds for this were that, under *Air Traffic Forecast 3* and the development of 2016 traffic scenarios, the Second Sydney Airport could be the predominant airport, leading to the run-down of Sydney Airport. This led to the proposition that the runways at Badgerys Creek should be aligned with the local prevailing winds (Options A and B), rather than with the existing direction of the parallel runways at Sydney Airport (Option C).

Other submissions asserted that the runways at the Second Sydney Airport should be orientated to preserve or enhance the *Long Term Operating Plan* at Sydney Airport.

Many submissions criticised the potential limitations and impacts on the secondary aerodromes of Bankstown, Camden and Hoxton Park. It was claimed that such constraints were not imposed in similar environments overseas, and instances of a mix of such activities in the Los Angeles and London areas, as well as in Melbourne and in Hobart were cited. Most of these submissions were concerned that, following the construction of the Second Sydney Airport, there would be little, if any, opportunity for flying training or sporting and recreational flying in the Sydney basin.

Other submissions were critical of the need to relocate the general aviation flying training areas, and claimed that there was insufficient consideration of the users of such flying training areas. Most of these submissions suggested that the EIS process should identify alternative sites for general aviation aerodromes and flying training areas, as well as describe the impacts on the new sites. It was suggested that the development of the Second Sydney Airport must be accompanied by a comprehensive plan for the future of general aviation in the Sydney region.

There was also concern that there has been insufficient consideration of industries affected by the closure of Hoxton Park Airport and the constraints imposed on Camden and Bankstown Airports.

Submissions from sporting aviation representatives criticised the impact on activities such as gliding, which has had a presence at Camden for over 40-years.

Several submissions referred to previous studies which had determined that no secondary airports in the Sydney basin would be affected by the construction and operation of the Second Sydney Airport.

There were claims that the constraints imposed by the location of the Department of Defence Establishment Orchard Hills had been underestimated.

A number of submissions expressed concern about fuel dumping and fuel venting, particularly the effect on air quality and water supply.

20.2.2 Issues Raised by the Auditor

The Auditor noted that, under Options A or B, there would be convergence of aircraft approaches to the north of the two airports and that this would affect the capacity of one or both airports. The Auditor suggested this problem had not been investigated and therefore the consequences for noise and other environmental impacts were not assessed.

The Auditor was critical that there was no consideration of the effect of the airport operations on other regional airports.

20.3 Responses to Aviation Issues

20.3.1 Standard Operating Requirements

Airspace for multi-airport environments is determined by a number of factors, including:

- operational and environmental requirements of each airport;
- runway directions and the resultant arrival and departure paths for each airport;
- obstacle clearance;
- noise abatement procedures;
- secondary airports and access to them; and
- restricted airspace.

The final approach path to a runway must be in line with the runway centre line. The departure path must follow the extended centre line until the aircraft passes through at least 500 feet (152 metres), after which it may turn, subject to obstacle clearance and the appropriate clearance by air traffic control. In determining airspace requirements, consideration must be given to the approach and departure paths and sufficient room for manoeuvring aircraft in the terminal area, particularly for positioning aircraft for final approach. Arrival and departure tracks are normally segregated to enable efficient use of airspace. The provision of segregated tracks is central to the safe and efficient operation of a terminal airspace environment at any reasonable traffic level.

A Standard Instrument Departure is a published procedure which prescribes the initial tracking instructions to be flown on departure from an aerodrome until the aircraft reaches a specified point on its air traffic control cleared route. It may also include altitude, performance and speed requirements or restrictions.

A Standard Arrival Route is a published procedure which prescribes the route to be flown from the en route phase to a fix at, or near, the destination aerodrome.

Standard Instrument Departures and Standard Arrival Routes are issued by air traffic control to aircraft just prior to departure or whilst en route. They enhance safety by providing the pilot with unambiguous instructions which assist in reducing potential air traffic conflictions, minimising air/ground talk time, and aircrew and air traffic controller workload. The use of these procedures usually necessitates altitude restrictions, and in many cases, crossovers between combinations of arriving and/or departing aircraft.

Aircraft operating under Instrument Flight Rules are required to be separated vertically by a minimum of 1,000 feet (about 300 metres), or when at the same altitude and under radar control, by a minimum of three nautical miles (about 5.5 kilometres). The minimum radar control separation standard will be increased if an aircraft following another could be subject to wake turbulence from the preceding aircraft.

20.3.2 Concept of Operations

For air traffic management purposes, the most efficient operating procedure at an airport equipped with parallel runways is when each runway is used by both arriving and departing aircraft. Aircraft using the left runway turn left shortly after take-off and usually join final approach from the left. Aircraft using runway the right runway turn right shortly after take-off and usually join final approach from the right.

The use of parallel runways has considerable air traffic management advantages over crossing runways because it requires less complex procedures on the ground and in the air.

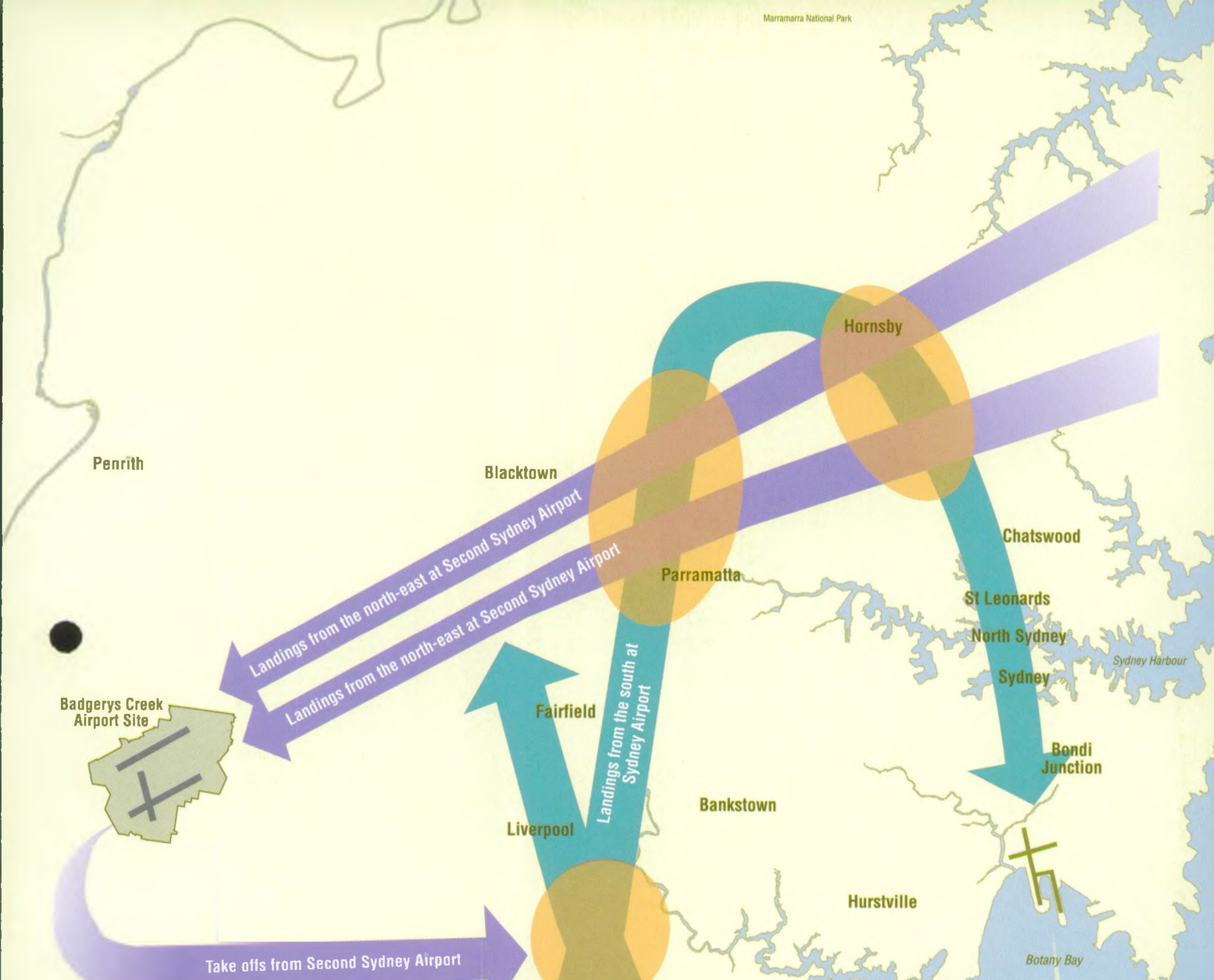
Should the Second Sydney Airport be constructed, complementary Standard Instrument Departures and Standard Arrival Routes, which would take into account the separation standards identified in *Section 20.3.1* of this Chapter, would be provided for Sydney Airport and the Second Sydney Airport. There would necessarily be a number of crossovers of flight tracks because some aircraft operating to or from the Second Sydney Airport would need to cross arrival or departure paths for Sydney Airport and, some aircraft operating to or from Sydney Airport would need to cross arrival or departure paths for the Second Sydney Airport.

In the case of Badgerys Creek Options A and B, the extended centre lines of the parallel runways to the north-east of the airport cross the northern extended centre lines of the parallel runways at Sydney Airport in the vicinity of Hornsby. Whilst air traffic management procedures would be devised to separate air traffic for each airport as far as is possible, there would still be a need for many flight paths to merge or cross. This would result in the need for complex procedures to be provided in order to segregate the aircraft from each airport, although this might not be conducive to the provision of a smooth flow of air traffic.

Under Option C, the number of potential conflictions would be reduced greatly because the Badgerys Creek aircraft would be operating to and from parallel runways that are in turn almost parallel with those at Sydney Airport. The traffic patterns would probably always be in the same direction, leading to a harmonious flow of air traffic.

Four typical scenarios below describe the considerations which would be necessary for safe and efficient airspace management. They are based on the assumption that parallel runways will continue to be used during peak traffic periods at Sydney Airport. Issues arising from specific modes under the Sydney Airport *Long Term Operating Plan* are addressed in *Section 20.3.8*.

When the wind in the Sydney area is from the south or south-west, which is a common occurrence, it is expected that Runways 16L/16R would be in use at Sydney Airport and that Runways 23L/23R would be in use at the Second Sydney Airport (*Figure 20.1*). Aircraft being positioned to join final approach for either airport would need to be radar vectored over the same area to the north-west of Sydney. It would probably be necessary to allocate four separate altitudes for the arriving aircraft, one for each runway at each airport, because some of the flight paths would be common and it is expected that segregation of air traffic would facilitate the optimum number of movements at each airport. The highest of these altitudes would need to be low enough to enable the aircraft to make a safe approach and landing. Such a scenario would also require the lowest aircraft to maintain an altitude of about 3,000 feet (914 metres) over built-up areas to the north-west of Sydney until established on the centre line and on final approach at about 10 to 12 nautical miles (about 18 to 22 kilometres) from the runway threshold.



Low Level Crossovers

Figure 20.1

Airspace Management Considerations for Option B: Sydney Airport Runway 16, Second Sydney Airport Runway 23

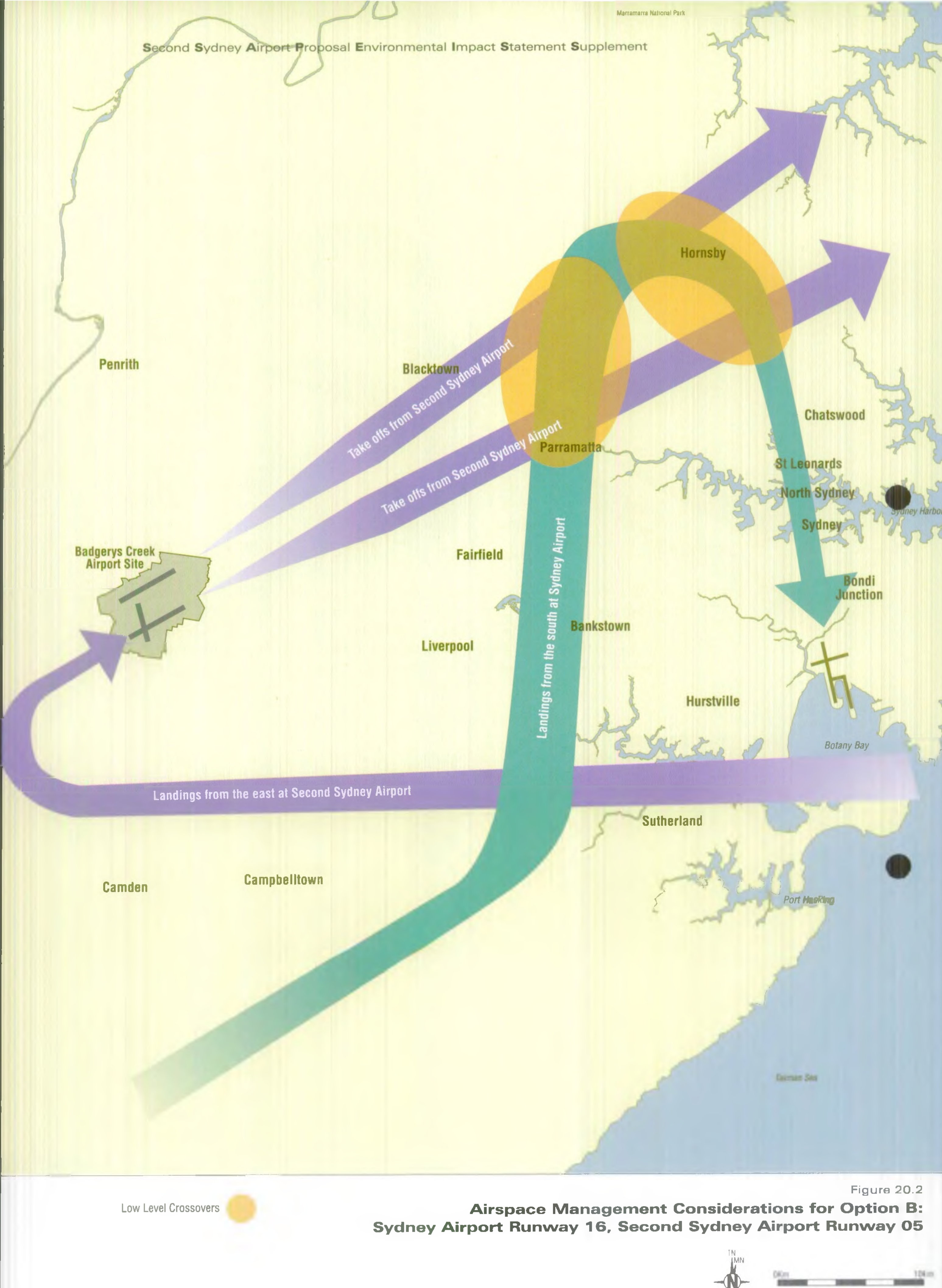


Figure 20.2
Airspace Management Considerations for Option B: Sydney Airport Runway 16, Second Sydney Airport Runway 05

Another common scenario would be when there are easterly or south-easterly winds, in which case operations at the Second Sydney Airport would be on Runways 05 and those at Sydney Airport would be on Runways 16L/16R, (*Figure 20.2*). To enable aircraft departing from the Second Sydney Airport and bound for the north or east to climb, and for aircraft arriving from the west or south-west and bound for Sydney Airport to descend, appropriate Standard Instrument Departures and Standard Arrival Routes incorporating altitude requirements or restrictions would be required. These would include the need for some aircraft to maintain an altitude of about 3,000 feet (914 metres) until the tracks had crossed and the conflictions no longer existed. The crossovers would occur over the Parramatta or Westmead areas, to the north-west of Sydney.

In the case of westerly and north-westerly winds, Runways 34L/34R would be in use at Sydney Airport and Runways 23L/23R at the Second Sydney Airport (*Figure 20.3*). Aircraft departing from Sydney Airport with destinations to the south and west would need to maintain an altitude of about 3,000 feet (914 metres) or 4,000 feet (1,219 metres) until clear of the approach paths to Badgerys Creek. Alternatively, aircraft could maintain a more northerly heading and climb above the Second Sydney Airport approach paths before turning to the west or south. In the latter case, aircraft arriving at the Second Sydney Airport would need to descend earlier and maintain altitudes of about 3,000 feet (914 metres) or 4,000 feet (1,219 metres) for a longer period prior to joining final approach.

In the case of northerly and north-easterly winds, when Runways 34L/34R were in use at Sydney Airport and Runways 05L/05R were in use at the Second Sydney Airport (*Figure 20.4*), some departing aircraft (probably those from the Second Sydney Airport) would need to climb to about 6,000 feet (1,829 metres) and those from Sydney Airport to no more than 5,000 feet (1,524 metres). Both groups would be required to maintain these altitudes until clear of the inbound tracks.

All of these scenarios would necessitate some aircraft maintaining relatively low altitudes between about 3,000 feet (914 metres) and 6,000 feet (1,829 metres) until clear of crossing tracks to or from the other airport, with adverse noise implications for residents because of the low altitudes involved.

In Badgerys Creek Option C, crossovers would be required for Badgerys Creek aircraft operating to or from the east, or for Sydney Airport aircraft operating to, and possibly from, the west. Because the initial tracks from each airport are not in conflict with the other airport, these crossovers would take place when the aircraft are much higher than in the case of Options A and B. For aircraft operating towards the north (*Figure 20.5*) or towards the south (*Figure 20.6*) from either airport, crossovers, if any, would occur further out, and at higher altitudes which would minimise any noise impacts.

In all of the above scenarios, the Standard Instrument Departures and Standard Arrival Routes would also need to avoid secondary airports, access lanes, RAAF Richmond Airport and to some extent, its associated Restricted Areas.

20.3.3 International Practices in Multi-Airport Environments

The examples of London and New York multi-airport environments cited in the responses to the Draft EIS provide a good indication of how similar problems could be resolved in the Sydney basin. The three main airports in the London area are:

- Heathrow, which has parallel runways aligned 09/27, and a single crossing runway aligned 05/23;

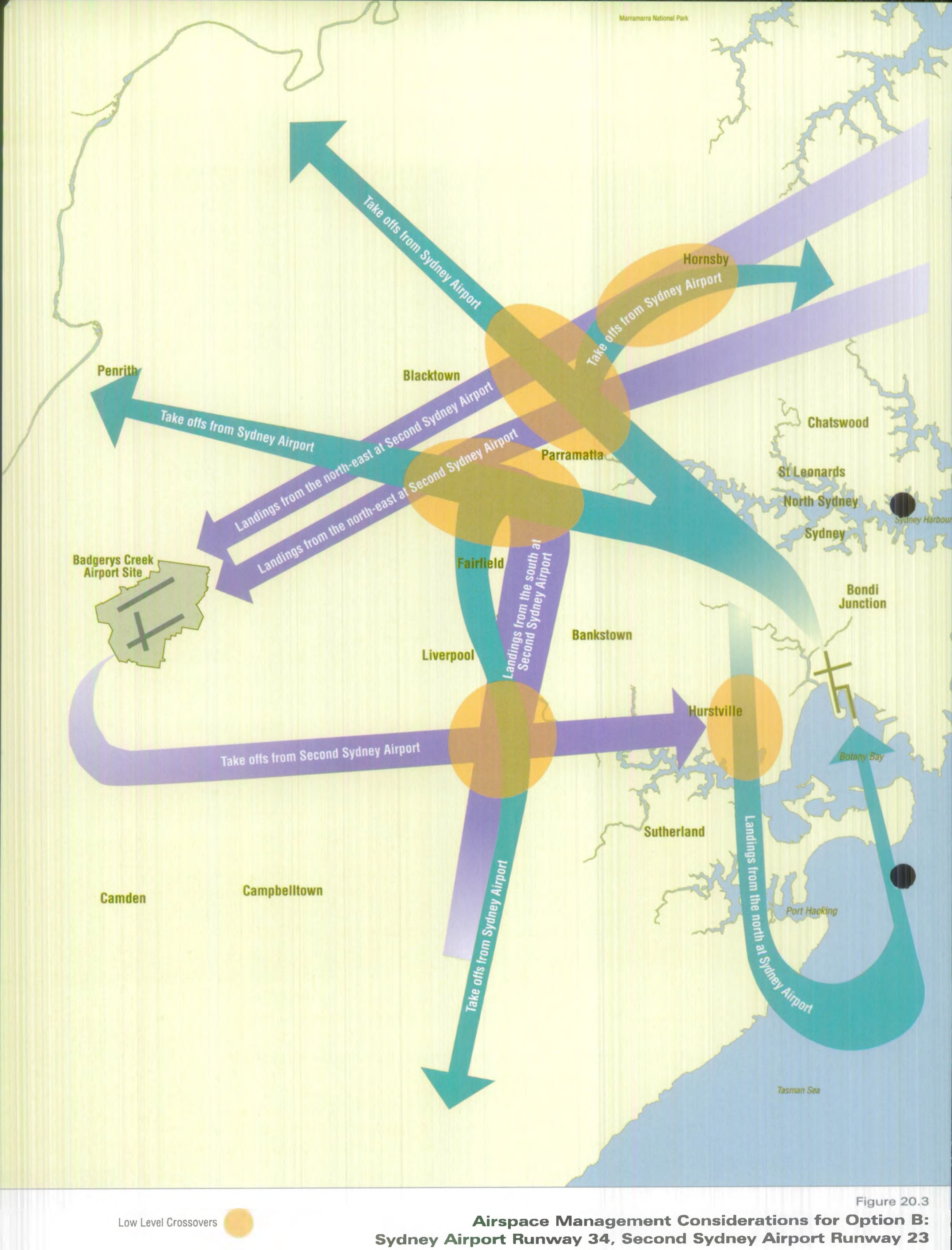


Figure 20.3

Airspace Management Considerations for Option B: Sydney Airport Runway 34, Second Sydney Airport Runway 23

Figure 20.4

Airspace Management Considerations for Option B: Sydney Airport Runway 34, Second Sydney Airport Runway 05

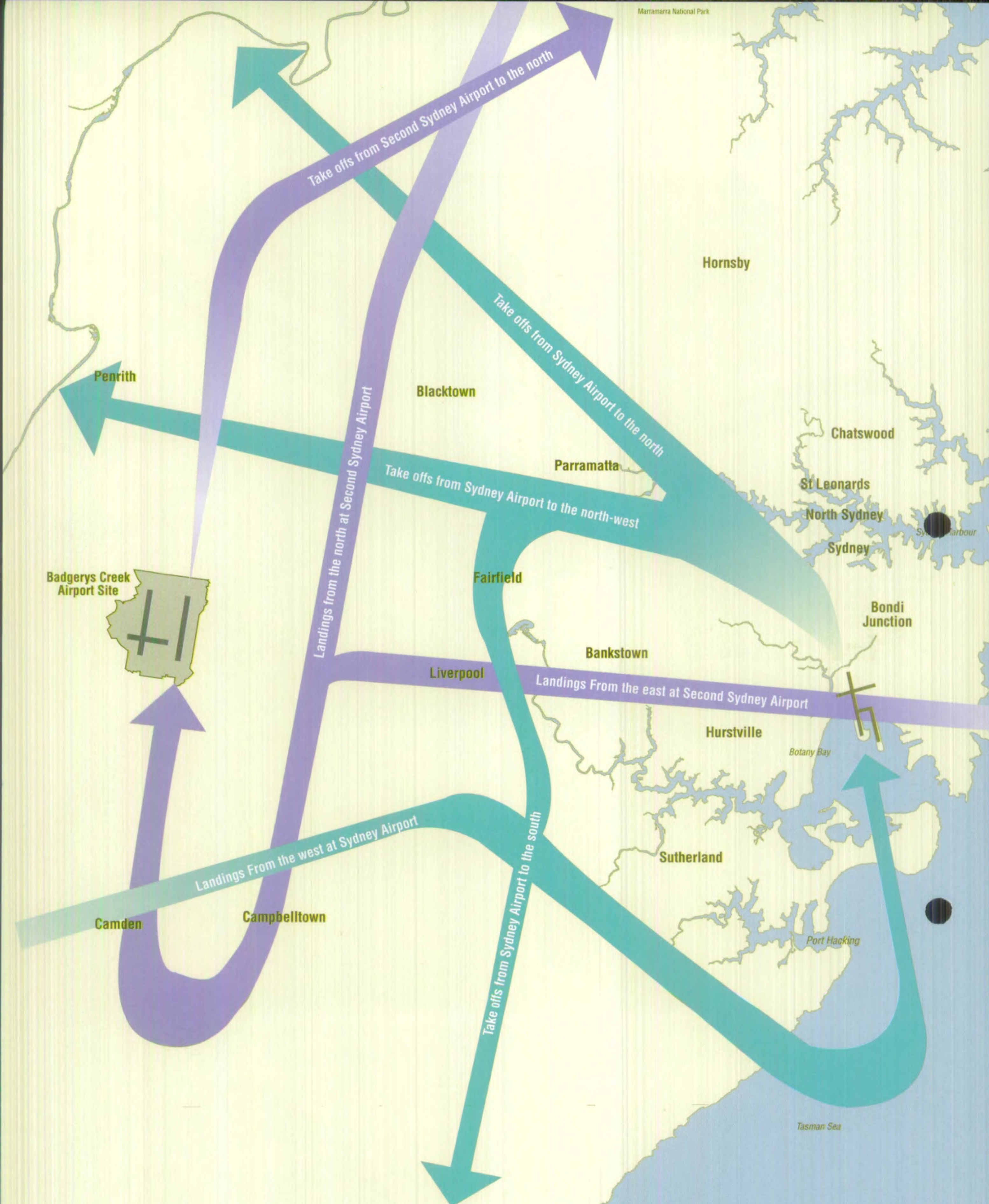


Figure 20.5

Airspace Management Considerations for Option C: Sydney Airport Runway 34, Second Sydney Airport Runway 36

Note: No low level cross overs would occur under this airspace management scenario

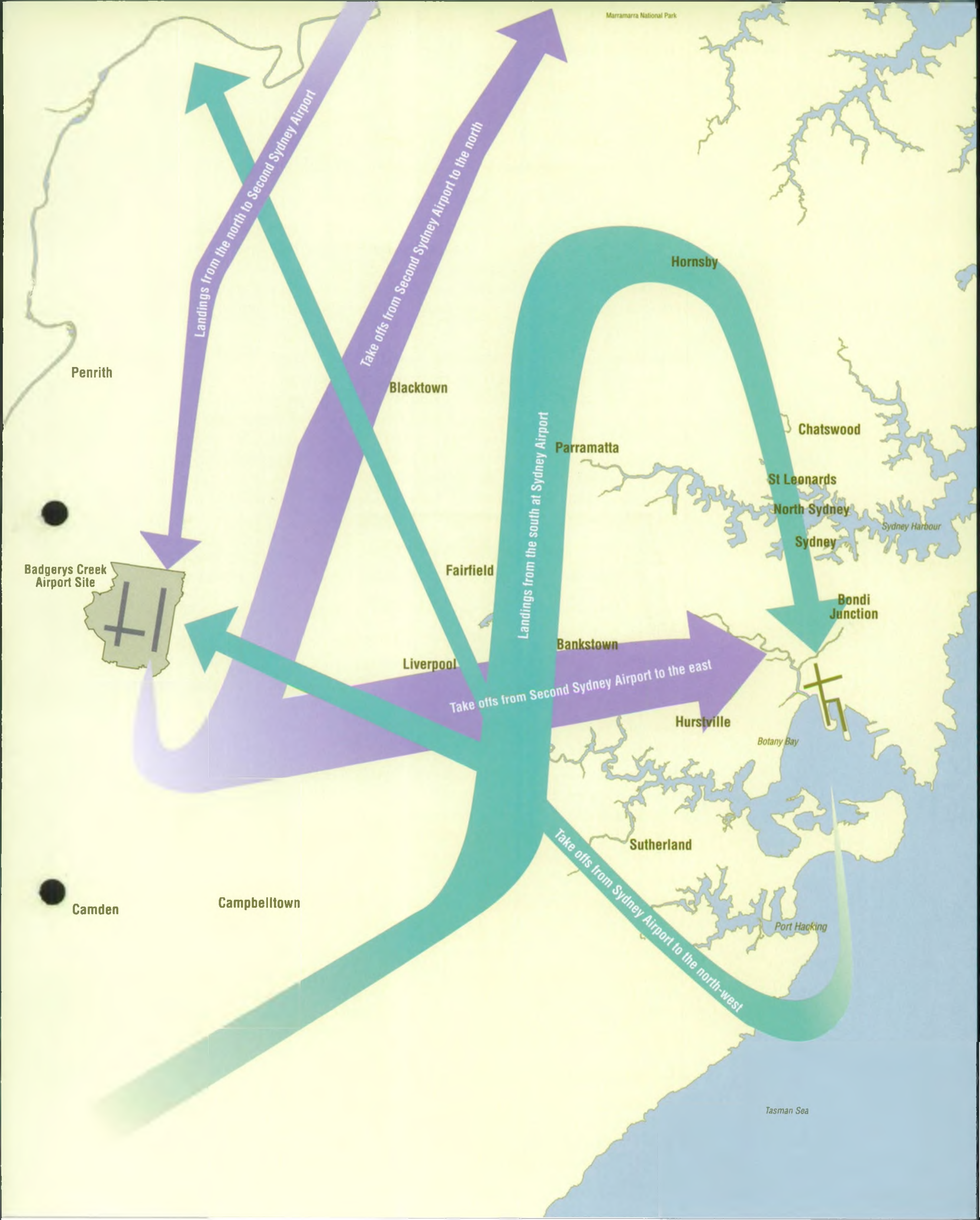


Figure 20.6

Airspace Management Considerations for Option C: Sydney Airport Runway 16, Second Sydney Airport Runway 18

Note: No low level cross overs would occur under this airspace management scenario

- Gatwick, which has parallel runways aligned 08/26; and
- Stansted, which has a single runway aligned 05/23.

The flow of air traffic is less complex because the final approach to, or the initial departure from each airport is in the same general direction. Even so, the London terminal area comprises a complex series of Standard Instrument Departures and Standard Arrival Routes for each airport, and air traffic controllers are required to impose a variety of altitude requirements and restrictions to ensure an efficient and orderly flow of air traffic.

In addition, holding patterns for the sequencing of arriving aircraft are provided within 20 nautical miles (37 kilometres) of the airports. Aircraft are required frequently to fly in these holding patterns at altitudes as low as 3,000 feet (914 metres). Departing and crossing aircraft are often required to maintain altitudes as low as 3,000 feet (914 metres) until clear of approach routes. This practice of low level holding in the terminal area has been recognised as operationally attractive because it ensures sufficient aircraft will be close to the airport to utilise landing slots should they become available, and it makes efficient use of airspace. It does, however, have environmental disadvantages.

The New York area also has three main airports:

- JF Kennedy Airport has two sets of parallel runways, aligned 04/22 and 13/31;
- La Guardia Airport has two single crossing runways aligned 04/22 and 13/31;
- Newark Airport has parallel runways aligned 04/22 and a single crossing runway aligned 11/29.

As in the London example, each New York airport has runways aligned in similar directions to the other airports. The runways nominated for use at Kennedy Airport dictate the runway to be nominated for use at La Guardia Airport, and, in turn, by Newark Airport.

The Standard Instrument Departures and Standard Arrival Routes in the New York terminal area form a complex web of tracks, with all having altitude requirements or restrictions. Instead of having holding patterns close to the airports as in the London example, the American practice is to direct aircraft on a long downwind leg, often at altitudes below 5,000 feet (1,524 metres), before turning back towards the runway in use.

Both practices of sequencing arriving achieve the same end, but cause aircraft to operate at relatively low altitudes in the terminal area, often over built-up areas.

An important reason why both the New York and London examples of air traffic management work efficiently is that there are similar runway directions at each airport in the respective terminal areas. The lessons learnt from these overseas examples support the argument that Badgerys Creek Option C is the preferred option for air traffic management purposes.

20.3.4 Airspace Design Criteria

The International Civil Aviation Organisation prescribes Standards and Recommended Practices which are issued to the aviation administrations of all member countries. These are broad enough to cover the circumstances for all member countries, but many countries also implement their own specific standards.

The International Civil Aviation Organisation Standard and Recommended Practice for the design of a control zone (which is controlled airspace extending from the ground to a specified height) is that it must extend out to a minimum of five nautical miles (9.3 kilometres) from an airport and also include the approach and departure paths for aircraft operating under Instrument Flight Rules. In 1995, the Australian Civil Aviation Safety Authority adopted a standard which necessitated the minimum size of a control zone for airports capable of handling wide-bodied jet aircraft to be a series of seven nautical mile (13 kilometre) arcs from each of the runway thresholds and joined by tangents to the arcs. (Civil Aviation Safety Authority, 1995). This standard was first applied in 1996.

In accordance with the prescribed standard, the airspace, particularly the control zone, required for the Second Sydney Airport would overlap part of the Hoxton Park Airport and its circuit area (*Figure 20.7*). Under the current standards, flying operations at Hoxton Park Airport would not be permitted, because for Options A and B at Badgerys Creek any operations immediately to the north of Hoxton Park Airport would enter the Badgerys Creek control zone and affect the Runway 23 approach path or the departure path from Runway 05. Under Option C, the operations at Hoxton Park Airport would be parallel to those at Badgerys Creek, but the current operational practices would still not permit this because the aircraft would enter the Badgerys Creek control zone and potentially affect operations there.

In summary, it would depend upon which airport option is selected and whether a staged development of the Second Sydney Airport is undertaken as to when flying operations at Hoxton Park Airport would be curtailed.

A similar problem applies to Camden Airport, where the Badgerys Creek control zone would overlap the circuit area and flying operations by powered aircraft would be seriously affected, but not necessarily curtailed. Operations by gliders would not be feasible because of the altitude constraints imposed on such activities. Parachuting which is currently carried out near Camden would not be feasible for the same reason. Options A and B would have less of an impact than Option C at Camden. Depending on which airport option is selected, and whether a staged development takes place, powered aircraft activities at Camden might not be affected during the initial operations of the Second Sydney Airport.

Access by aircraft operating to or from the west of Bankstown Aerodrome would be disrupted because of the airspace requirements associated with Badgerys Creek. New access lanes would need to be devised to keep general aviation aircraft away from the Second Sydney Airport flight paths. These also might be introduced on an incremental basis subject to the option and the staging selected for Badgerys Creek, hence delaying their full impact.

In the submissions to the Draft EIS, there were claims that an earlier study had concluded that the operations at the Second Sydney Airport would not affect general aviation aerodromes in the Sydney basin. The conceptual airspace which was considered in 1994 by representatives from the then-Civil Aviation Authority and the Regional Airspace Users Advisory Committee was based on earlier design criteria, since superseded. It was also considered at the time that Badgerys Creek would be sited and orientated in a manner which is now known as Option A, and probably used as a low-capacity airport, rather than a full scale international standard airport.

20.3.5 International Practices for Secondary Airports

In the Los Angeles area there are several general aviation aerodromes close to the major airports of Los Angeles International, John Wayne Orange County, Long Beach and Burbank. The control zones of these airports do not comply with the International Civil Aviation Organisation Standards and Recommended Practices.

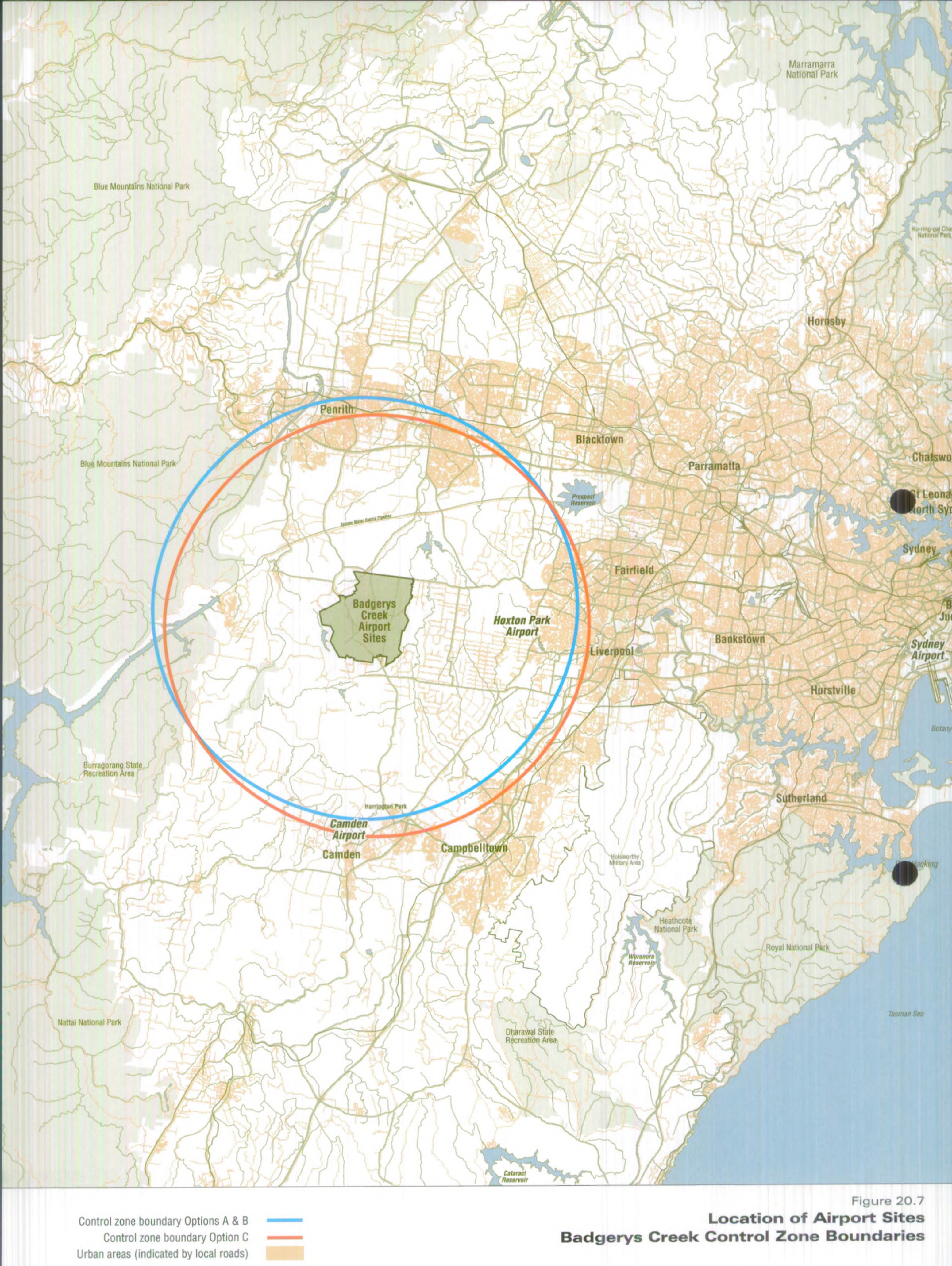


Figure 20.7
Location of Airport Sites
Badgerys Creek Control Zone Boundaries

However the United States' Federal Aviation Administration has imposed very rigid procedures which enable operations to be carried out at nearby general aviation airports, such as Torrance, Compton and Hawthorne. The significant reason why Compton and Hawthorne have been able to continue to exist is because the runways are aligned in a similar direction to those at Los Angeles International Airport. Flying operations from both Compton and Hawthorne are confined to the south of the airports, and aircraft operating into or out of both locations are subject to altitude restrictions. Other constraints on activities at general aviation airports in the Los Angeles area include strict limits on, or prohibition of, training activities and night-time operations, requirements on circuit directions and application of noise abatement procedures.

Under the current International Civil Aviation Organisation and Australian airspace design standards, Hawthorne and possibly Compton Aerodromes would not be able to operate.

In the London area, secondary aerodromes such as Fairoaks and Denham are required to operate in harmony with the major airports and consequently suffer several significant constraints. Aircraft are restricted on circuit heights, routings to and from the aerodrome and climbs in the vicinity of the airfield, until clear of controlled airspace.

20.3.6 Australian Multi-Airport Environments

In Melbourne there are two airports to the north-west of the city. Essendon, formerly the main airport, is now a general aviation aerodrome that is fully equipped for operations by aircraft operating under Instrument Flight Rules. Melbourne Airport at Tullamarine, five nautical miles (nine kilometres) north-west of Essendon, is the major international and domestic airport for the city. Each airport has two crossing runways, both aligned in similar directions: Melbourne 18/36 and 09/27 and Essendon 17/35 and 08/26, and traffic patterns are normally in the same direction. The independent activities at Essendon are confined to circuit training or travel flights through an access corridor, and any flight into the Melbourne control zone requires prior co-ordination with air traffic control. Air traffic can be managed successfully at both airports because of the similarities of the runway directions.

Hobart has a main airport for regular public transport and freight operations and a general aviation airport at Cambridge. Cambridge Airport is equipped only for operations under Visual Flight Rules. The two airports share common airspace, although air traffic control is not provided on the ground at Cambridge Airport. The pilot of any aircraft intending to depart from Cambridge Airport must contact Hobart control tower and seek a clearance to operate prior to commencing take-off. Similarly, for aircraft bound for Cambridge, the pilot must contact Hobart control tower prior to entering the control zone. The amount of flying activity at both Hobart and Cambridge airports combined is less than 17 percent of that of Sydney Airport alone, thus bearing little relationship to the Sydney basin environment.

20.3.7 Sydney Airport Long-Term Operating Plan

The current Government policy of noise sharing in the Sydney area has led to the introduction of the *Long-Term Operating Plan for Sydney (Kingsford Smith) Airport and Associated Airspace* (Airservices Authority, 1996), which incorporates a series of operating modes for air traffic at Sydney Airport. When weather conditions permit, the preferred approach is to have aircraft flying over water wherever possible. At most times this means that either arriving or departing aircraft will fly over Botany Bay and the other departing or arriving aircraft will at some stage fly over built-up areas. The objective of sharing as far as practicable the noise impact of overflight of residential areas means that Runway 07/25 is used during particular hours of the day, and when weather conditions permit.

Should Badgerys Creek Options A or B be selected, there are some scenarios which would necessitate modification to some *Long-Term Operating Plan* modes prior to commencement of operations. These modifications would be most likely to occur to the operating modes which require aircraft at Sydney Airport to depart from Runway 34L or arrive on Runway 07. Little, if any change to existing *Long-Term Operating Plan* flight paths would be envisaged for other runways, although altitude limitations on some tracks would be required.

Two examples are given of necessary changes to the Sydney Airport *Long-Term Operating Plan*. When using Runway 34L, departing aircraft bound for the north-west and west, and heavy aircraft bound for the east, initially track over, or north of the Parramatta area before turning onto their en route track. These aircraft would potentially conflict with aircraft either arriving on Runways 23L/23R or departing from Runways 05L/05R at Badgerys Creek. If existing *Long-Term Operating Plan* tracks were used, aircraft using Badgerys Creek would have to fly at lower altitudes than they otherwise would in order to maintain adequate vertical separation from aircraft departing from Sydney Airport. If, however, aircraft departing Sydney Airport Runway 34L maintained a more northerly direction, then aircraft using Badgerys Creek would be able to fly at higher altitudes.

When Sydney Airport Runway 07 is required for arrivals, aircraft from the north and north-west would also be in conflict with aircraft departing from Badgerys Creek Runways 05L/05R or approaching to land on Runways 23L/23R. Standard Instrument Departures and Standard Arrival Routes could be devised to meet the tracking requirements of the *Long-Term Operating Plan*, although it would be necessary to maintain aircraft at relatively low altitudes (between 3,000 feet (914 metres) and 6,000 feet (1,829 metres) over built up areas in order to maintain vertical separation. Alternatively, in order to have aircraft maintain higher altitudes over built up areas, the flight paths would need to be changed.

Any such changes would be subject to environmental considerations.

It appears that Badgerys Creek Option C would enable the existing and planned flight paths associated with the *Long-Term Operating Plan* to remain close to the present paths.

20.4 Other Aviation Issues

20.4.1 Flying Training Areas

The flying training areas which service the Sydney basin extend from Bankstown Airport, west to the Nepean River, and from the M4 Motorway south to Appin. The areas are classified as Danger Areas and extend from ground level to 4,500 feet (1,370 metres). Most aircraft using the training areas originate from either Bankstown, Hoxton Park or Camden Airports. The Danger Area classification is a warning to pilots about the high density flying activity in the area.

The flying training areas are used by beginners as well as experienced pilots for most components of flying training, practice and recreational flying. The flying training organisations cater for local and overseas students, private and commercial pilots. Significant commercial investment has been made by some training organisations with the intention of attracting pilots, particularly from overseas, to an integrated flying training environment.

Ideally, flying training areas feature the characteristics of:

- adequate dimensions, having regard to the numbers and types of aircraft that will utilise the area;
- airspace from ground level up to 5,000 feet (1,524 metres) above ground level;
- being clear of other civil and military aerodromes;
- having well defined visual boundaries;
- not being located over built-up areas;
- not being located over rugged terrain;
- being clear of frequently used other tracks and airspaces; and
- being within close proximity to the normal operating base; preferably within five minutes flying time, but no longer than ten minutes flying time.

The Sydney basin flying training areas have been progressively encroached upon by urban development. The areas at which low altitude training activity can be carried out are becoming further away from the base aerodrome than originally designed. The airspace required for the Second Sydney Airport, which would include a control zone and controlled airspace steps, would partly cover almost the whole of the existing flying training areas, rendering them unusable.

However, the impact of the construction of the Second Sydney Airport on the flying training areas could also be expected to be incremental. This would depend on which airport option is selected and the nature of any staged development. If only a single runway is constructed in the first stage, there would be a smaller control zone and corresponding associated airspace than there would be with the master plan development. This would provide the opportunity to re-assess whether the flying training areas can be re-designed to accommodate at least some of the required activities. During the design, development and construction period, access to existing flying training would not be affected.

The future of the RAAF Base Richmond is under review, and, should the amount of RAAF flying significantly decrease, it might be possible to utilise the existing Restricted Areas as civil flying training areas. Any proposal to use this area would need to be evaluated by the Department of Defence, Airservices Australia, Civil Aviation Safety Authority and aviation industry representatives. Apart from this area, there are only small areas in the Sydney basin that could be suitable for flying training, and these satisfy very few of the above desired characteristics.

20.4.2 Relocation of General Aviation Activities

If the development of the Second Sydney Airport proceeds and thus forces the eventual closure of, or imposes severe restrictions on, general aviation aerodromes, there is expected to be a migration of some flying activities from the Sydney basin. Following the closure of Schofields airport in 1995, its aviation activity was relocated to Bankstown Airport and, to a lesser extent, Hoxton Park Airport. Significantly, though, there is anecdotal evidence that many recreational pilots ceased their flying activity altogether because of the distance they were then required to travel to a general aviation aerodrome.

It is unlikely that the 100,000 annual aircraft movements currently at Hoxton Park Airport and a portion of the 120,000 annual aircraft movements currently at Camden could be absorbed into Bankstown. As there are few, if any, alternatives remaining in the Sydney basin for general aviation activities, it is probable that a significant number of pilots would reduce their flying activities, or relocate to aerodromes outside the Sydney basin such as Wollongong or Warnervale. This could have a major impact on the viability of flying training organisations, maintenance organisations, engine overhaul workshops, refuelling companies and the many other support activities associated with aviation. The operators which chose to stay in the Sydney basin would incur extra expense in transit times to and from the flying training areas.

20.4.3 Department of Defence Establishment Orchard Hills

The Department of Defence maintains a weapons storage and test facility at Orchard Hills. The Australian Ordnance Council has recommended that there is no need for special restricted airspace over weapons storage areas, although such airspace is still necessary for the demolition and testing of weapons.

Even if there is no need for restricted airspace for weapons storage, co-ordination procedures would have to be developed between the Department of Defence and air traffic control to enable occasional weapons detonation to take place. This type of co-ordination procedure is used when firing or weapons detonation takes place near other aerodromes.

20.4.4 Fuel Venting and Fuel Dumping

Fuel discharge from aircraft occurs in three ways: namely unintentional fuel discharge, fuel venting and fuel dumping.

Unintentional fuel discharge is a rare event; it occurs only when a large aircraft has faulty fuel vent valves in incorrectly or overloaded wing fuel tanks. The faulty valves allow fuel in the wings fuel surge tanks to escape directly into the atmosphere.

Incidents of unintentional fuel discharge from aircraft operating over the Sydney area have been reported on four occasions in recent years. The incidents reported involved a single operator of an early model Boeing 747 aircraft dating from the early 1970s. The Department of Transport and Regional Services is currently preparing regulations that address this issue.

Fuel discharge is often confused with condensation of water vapour from the aircraft wing tip, which, under certain atmospheric conditions, creates a white stream of water vapour forming behind an aircraft's wings. Positive visual identification of fuel discharge requires an experienced observer.

Fuel venting is a separate issue, involving the release of fuel from the aircraft to the atmosphere from the process of engine shutdown. Civilian jet aircraft manufactured since February 1982 have been required to comply with an international standard (International Civil Aviation Organisation *Annex 16 Volume II Part I*) which requires that aircraft be designed and constructed to prevent the venting of fuel.

Fuel dumping is an unusual event for which allowance is made in certain circumstances, such as when an aircraft must reduce weight in order to land. An example of such a circumstance is an aircraft returning to an airport immediately after take-off following an engine failure or other safety related issue, and which needs to dump fuel so as not to exceed the maximum allowed landing weight.

Except in an emergency, fuel dumping takes place at an altitude of greater than 6,000 feet (1,829 metres) above ground level, to ensure that fuel dumped is completely vaporised. Aircraft using the Sydney basin that need to dump fuel are required to do so over the Tasman Sea. The location of Badgerys Creek, being approximately 55 kilometres from the coastline, is not so significant as to bring about any change to current operating procedures for fuel dumping.

The ability to dump fuel is limited mainly to wide-body aircraft such as the B747, DC10, Airbus A340 and some models of the B767. Dumping of fuel cannot be carried out by most of the narrow body aircraft operated domestically, such as the B737 and A320, or by other models of the B767.

The Bureau of Air Safety investigation records fuel-dumping events that are the result of a safety incident. It reports that 26 such incidents were recorded in the period 1 January 1988 to 3 December 1998. It should be noted that as these figures might not be exhaustive, as they do not include non-safety related incidents.

20.5 Overview of Aviation

20.5.1 Draft Environmental Impact Statement

The Draft EIS addressed the operational issue of air traffic management in regard to airport design, runway configuration, runway orientation and flight paths.

It also took into consideration the impact on other airports, their airspace and their activities, and particularly the interaction with Sydney Airport and its *Long-Term Operating Plan*, as a result of the airspace requirements for the Second Sydney Airport. The Draft EIS concluded that Option C is the preferred Option for air traffic management purposes.

Impacts on other aviation activities were discussed, as was the interaction with the Defence Establishment Orchard Hills.

20.5.2 Public Submissions

Some public submissions raised concerns about the interaction between Sydney Airport and general aviation aerodromes, and its effect on airspace in the Sydney basin currently used by general aviation. Comparisons were made with overseas examples, and it was argued that the proposed Sydney basin's complexity, constraints and restrictions were all overstated.

The general aviation community expressed concern about the impact on flying training, recreational flying and the potential closure of general aviation aerodromes. Questions about where such activities and their associated support and maintenance industries would be relocated were also asked.

Some submissions suggested that fuel dumping and fuel venting are common events, and would significantly impact on residential areas, water storage areas and national parks following the commencement of operations from the Second Sydney Airport.

20.5.3 Supplement

This Supplement provides further explanation (to that provided in the Draft EIS) of the airspace arrangements necessary for the efficient operation of the Second Sydney Airport and Sydney Airport. It provides a detailed description of the interaction between the airports and highlights the airspace management advantages of Option C.

The evidence from the United States and the United Kingdom confirms that the best operating scenario for multi-airport environments is for the operating directions from each airport to be as close to parallel as possible to the others.

It is concluded that Option C is the preferred option from an airspace management perspective and more consistent with the *Long-Term Operating Plan* for Sydney Airport.

This Supplement explains the differences in airspace requirements between various countries, and confirms that there will be significant impacts on the general aviation industry in the Sydney basin. It also offers more options for the continuation of flying training and recreational flying.

Fuel dumping and fuel venting are extremely rare occurrences. Except in an emergency, there would be no need for fuel dumping to take place in the Badgerys Creek area and new regulations are being developed to minimise the already low incidence of inadvertent fuel venting.

A major airport at Badgerys Creek would limit the flying training and general aviation activities from Hoxton Park and Camden Airports.

Chapter 21

Visual and Landscape Impacts

Chapter 21
Visual and Landscape Impacts

21.1 Summary of the Draft Environmental Impact Statement

21.1.1 Methodology

The aims of the visual and landscape assessment in the Draft EIS were to describe the visual and landscape quality of the sites of the airport options, determine the likely impacts of airport construction on visual and landscape quality and propose measures to avoid or reduce those impacts.

Landscape impacts were defined in the assessment as those affecting the general fabric and pattern of the existing landscape and its significance in terms of heritage, cultural and environmental values. Visual impacts were defined as changes to the quality of views or viewing opportunities into the airport sites.

The existing landscape was described in terms of topography, vegetation and land use patterns. Following this, views of the site that were potentially affected by the proposal were identified and mapped, and the level of visual sensitivity of each view assessed.

21.1.2 Existing Environment

The sites of the airport options are all located in the South Creek Valley, in a transitional landscape zone between the relatively flat Cumberland Plain and the foothills of the Blue Mountains. The topography of the sites is gently undulating, with rounded ridgelines along The Northern Road in the western parts of the sites, and lower flatter areas in the eastern parts of the sites, near Badgerys Creek. Approximately 90 percent of the sites consists of pastures and grasslands, with scattered patches of remnant woodland throughout.

A number of local studies have identified landscapes of heritage significance within the airport sites, including Badgerys Creek and other corridors of remnant vegetation in the area. This landscape is common in the western Sydney region and was not considered to have particular significance for visual and landscape quality.

21.1.3 Visual and Landscape Impacts

Development of the Second Sydney Airport would involve the complete modification of the existing landscape and visual environment. Although the airport options would all have similar impacts, Option A would involve the least impact, as it would require the least land area.

Construction of the Second Sydney Airport would result in major modification of the existing landform between Badgerys Creek in the south-east and Cosgrove Creek in the north-west. The upper sections of Oaky Creek and numerous other swale formations in the area would be permanently removed. Nearly all existing vegetation would be cleared from the airport sites. The loss of remnant vegetation would be significant, even though the airport sites have been extensively cleared for agriculture. The proposal would contribute to the incremental loss of native vegetation cover in western Sydney. The existing rural visual character would be replaced by a large scale, flat industrial and commercial environment. Viewing opportunities into the site would also be reduced.

21.2 Summary of Visual and Landscape Issues

21.2.1 Issues Raised in Submissions

General Issues

Concerns raised in submissions on the Draft EIS were mainly concerned with the visual and landscape impacts associated with operation of the proposed airport, in particular lighting and aircraft overflights.

Some submissions questioned the potential visual and landscape impacts of the Second Sydney Airport. Other submissions made general criticisms of the inadequacy of visual and landscape assessment without specifying any particular facet requiring improvement.

Concerns were expressed in submissions about potential reductions in the visual quality and landscape heritage values of the Greater Blue Mountains Area nominated for World Heritage listing.

Submissions from the Western Sydney Alliance and from western Sydney councils stated the belief that the proposed mitigation measures were generally inadequate and, more specifically, that the proposals for landscaping to ameliorate the landscape impacts were not feasible for airports. There was concern that these proposed mitigation measures would be inconsistent with other assessments in the Draft EIS, such as that of bird and bat strike, in relation to hazards and risks. Other submissions suggested that more information should have been included in the assessment, dealing with such matters as views of flight paths and viewing catchments.

Cumulative Impacts

Submissions on the Draft EIS noted that, generally, impacts of land use changes and infrastructure development associated with development of the airport were likely to be significant, but that these were considered to have been addressed in insufficient detail. Infrastructure included, for example, roads, rail lines, navigational aids, fuel storage areas, and car parks.

In particular, the Draft EIS was criticised for not describing possible visual and landscape impacts associated with the potential development of industrial land identified in *Technical Paper No. 2*. The lack of integration of the planning and visual assessments was also a point of criticism.

Operational Lighting Impacts

Concerns were raised by Penrith City Council and *Communities Against an Airport in Western Sydney*, among others, that significant lighting impacts could result in areas adjoining the airport sites from lighting required for operation of the airport, commercial activities generated by the airport and associated infrastructure. It was suggested in these submissions that the Draft EIS did not address potential operational lighting impacts in sufficient detail.

Aircraft Overflights

The potential impact of aircraft overflights was also raised in submissions to the Draft EIS as having not been addressed in the visual impact assessment. The possibility that aircraft would intrude on local viewing opportunities was considered to be a negative visual impact that should have been included in the assessment.

21.2.2 Issues Raised by the Auditor

The Auditor found that, overall, the visual assessment suffered from some key weaknesses. These key weaknesses related to the Draft EIS not examining the relationship between potential land use change and the resultant visual impact or assessing the effect of night lighting.

21.3 Response to Visual and Landscape Issues

21.3.1 General Issues

Methodology

The methodology adopted for the visual and landscape assessment is discussed in Chapter 23 of the Draft EIS and in Chapter 3 of *Technical Paper No. 14*. It involved a description of the existing landscape and visual environment, identification and analysis of potential impacts and determination of appropriate mitigative measures. This methodology was consistent with best practice for visual and landscape assessment and took into consideration the fact that sites of the airport options would be substantially altered by construction activities. It included an assessment of the landscape surrounding the airport sites and described the visual quality relative to the western Sydney region and the South Creek catchment.

Analysis of the existing environment involved examining the landscape and visual character of the sites of the airport options within the Cumberland Plain and South Creek Valley in regard to topography, vegetation and existing land uses. Visual field analysis involved examining primary viewing opportunities, generally up to four kilometres from the sites.

In response to concerns raised in submissions and by the Auditor that the visual and landscape assessment was either inadequate or suffered from key weaknesses, additional assessment has been undertaken in respect to the following:

- potential impacts on the Greater Blue Mountains Area World Heritage nomination;
- cumulative impacts of major infrastructure associated with the Second Sydney Airport;
- analysis of the potential impacts arising from operational lighting; and
- further consideration of appropriate environmental management measures.

Greater Blue Mountains Area World Heritage Nomination

An area known as the Greater Blue Mountains Area has been nominated for World Heritage listing by a joint team of the NSW Government and Environment Australia (Environment Australia, 1998). The area comprises the Blue Mountains, Wollemi, Yengo, Nattai, Kanangra Boyd, Gardens of Stone and Thirlmere Lakes National Parks and the Jenolan Caves Karst Conservation Reserve. The nominated area extends over one million hectares (Environment Australia, 1998) and lies, at its closest point, approximately seven kilometres west of the sites of the proposed airport options. Two of the key heritage values of the nominated area are its 'dramatic scenery' and 'high visual quality' (Environment Australia, 1998). This section discusses the potential visual and landscape impacts of the Second Sydney Airport on the World Heritage values of the nominated area.

A substantial number of aircraft already pass over the Blue Mountains. Regional, domestic and international flights bound for destinations west of Sydney use a navigation beacon located at Katoomba. Light aircraft, flying at low altitudes for sight-seers, also contribute to local air traffic. Thus the Greater Blue Mountains Area is already subject to the visual effects of aircraft passing overhead.

Parts of the Blue Mountains National Park, Lake Burragorang and Bents Basin State Recreation Areas would be subject to aircraft overflights during operation of the Second Sydney Airport, as discussed in Chapter 14 of the Draft EIS. It can be assumed that these flights would be at lower altitudes than those currently operating from Sydney Airport and possibly other airports in western Sydney. Hence there would be impacts on the visual quality of the Greater Blue Mountains Area World Heritage nomination.

The potential impacts of aircraft overflights on the visual quality of the nominated area are likely to depend on a number of factors: the frequency of flights; type of aircraft; the altitude of the aircraft; the sensitivity of the viewer; and the location of the viewer during the overflight. Thus the intensity and frequency of the visual effects imposed by aircraft would vary.

A report on the effects of aircraft overflights on National Parks in the United States (United States Department of the Interior and National Parks Service, 1995) revealed that one-fifth of visitors remember seeing or hearing aircraft during their visit. However, only three percent reported that they were annoyed by hearing or seeing aircraft. Visitor surveys also show that 93 percent of respondents visited the park to view the scenery, while 91 percent visited to experience quiet. These results suggest that visual quality is rated highly by national park visitors but only a small fraction of visitors are adversely affected by aircraft overflights.

The visual quality of the Greater Blue Mountains Area is likely to be affected to a limited extent by aircraft overflights during operation of the Second Sydney Airport. As stated in Section 12.7 of the Draft EIS, Options A and B may generate up to 25 aircraft overflights a day, exceeding 70 dBA, and up to five overflights a day, exceeding 80 dBA, in some areas of the Blue Mountains National Park. South of Lake Burragorang, fewer overflights would occur, with up to 15 exceeding 70 dBA and only one or two exceeding 80 dBA. It is possible that this frequency of flights could have significant visual impacts on recreational users of natural areas within the Greater Blue Mountains Area, particularly those located directly underneath flight paths.

Option C would have less effect than the first two options. No overflights would exceed 80 dBA within the Blue Mountains, although up to seven or eight movements daily would exceed 70 dBA. It is unlikely that this frequency of flights would have significant visual effects in these areas.

The extent of the impacts, however, cannot be quantified fully until detailed design of the airport, including further definition of flight paths and aircraft operation schedules, is completed. Research into the visual effects of aircraft on national parks in Australia would also be required to further quantify potential impacts on park users.

21.3.2 Cumulative Impacts

Development of the Second Sydney Airport would require the provision of services and infrastructure. The major infrastructure developments would include road, rail water, wastewater, electricity, telecommunications, aviation fuel and natural gas. Alternatives for the provision of services and infrastructure were considered during preparation of the Draft EIS. The preferred alternatives are shown on Figure 10.14 in the Draft EIS. Alternative road and rail access proposals and other road network improvements are described in *Chapter 19* of this Supplement.

The airport is also likely to be a catalyst for the development of commercial, industrial and residential land uses in surrounding areas. Future land use assumptions for the airport options are discussed in *Technical Paper No. 2*.

Infrastructure associated with development of the airport would, in some cases, such as road infrastructure, involve substantial changes to the local visual environment and landscape surrounding the airport sites. These changes would represent a cumulative visual and landscape impact associated with development of the airport. As stated in Chapter 10 of the Draft EIS, additional infrastructure for electricity, telecommunications, aviation fuel and natural gas would generally follow existing easements; and some, such as fuel, gas and water supply pipelines, would be placed underground, thus minimising the impacts on the visual quality of surrounding areas.

Assessment of the potential visual and landscape impacts of future development outside the sites of the airport options was not within the scope of the assessment required by the EIS Guidelines. Provision of infrastructure would be subject to State Government policy and environmental assessment legislation and future land use changes would be based on relevant local government zonings and development approvals.

21.3.3 Operational Lighting Impacts

In response to concerns raised by the Auditor and in some submissions, a report on the potential impacts of airport operational lighting has been prepared. The full report is attached in *Appendix I* and summarised below.

The aims of the lighting impact assessment were to describe the existing lighting environment, determine the likely lighting environment during construction and operation of the airport, assess the potential impacts of airport lighting and propose mitigative measures to minimise lighting impacts. The assessment involved a review of existing documentation for the Draft EIS, including *Technical Paper No. 14*, topographic maps and field surveys. A survey of Melbourne Airport was conducted on 22 October, 1998 to identify the existing lighting environment and impacts of an airport with similar features to that of the Second Sydney Airport. Melbourne Airport was chosen in preference to Sydney Airport because of its similar setting, that is, in a predominantly rural and rural-residential environment and the absence of light intensive land uses, such as Port Botany, in close proximity. The sites of the airport options and surrounding areas within the viewing catchment of the sites were surveyed on 29 October, 1998 to identify the existing lighting environment and potential views into the airport sites.

The sites of the airport options lie within a gently undulating rural landscape with broad rounded crests and ridges. There is approximately 40 metres of topographic relief within the sites, from 107 metres above sea level at The Northern Road to 70 metres above sea level along Badgerys Creek. Major ridgelines occur along The Northern Road, which offer the best views into the sites at close distance. Viewing opportunities are limited in all directions within 10 kilometres of the sites. Luddenham, approximately five kilometres north-west of the sites, occupies a point of higher elevation. Beyond this area, the best viewing opportunities are found in villages located in the foothills of the Blue Mountains, such as Silverdale and Warragamba. Potential viewpoints, their actual elevation, their elevation relative to the average elevation of airport runways and infrastructure, and their distance from the centre of the sites of the airport option are summarised in *Table 21.1* and shown on *Figure 21.1*.

Table 21.1 Potential Viewpoints into the Airport Sites

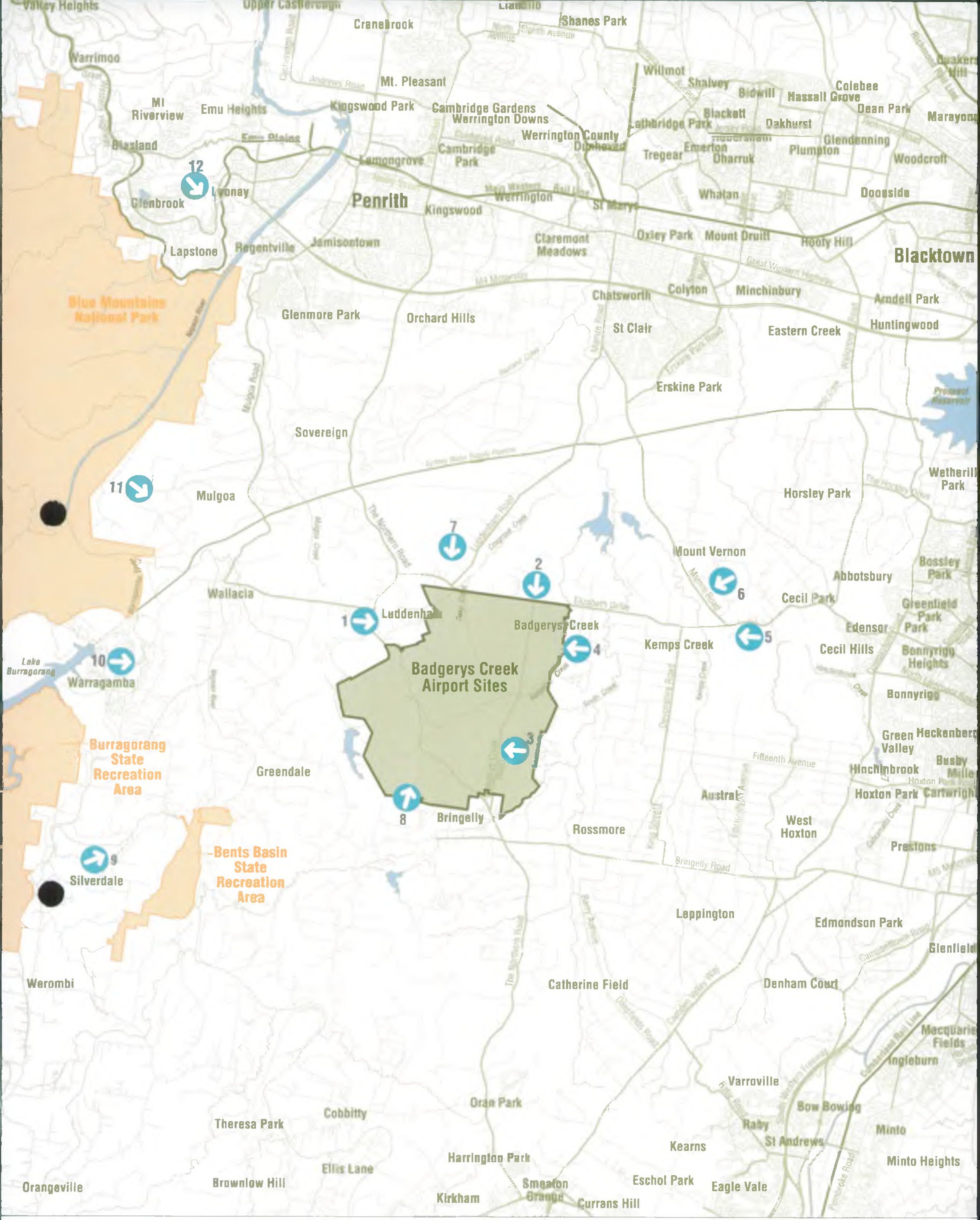
View-Points	Locations	Height (metres above sea level)	Relative Elevation[1] (metres)	Distance to Centre[2] (kilometres)
1	The Northern Road, Badgerys Creek	100 to 105	+ 20	3
2	Elizabeth Drive, Badgerys Creek	65 to 90	-20 to -5	2.5
3	Badgerys Creek Road, Badgerys Creek	60 to 75	-15 to -10	1.5
4	Lawson Road, Badgerys Creek	60 to 65	-20 to -15	3.5
5	Cecil Park Communication Tower	140	+ 55	10
6	Mount Vernon Road	105	+ 20	9
7	Blackford Hill, Hill View	100	+ 15	4
8	Dwyer Road, Bringelly	105	+ 20	3
9	Silverdale	235	+ 150	12.5
10	Warragamba	100 to 140	+15 to +60	10
11	Mount Henry, Hillcrest	190	+ 105	11.5
12	Lapstone Tower, Lapstone	200	+ 115	16

Notes: 1. Elevation of viewpoint relative to average elevation of the runways and infrastructure on the sites of the airport options, that is, RL 85.
2. Distance of viewpoint from centre of the sites of the airport options.

The existing night light environment is generally rural in character, with most surrounding topographical features generally in darkness. The nearest significant light source is a strip of street lights along The Northern Road, Luddenham, which is visible at distances of up to 15 kilometres.

The operational lighting environment for the Second Sydney Airport has yet to be designed in detail. The impact assessment was therefore based on conceptual master plans and on comparison with the existing lighting environment at Melbourne Airport. It is likely that the airport lighting network would comprise a variety of light fittings of different purposes and properties. The types of lights anticipated for use during operation of the airport and their properties are listed in *Table 21.2*. The lighting requirements for the proposal would involve general area lighting and specific task lighting. Airport lighting would be strictly controlled and monitored to create safe conditions for aircraft.

The potential impacts that might arise from the operational lighting environment include 'skyglow', 'discomfort glare' and 'disability glare'. Skyglow, where part of the night sky is illuminated across a broad area, reducing the opportunity to view the sky, is an indirect lighting effect that would result from orange halide lights that are generally used to illuminate buildings and work areas. This effect would only be noticeable beyond one kilometre from the airport sites and would be most intense at distance of three to 10 kilometres from the sites. Skyglow would affect a greater number of viewers than direct lighting effects, although impacts would not be significant. Discomfort glare refers to the partial or indirect impairment of a view resulting from an artificial lighting environment; disability glare involves a direct impairment of the view of an object and usually results in significant impacts to the viewer. Lighting impacts can vary according to the sensitivity of the viewer and are therefore subjective in nature.



View Points

1 Northern Road
2 Elizabeth Drive
3 Badgerys Creek Road (Option A and B only)
4 Lawson Road
5 Cecil Park Communications Tower
6 Mount Vernon Road
7 Blackford Hill, Hill Road
8 Bringelly, Dwyer Road
9 Silverdale
10 Warragamba
11 Mount Henry, Hillcrest
12 Lapstone, Lapstone Tower

Figure 21.1
Locations in the Area with Views Into the Airport Sites

Table 21.2 Predicted Operational Lighting System for the Second Sydney Airport

Light type	Locations	Direction[1]	Intensity[2]	Angle[3]
Infrastructure Lights	Buildings and Work Areas	Shielded Down	500 candela	not applicable
General Runway lights	Edge of all runways	Omni-directional	100 candela	30
High Intensity Approach lights	Up to 900m out from landing runway	Uni-directional	20,000 candela	60
High intensity sideline lights	Side of landing runway	Uni-directional	5,000 candela	100
High intensity identification strobe lighting	Glide zone within airport perimeter	Uni-directional	200,000 candela	50
Tower identification light (TIL) alt. Green/white	Top of control tower	Rotating omni-directional	100,000 candela	3600
Taxi runway and Pavement lights	Pavements	Uni-directional	200 candela	not applicable
Warning lights and General signage	Various	Omni-directional	Various	not applicable

Notes:
1. *Omni-directional-light transmits in all directions.*
Uni-directional-light transmits in one direction.
2. *Candela = standard unit of light intensity.*
3. *Angle of light direction measured in a vertical plane.*

All high intensity runway approach, sideline and strobe lights are unidirectional and would be well shielded. These lights have the potential to have low impacts, in the form of discomfort glare if the viewer is located within an area not shielded from lighting. This would include areas elevated above three degrees from the light source in the exact direction of the light. No potential viewing locations are situated within this zone. High intensity lights would be imperceptible beyond one kilometre from the source of the light if the viewer is outside the shielded area.

A tower identification light, used for aircraft navigation, would be elevated, omni-directional and flash signals alternately white and green. Without appropriate screens, light would be intrusive at close distances and at higher elevations between five to ten kilometres from the airport sites. Runway (taxi area) and pavement lights have low intensity levels and result in negligible effects when viewed from beyond the perimeter of the airport.

The lighting impacts at viewpoints listed in *Table 21.1* are summarised in *Table 21.3*.

Lighting impacts are expected to be similar for all airport options, with many of the potential viewers screened by existing vegetation and topography. Night lighting impacts would include:

- moderate to high impacts from infrastructure lights within five kilometres of the airport;
- moderate impacts between three and 10 kilometres of the airport due to skyglow;
- low to negligible impacts from high intensity lights, but only when the viewer is elevated at above three degrees and almost in a direct line from the light source. It should be noted that no potential viewing points lie within this zone; and

Table 21.3 Summary of Lighting Impacts (Without Mitigation Measures)[1]

View-Points	Locations	Infrastructure Lights	Skyglow	High Intensity Lights	Tower Identification Light
1	The Northern Road, Badgerys Creek	H	M	L	VH
2	Elizabeth Drive, Badgerys Creek	H	L	N	H
3	Badgerys Creek Road, Badgerys Creek	VH	N	N	H
4	Lawson Road, Badgerys Creek	H	M	N	H
5	Cecil Park Communication Tower	L	M	L	H
6	Mount Vernon Road	L	M	N	H
7	Blackford Hill, Hill View	M	M	L	H
8	Dwyer Road, Bringelly	M	M	L	H
9	Silverdale	L	L	N	M
10	Warragamba	L	L	N	M
11	Mount Henry, Hillcrest	L	L	N	M
12	Lapstone Tower, Lapstone	N	L	N	L

Note: 1. Abbreviations.
N = negligible;
L = low;
M = moderate;
H = high; and
VH = very high.

- high to very high impacts from the tower identification light resulting from its high intensity, colour and movement and distances up to 10 kilometres.

Viewers most likely to experience adverse impacts would be residents of Luddenham, Bringelly and Kemps Creek. At middle distances, around 10 kilometres from the airport, lighting impacts would vary from low to moderate, depending on exposure to the tower identification light.

21.3.4 Aircraft Overflights

The western Sydney region contains a military airport (RAAF Base Richmond), a major general aviation airport (Bankstown) and a number of local airfields used for training and recreation (refer Figure 4.3 of Draft EIS). In addition, aircraft from Sydney Airport travel over the region at moderately high altitudes towards regional, national and international destinations. Bankstown Airport is Sydney's primary general aviation airport and is the major general aviation, training, maintenance and support facility in Australia. It generates a significant amount of daily air traffic in western Sydney (refer Chapter 4 of Draft EIS). Aircraft are therefore currently part of the skyward landscape or 'skyscape' of western Sydney.

The air-space above Badgerys Creek forms part of the general aviation flying training area for aircraft based at Bankstown and Hoxton Park and is therefore already subject to aircraft overflights, at low altitudes and frequencies. Generally the area has a relatively quiet, rural character.

Operation of the Second Sydney Airport would increase the number of aircraft within the western Sydney skyscape. Aircraft would be at lower altitudes than those currently operating from Sydney Airport and would be frequently visible in the sky from most viewing locations in the region.

The degree of the visual impact of aircraft overflights would be proportional to the proximity of the viewer to the site and would vary according to the sensitivity of the viewer. Impacts would be greatest at locations close to the airport sites, such as Luddenham and Bringelly, and would decrease to negligible at more distant locations, such as Richmond or Picton. At mid-distance viewing locations, (distances of approximately 10 kilometres from the airport sites), impacts would be low to moderate, but would be greater at elevated locations, such as Warragamba and Silverdale. At a regional level, the addition of aircraft to the sky resulting from operation of the Second Sydney Airport would not constitute a significant change in visual character, owing to the current use of airspace by a variety of aircraft.

The visual impacts of aircraft overflights would be similar for all airport options at mid-distance and long-distance locations. However, impacts would differ between airport options at locations close to the airport sites because of the different location and alignment of the runways. Further assessment of the degree and nature of impacts at these locations would be appropriate following detailed design of the airport and the determination of flight paths and operating schedules.

21.3.5 Environmental Management

This section provides a response to issues raised in submissions from the Western Sydney Alliance and others regarding the mitigation and management of potential visual and landscape impacts associated with the proposal.

Retention of Existing Vegetation

One of the key recommendations of the visual and landscape assessment in the Draft EIS was that vegetation along the perimeter of the airport sites should be retained as far as possible to minimise the visual impacts of construction activities. By contrast, the assessment of flora and fauna impacts was based on the assumption that all standing vegetation within the airport sites would be cleared during construction of the airport. Thus the assumptions of the flora and fauna and visual and landscape assessments were inconsistent.

A key recommendation of the revised flora and fauna assessment described in *Chapter 14* of this Supplement is that the retention of on-site vegetation is a significant means of reducing impacts to endangered ecological communities. This measure would also have the advantage of reducing visual impacts during construction of the proposal, when most vegetation clearance would occur, and during operation, as proposed revegetation programs increase the area of vegetation cover within the airport sites in the long term. These measures have been reviewed by airport planners and are generally found to be feasible, that is, they can be accommodated without adversely affecting airport operations or aircraft safety.

Greater Blue Mountains Area World Heritage Nomination

Options for mitigation of visual impacts on the Greater Blue Mountains Area World Heritage nomination are limited and would consist primarily of changes to flight paths and flight schedules. The joint NSW-Commonwealth Government team responsible for submitting the proposal for nomination of the area should be consulted following the detailed design phase to ensure that the values of the proposed World Heritage area are not threatened by operation of the airport. An option would be that, following construction of the airport, visitor surveys be undertaken in national parks and reserves in the nominated area to determine the significance of visual impacts from aircraft overflights. The results of surveys would be used to consider appropriate mitigation measures, such as modification of flight paths to reduce visual impacts.

Vegetation Management

Environmental management measures proposed in *Technical Paper No. 14* would still apply to construction and operation of the airport. As stated in *Chapter 14* of this Supplement, revegetation would aim to re-establish vegetation communities that currently exist on the airport sites. Proposed landscaping would use native plant species identified as components of Cumberland Plain Woodland and River-flat Forest, two endangered ecological communities existing within the airport sites, and regionally significant species (refer *Chapter 14* of this Supplement). The feasibility of re-introducing the nationally endangered plant *Pultenaea parviflora* would be investigated through consultation with Mount Annan Botanic Gardens, as discussed in *Chapter 14*.

Operational Lighting

The impacts of lighting during operation of the Second Sydney Airport would result mainly from infrastructure lights and tower identification lights. Skyglow created by infrastructure lights could be reduced to acceptable levels with suitable light shielding. Potential options for shielding include:

- avoiding direct lighting of lightly coloured surfaces, such as white concrete and metal finishes;
- selecting colours which are light absorbing; and
- erecting fittings on high towers to distribute luminance evenly and shielding fittings carefully to avoid lateral glare.

The potential would exist for the tower identification light to be shielded below three degrees. Such screenings would largely eliminate the impact of this light.

Suitable screening of infrastructure lights and the tower identification light would eliminate disability glare, reduce discomfort glare to acceptable levels and, therefore, overcome significant lighting impacts.

Aircraft Overflights

There would be limited opportunity to mitigate the visual impacts of aircraft overflights. It is possible that some of the proposed measures to ameliorate noise impacts, such as modifying flight paths (refer *Chapter* 8 of this Supplement), might have the added advantage of also reducing visual impacts. In general, the visual impacts of aircraft overflights are considered largely unavoidable during operation of the airport.

21.4 Overview of Visual and Landscape Impacts

Development of the Second Sydney Airport would involve substantial modification to the landscape and visual quality of the sites of the airport options. The existing rural visual character would be replaced with a built-up commercial-industrial landscape.

Operation of the airport would lead to indirect adverse impacts on the visual quality of the proposed Greater Blue Mountains Area World Heritage nomination, through the occurrence of aircraft flying overhead. Similarly, the visual character of areas around the airport sites would be negatively affected by aircraft overflights.

The proposal also has the potential to act as a catalyst for further urban development in the western Sydney region and would generate infrastructure and commercial activity in areas outside the airport sites. As described in *Technical Paper No. 2*, infrastructure required for the airport would utilise existing easements and hence visual and landscape impacts are not expected to be significant. However, these developments would be subject to environmental impact assessment under State legislation.

Operational lighting impacts are expected to be significant in areas close to the airport sites without mitigation measures, depending on the position of the viewer relative to high intensity lights and the sensitivity of the viewer. Skyglow from infrastructure lights is likely to be visible to a larger number of viewers in mid-distance sites, particularly those at higher elevations, although the degree of impact would be low. A flashing tower identification light for aircraft navigation purposes would be visibly intrusive at close distances and elevated mid-distance sites. Overall, the significance of lighting impacts would generally be proportional to elevation and proximity to the airport sites.

Options for mitigation of visual impacts associated with aircraft overflights would be limited. Mitigation of direct landscape impacts within the sites of the airport options would relate primarily to landscaping proposals and maximising the retention of existing vegetation. Regionally significant plant species and species associated with the endangered ecological communities Cumberland Plain Woodland and River-flat Forest would be used in landscaping of the airport sites. Appropriate shielding of infrastructure lights and the tower identification light would reduce potential lighting impacts to low levels.

Chapter 22

Economic Issues

Chapter 22
Economic Issues

22.1 Summary of the Draft Environmental Impact Statement

22.1.1 Economic and Financial Costs

Chapter 24 of the Draft EIS provided a summary of the key financial and economic costs associated with the proposal. Available costs were presented, including the costs of construction, on-site and off-site infrastructure, and an estimate of noise mitigation costs and property devaluation associated with noise impacts of the airport. The Draft EIS noted that a number of potentially significant costs were not valued, including relocation of Defence facilities at Orchard Hills and impacts on the operation of the other Sydney basin airports.

22.1.2 Economic Impact Assessment

Methodology

Chapter 25 of the Draft EIS included an analysis of the economic impacts of the proposal. The economic analysis in both chapters drew on detailed analysis in *Technical Paper No. 15*. The Draft EIS examined impacts of the proposal on employment and business, agricultural displacement, property devaluation from noise impacts, and displacement of business. The assessment concentrated on the region comprising several local government areas surrounding the airport options. Estimates of direct and indirect employment impacts were presented.

Regional Economic Characteristics

A comparison of the main economic indicators for the Badgerys Creek region with those of the Sydney Statistical Division indicated that:

- unemployment is higher in the Badgerys Creek region;
- employment in the manufacturing and trade sectors is larger in the Badgerys Creek region; and
- agriculture across Sydney and in the Badgerys Creek region is a relatively minor source of employment.

The reliance of the Badgerys Creek region on trade and manufacturing was contrasted with the predominantly service-oriented industries surrounding Sydney Airport.

Employment Impacts of Airport Construction

For any of the airport options, average on-site employment levels over the construction period (for the master plan level of development) were estimated to be about 1,400 people. About 8,400 person years of on-site labour and an additional 17,000 person years of indirect employment was projected for the regional economy over the course of the construction period.

Employment Impacts of Airport Operations

Based on studies of employment at Sydney Airport, the Draft EIS estimated that the proposal would generate between 52,000 and 63,000 jobs in Sydney by 2016, compared with a situation in which Sydney Airport was restricted to 30 million passengers annually and no second airport was constructed.

General Economic Impacts

The Second Sydney Airport would significantly influence the regional economy, requiring development of new industries to service the airport. The losses to agricultural production (estimated in the Draft EIS to be between $400,000 and $1.9 million per annum) from a Second Sydney Airport are relatively small, with any production losses likely to be replaced by agricultural activity elsewhere in the region or State. The relatively poor quality coal deposits on the site are unlikely ever to be commercially mined.

Aircraft overflight noise from the proposed airport could result in property devaluation in the range $25 to $67 million (depending on the airport option chosen). There would also be indirect impacts on property values caused by changes in the development potential of land.

22.2 Summary of the Issues Related to Economics

22.2.1 Issues Raised in Submissions

Viability of the Second Sydney Airport Proposal

A number of submissions, including those from the NSW Government and the Western Sydney Alliance, were critical that a full benefit cost analysis was not undertaken for the Draft EIS. A range of other comment was linked to this criticism. Another comment in submissions was that a 'do nothing' option was not developed as the basis for a benefit cost analysis.

Comment was also made on the cost estimates, including the lack of an attempt to value some items such as environmental impacts, the impact on Sydney basin airport facilities, secondary risks associated with airport operation, impact on recreational opportunities in western Sydney, and the relocation of Defence facilities. Some authors concluded that the costs for the proposal were underestimated.

Submissions from the Australian Business Chamber and others noted that the benefits of the proposal might have been better described in the Draft EIS.

Submissions also commented that some impacts should have been considered or considered in more detail, including those associated with airport-related infrastructure, impacts on local government finances, and costs of lost agricultural production.

Some submissions argued that the results of a financial feasibility study on the proposal should have been made public.

Regional Economic Impacts of the Proposal

Some submissions noted what were seen as modelling and methodological shortcomings in the assessment of regional impacts of the proposal. Specific comment was also made criticising the geographic definition used for presenting and comparing economic data.

Most comment focused on the employment estimates contained in the Draft EIS. There was a view that the employment estimates were overstated, including as a result of a perceived failure to take account of job losses in existing industries. The Western Sydney Alliance, among others, considered that the jobs required by an airport do not match workers' skills found in western Sydney. Conclusions were also reached in submissions that the estimated increase in employment was insufficient to offset the negative impacts of the proposal.

A small number of authors commented that the employment generated by the proposal would benefit western Sydney.

Other Issues

A number of submissions commented (in response to Chapters 6, 7 and 24 of the Draft EIS) that market forces should determine the timing and role of a second Sydney airport.

There was also comment that the Draft EIS did not adequately address the issue of funding for airport-related infrastructure, and submissions from the NSW Government and Total Environment Centre, among others, considered that the Commonwealth should fund this infrastructure.

22.2.2 Issues Raised by the Auditor

The Auditor noted that the failure to present a 'do nothing' option meant that the Draft EIS did not present the broad range of alternatives necessary for an economic assessment. The report also commented that the Draft EIS did not provide a methodology capable of establishing the net economic effect of the proposal, and that not all relevant impacts were included in the analyses which were undertaken.

22.3 Economic and Financial Viability of the Airport Proposal

22.3.1 Introduction

The viability of a proposed infrastructure development such as an airport can be assessed from either a financial or an economic perspective. A financial viability study focuses exclusively on accounting costs and revenues to provide a picture of the financial value of an asset such as an airport. It attempts to answer the question: "What would be the financial returns for an owner/operator from an investment in the construction and operation of the facility?"

Economic viability is a broader concept than financial viability. An economic viability study (benefit cost analysis) takes account of the wider economic costs and benefits of a proposal, in order to assess whether benefits outweigh costs. It attempts to answer the question: "Would the construction and operation of an airport be in the interests of the community as a whole?"

An economic benefit cost analysis takes into account not only the financial costs and benefits (for example, airport costs and revenues), but also environmental costs (for example, noise and air quality impacts) and the benefits of the proposal to the general economy. As in a financial analysis, account is also taken of risk and the cost of having money committed to a particular use over a period of time.

A benefit cost analysis was not undertaken for the Draft EIS, due to:

- the difficulty in defining the future capacity of Sydney Airport (the 'do nothing' option); and

- the complexity of valuing many of the environmental impacts associated with the development.

Since the preparation of the Draft EIS, and in response to public comment, significant additional work has been undertaken on both the financial and economic viability of the Second Sydney Airport proposal. Further details on the methodology adopted, and the results obtained, are set out in *Appendix J1*. It has not, however, been possible to overcome all the constraints which limited the work undertaken for the Draft EIS.

22.3.2 Economic Viability

There were four steps involved in the economic benefit cost analysis of the airport proposal. These were to:

- establish a 'do nothing' scenario to help define the timing and scale of the second airport development;
- identify and, where possible, value the costs and benefits of the proposal in monetary terms;
- discount these costs and benefits for time and risk; and
- calculate summary statistics, including net present value, internal rate of return and benefit cost ratios.

The Base Case or 'Do Nothing' Option

As discussed in *Section 4.4.1* of this Supplement, defining a 'do nothing' option as it relates to Sydney Airport has become clearer since the preparation of the Draft EIS because the operating environment for Sydney Airport is now more settled.

Two capacity scenarios for Sydney Airport have been developed for this analysis. Both scenarios are based on the assumption that the future capacity of Sydney Airport would be determined by the number of aircraft that can be handled in peak hours, rather than by the number of passengers which can be catered for. The aircraft handling limit is set by the number of slots allocated per hour, which is set by legislation at 80. The differences between the scenarios therefore reflect different assumptions about aircraft types and load factors (percentage of occupied seats). Both scenarios are broadly consistent with the current operating environment at Sydney Airport (refer to *Section 4.4.1*):

- *Sydney Airport Capacity Scenario 1* puts maximum capacity at Sydney Airport at around 34 million passengers annually (including international transit passengers). It assumes that current trends in aircraft size and loading apply, and that the percentage of slots allocated to regional, domestic, and international aircraft remains unchanged; and
- *Sydney Airport Capacity Scenario 2* puts maximum capacity at Sydney Airport at around 38 million passengers annually (including international transit passengers). It assumes that there would be a significant consolidation of regional/domestic services over time. It works on the basis that every three regional aircraft movements would, in the longer term, be consolidated into two movements without impacting on total regional passenger movements. The result is an increase in average aircraft size and the number of passengers which could be handled.

These scenarios represent only two of the range of possible capacity scenarios for Sydney Airport. It is feasible that, within current policy settings, capacity at the

Airport could be extended further by action by major airlines to increase load factors and aircraft size.

The capacity of Sydney Airport could also be extended by a proportion of regional traffic moving to Bankstown Airport as discussed in *Chapter 4* of this Supplement.

On the other hand, it could also be argued that the maximum capacity of Sydney Airport could be lower than either *Sydney Airport Capacity Scenario 1* or *2* because significant environmental pressures could increasingly constrain the Airport over time.

Benefits

The main reason for constructing a Second Sydney Airport would be to meet the forecast air transport demand for the Sydney basin. Measuring the major benefit of the Second Sydney Airport in these terms therefore relies on measuring the cost of constraining air transport to and from the Sydney basin to the limit of Sydney Airport (as specified by *Sydney Airport Capacity Scenarios 1* and *2*). In other words, the benefit of being able to meet demand through a Second Sydney Airport is the obverse of the cost of not being able to meet demand at Sydney Airport. It is therefore necessary to estimate the value which potential travellers would place on travelling to and from Sydney by air.

The benefits of the proposal are measured by estimating what people would be willing to pay to travel by air, over and above the price they would have paid if airport capacity in the Sydney basin was unconstrained. That is, the economic cost of not being able to meet air transport demand for Sydney is measured as the additional amount each consumer would be willing to pay for air travel above the current fares. (This commonly used tool of economic analysis is termed the loss of consumer surplus).

Four variables are required to estimate the consumer surplus (refer to *Appendix J1*):

- forecast demand for air travel in the Sydney basin, using revised high, central and low forecasts by the Department of Transport and Regional Services (these forecasts are based on those presented in *Section 4.3.3* of the Supplement);
- the maximum capacity of Sydney Airport, which is defined by *Sydney Airport Capacity Scenarios 1* and *2* (discussed above);
- the average price of an air ticket to Sydney, which is based on the average passenger yield achieved by Qantas, whose operations were assumed to represent activity at Sydney Airport; and
- the responsiveness of consumers to changes in the price of air travel.

The responsiveness of passengers to changes in price (price elasticity of demand) reflects how much they value air travel to Sydney over alternative uses for their money. If demand is relatively unresponsive to price (price inelastic), consumers have less opportunity or desire to substitute alternative consumption for air travel; they thereby incur relatively large economic costs if their capacity to travel by air is constrained.

Alternatively, if demand is relatively responsive to price (price elastic), air travellers are able to more easily substitute other expenditures for air transport; they thereby incur smaller costs if for some reason they are not able to travel by air.

Elasticities for air travel have been measured in a number of studies with little consensus. No published estimates of the elasticity of demand for domestic consumers in Australia have been identified, although there is published data for international routes to and from Australia (Bureau of Transport and Communications Economics, 1995).

For this analysis, elasticities of minus 1.2 (relatively elastic), minus 0.8 and minus 0.4 (relatively inelastic) were used. These measures were consistent with those used in other, available studies. This range also reflects the likelihood that, as the size of unsatisfied demand grows, it would increasingly encompass those consumers who value air travel to and from Sydney more highly, such as business travellers. This would mean that demand would tend to become more inelastic over time, that is people would be willing to pay more.

The amount of unsatisfied demand for air travel to Sydney in any year (given by the forecast demand for air travel in the Sydney basin minus the capacity of Sydney Airport) is combined with the current price for access to Sydney Airport (average ticket price) and the responsiveness of consumers to changes in price (price elasticity of demand) to put a dollar value on the cost to consumers of constraining demand in the Sydney basin. As stated already, meeting this demand through construction of the Second Sydney Airport will deliver this dollar value as an economic benefit.

In this analysis the size of the benefit has been discounted to reflect the likelihood that not all people who cannot fly to Sydney Airport would choose to fly to the Second Sydney Airport. Based on a qualitative assessment undertaken by the Department of Transport and Regional Services and discussions with the major airlines, it was assumed that 90, 75 and 60 percent of unsatisfied demand for international, domestic and regional services respectively would transfer to Badgerys Creek. As noted below in the discussion of costs, this reduced benefit can be seen as a substitute for costs associated with the additional travel times and any inconvenience experienced by travellers.

The consumer surplus is the most significant benefit included in the analysis undertaken for the Supplement. The other benefit included is the revenue generated by the Second Sydney Airport (based on estimates used for the assessment of financial viability).

The Auditor made some preliminary comment on the approach taken to estimating consumer surplus in this Supplement. The Auditor considered that the methodology adopted to estimate consumer surplus benefits is too simplistic. Instead, the Auditor would prefer the analysis to reflect a drop in price for airport services in the Sydney basin with the advent of a second major airport. The analysis for this Supplement has not been amended to reflect the Auditor's comments on this point. In particular, the proponent considers that the (present) assumption that prices would remain the same is more realistic, and better reflects the likely regulatory and commercial constraints acting on the operator of a multi-airport system. Nevertheless, the Auditor has noted that, if its suggested approach were used, it would in all likelihood indicate higher benefits for consumers and higher benefit cost ratios.

Costs Included in the Benefit Cost Analysis

The analysis draws chiefly on information gathered in preparation of the Draft EIS. A list of the major impacts included and the method of valuing them is summarised below.

Airport Construction Costs: The estimates of construction costs used in the benefit cost analysis were those for airport development Option C prepared for the Draft EIS (Second Sydney Airport Planners, 1997a): Option C was chosen as it represents the intermediate airport option in terms of overall construction costs.

Airport Operating Costs: Based on Department of Transport and Regional Services' estimates.

Off-site Infrastructure: Cost estimates prepared for the Draft EIS (Second Sydney Airport Planners, 1997a) and the Supplement.

Aircraft Noise: The loss of amenity from aircraft noise is based on estimates of the reduced property values contained in the Draft EIS (Section 12.6), together with the estimated costs of noise management.

Air Quality: Reductions in air quality will be partly reflected in reductions in property values. In addition it was assumed that, as a worst case scenario, all cancer cases resulting from degradation of air quality would be terminal. The value of human life was estimated on the basis of the guidelines used by the US Federal Aviation Authority.

Water Quality: Surface water discharged from the airport site would be of better quality than existing run-off and would have positive impacts on the ecology of streams. The improved quality would be achieved by providing safeguards and implementing procedures to prevent contaminants entering the drainage system and by treating all surface water in water quality control ponds prior to discharge. The costs of constructing these facilities have been included in the airport construction costs, but the associated benefits have not been quantified. CSIRO has advised that there would not be a significant risk to drinking water from airport operations.

Displaced Production: Estimates of agricultural production foregone made for the Draft EIS (Section 25.5.3).

Risk of Aircraft Crash: Cost estimated to represent the adverse impact of such an event on the crash site.

Airport Travel Time and Inconvenience: As a proxy for additional travel time for passengers using the Second Sydney Airport it is assumed that some passengers choose not to fly to an airport at Badgerys Creek if they cannot access Sydney Airport (this is reflected directly in reduced benefits associated with the proposal).

Diversion of Local Road Traffic: Cost of diversion of local traffic is estimated based on traffic modelling undertaken for the Draft EIS (*Technical Paper No. 13*, Table 7.6).

Costs Not Included in the Benefit Cost Analysis

Due to methodological difficulties and lack of data, it was not possible to quantify some of the environmental and other costs associated with the airport proposal. These costs are discussed below.

Defence Establishment Orchard Hills: There is uncertainty about whether the Defence Establishment could co-exist with the airport development, particularly Option C. No estimates of the probability and cost of relocating the facilities are available.

Mineral Resources: There is uncertainty about whether light firing clay and shale deposits would be sterilised by different airport development options. There is also uncertainty about whether such deposits are economic. Similarly, there is doubt that mining coal reserves identified on the airport site would be either economically viable or technically feasible (see Supplement *Section 12.3.2*).

Aboriginal Cultural Heritage: The Draft EIS (Section 20.7) found that the surviving archaeological resource has low scientific value, although the area is valued by the local Aboriginal community for its cultural significance. Valuing this in monetary terms would be very difficult. The Draft EIS (Section 20.6) contains a detailed management program for heritage items that could mitigate the cost of impacts (although no costing of these management measures has been undertaken).

Non-Aboriginal Cultural Heritage: Impact varies for different airport development options. Valuing these impacts in monetary terms would be difficult. The Draft EIS (Section 21.5) outlines management measures for each heritage item that could mitigate the cost of impacts (although no costing of these measures has been undertaken).

Flora and Fauna: Valuing these impacts in monetary terms would be difficult. This Supplement details an environmental management plan that could mitigate the cost of impacts (although no costing of these management measures has been undertaken).

Potential Loss of Amenity in National Parks: It is a matter of judgement as to whether or not aircraft overflight would have a noticeable negative impact on amenity of those using National Parks. Determining and valuing any such impacts in monetary terms would likely require extensive surveys of National Park users. This has not been undertaken for this Supplement. Potential impacts would also depend on the airport development option chosen and flight paths used by aircraft.

Visual and Landscape: The impacts are partly costed in the estimated decline in housing values.

Other Sydney Basin Airports: The Draft EIS (Section 22.7) details the impacts on other Sydney basin airports. Valuing the costs of these impacts in monetary terms is made difficult by the complex interaction of factors affecting airport operations in the Sydney basin, and the potentially different impacts on the secondary airports depending on which Badgerys Creek airport option is chosen. To put the impacts in perspective, Bankstown, Camden and Hoxton Park together serviced over 600,000 general aviation movements in 1997-98 with a total turnover of around $8 million (Federal Airports Corporation, 1998).

Allocating Costs and Benefits

The analysis presents a regional breakdown of results for Australia, NSW, Sydney and the Badgerys Creek region. The geographic definition of the Badgerys Creek region used for the model covers the Statistical Local Areas of Baulkham Hills, Blacktown, Camden, Campbelltown, Fairfield, Liverpool, Penrith and Parramatta.

Given that the major component of benefits is determined by consumption of air travel, the analysis allocates benefits on the basis of estimated use of air transport by residents of those regions. *Table 22.1* shows this allocation.

Table 22.1 Estimated Regional Share of Benefits of the Second Sydney Airport

Region	Share of Benefits (percent)
Australia	100
NSW	100
Sydney	92
Badgerys Creek region	17

Source: Department of Transport and Regional Services, 1998.

The allocation of costs is problematic. How the construction of the Second Sydney Airport and related infrastructure would be funded has not been determined. Commonwealth Government policy is to privatise the airports in the Sydney basin following the satisfactory resolution of aircraft noise issues at Sydney Airport. In addition, under the *Airports Act, 1996*, Sydney Airport and the Second Sydney Airport are required to have common ownership. The Second Sydney Airport could therefore be developed through a range of means, including construction by the Commonwealth or sale of Sydney Airport with an obligation to develop the Second Sydney Airport. Whatever the outcome, it is unlikely that the Commonwealth would fund an airport at Badgerys Creek purely from taxpayer revenue. It is also likely that a portion of airport-related infrastructure would be funded by the NSW Government.

Nevertheless, the Commonwealth (and therefore the Australian taxpayer) is likely to bear the ultimate risk for the development (for example, in the form of a lower sale price received for Sydney Airport with a development obligation attached). In addition, a substantial part of any NSW Government expenditure could be expected to draw on Commonwealth taxpayer funds made available through the Commonwealth-State grants system. On this basis, the analysis allocates the costs of the project according to regional payment of Commonwealth taxation. These shares are shown in *Table 22.2*.

Table 22.2 **Estimated Regional Share of Costs of the Second Sydney Airport**

Region	Share of Costs (percent)
Australia	100
NSW	36
Sydney	24
Badgerys Creek region	6

Source: Department of Transport and Regional Services, 1998.

Results of the Benefit Cost Analysis

The results are presented in terms of the three standard measures of the economic worth of a project:

- *net present value*, which is the sum of the discounted project benefits less discounted project costs – a project is potentially viable if total discounted benefits is greater than total discounted costs (that is, the net present value is greater than zero);
- *benefit cost ratio*, which is the ratio of the present value of benefits to the present value of costs – a project is potentially viable if the present value of benefits exceeds the present value of costs (that is, the benefit cost ratio is greater than one); and
- *internal rate of return*, which is the discount rate at which the net present value of a project is equal to zero, that is, discounted benefits equal discounted costs – a project is potentially viable if the internal rate of return equals or exceeds the discount rate used in the analysis.

Table 22.3 shows the results for these three standard measures for the Stage 1 (10 million passengers per year) and the master plan (30 million passengers per year) developments, based on *Scenarios 1* and *2* for the future capacity of Sydney Airport.

While the results presented in *Table 22.3* reflect preferred assumptions, the benefit cost results are extremely sensitive to changes in the price elasticity of demand and the rate of aviation demand growth (see discussion of sensitivity below).

Table 22.3 Economic Viability of the Second Sydney Airport Proposal: Stage 1 and Master Plan Developments

Second Airport Development	Sydney Airport Capacity (million pax per year)	Internal Rate of Return (percent)	Benefit Cost Ratio	Net Present Value ($ billion)
Stage 1	34	12	2.4	3.7
	38	12	2.3	2.7
Master Plan	34	12	2.2	4.3
	38	12	2.1	3.1

Source: Department of Transport and Regional Services, 1998
Notes:
1. *Price elasticity of demand was assumed to be -0.8.*
2. *The Sydney Airport capacity figures of 34 and 38 million passengers per year, which include international transit passengers, correspond to Sydney Airport Capacity Scenarios 1 and 2 respectively.*
3. *Discount rate of 7 percent (real) was assumed.*
4. *The 'central' passenger demand forecast was used (refer Chapter 4 of EIS Supplement).*
5. *Results refer to the Australian economy as a whole.*
6. *Modelling based on staged development of Badgerys Creek Option C, with off-site infrastructure costs included.*

Based on the results set out in *Table 22.3* and the underlying assumptions, the construction of the Second Sydney Airport would be beneficial from an economic point of view. The internal rate of return is significantly more than the discount rate of seven percent, the benefit cost ratio is clearly more than one, and the estimated net present value is positive.

Table 22.4 shows the range of results allocated by region.

Table 22.4 Economic Viability of the Second Sydney Airport: Results by Region

Second Airport Development	Region	Internal Rate of Return (percent)	Benefit Cost Ratio	Net Present Value ($ billion)
Stage 1	Australia	12	2.4	3.7
	NSW	19	5.8	5.3
	Sydney	21	7.4	5.1
	Badgerys Creek Region	23	5.5	1.7
Master Plan	Australia	12	2.2	4.3
	NSW	19	5.4	6.5
	Sydney	22	7.1	6.3
	Badgerys Creek Region	24	5.7	2.0

Source: Department of Transport and Regional Services, 1998.
Notes:
1. *Price elasticity of demand was assumed to be -0.8.*
2. *Discount rate of 7 percent (real) was assumed.*
3. *The 'central' passenger demand forecast was used (refer Chapter 4 of EIS Supplement).*
4. *It was assumed that Sydney Airport would reach capacity in 2006/07 at 34 million passengers per year, including international transit passengers (Sydney Airport Capacity Scenario 1).*
5. *Modelling based on staged development of Badgerys Creek Option C, with off-site infrastructure costs included.*

The variation of outcomes among regions results from the different extents to which they bear the costs and benefits of an airport at Badgerys Creek. In particular, the financial cost of establishing the Second Sydney Airport varies across taxpayers in proportion to their liability to pay taxation as individuals to the Commonwealth. In contrast, the travel benefits of the airport varies in proportion to the place of residence of those flying. The health, noise and risk costs of a Second Sydney Airport at Badgerys Creek would be borne solely by local residents. Sydney as a whole is the largest winner, gaining most of the benefits, but bearing only part of the costs.

Table 22.5 shows the net present value of benefits and costs.

Table 22.5 Net Present Value of Benefits and Costs

Benefits and Costs	$ (million)
Benefits	
Consumer Benefits	6,600
Operating Revenue	1,310
Total Benefits	*7,910*
Costs	
Airport Construction	1,850
Depreciation	1,050
External Infrastructure	500
Operating Costs	160
Noise and Local Amenity	40
Mining and Agricultural Production	18
Crash Fatalities and Injuries	1
Total Costs	*3,620*

Source: Department of Transport and Regional Services, 1998.
Notes: 1. 1996 prices
2. Price elasticity of demand was assumed to be -0.8.
3. Discount rate of 7 percent (real) was assumed.
4. The 'central' passenger demand forecast was used (refer Chapter 4 of EIS Supplement).
5. Sydney Airport Capacity Scenario 1 capacity for Sydney Airport.

Sensitivity of Results to Alternative Assumptions

The benefit cost results are extremely sensitive to the changes in the price elasticity of demand and the rate of demand growth as shown in *Table 22.6*.

Table 22.6 Economic Viability of the Second Sydney Airport: Sensitivity of Master Plan Results to Changes in the Price Elasticity

Price Elasticity of Demand	Internal Rate of Return (percent)	Benefit Cost Ratio	Net Present Value ($ billion)
-0.4	17	4.1	11.0
-0.8	12	2.2	4.3
-1.2	10	1.6	2.2

Source: Department of Transport and Regional Services, 1998
Note: 1. The central' passenger demand forecast was used (refer Chapter 4 of EIS Supplement).

It can be seen that, if the demand for air transport is relatively inelastic (say minus 0.4), then the estimate of the economic value of the project is larger. When demand is more inelastic, consumers have relatively little opportunity or desire to make other travel arrangements and thereby suffer a relatively large loss of economic welfare by capacity constraints at Sydney Airport.

Alternatively, if demand is relatively elastic (say minus 1.2), then the economic value of the project is smaller. When demand is more elastic, air travellers are able to more easily substitute other expenditures for air transport and thereby suffer little loss of economic welfare if for some reason they are not able to travel by air.

The sensitivity of the viability results to changes in demand are shown in *Table 22.7*.

Table 22.7 Economic Viability of the Second Sydney Airport: Sensitivity of Master Plan Results to Changes in Demand

Demand Growth	Internal Rate of Return (percent)	Benefit Cost Ratio	Net Present Value ($ billion)
Low	8	1.1	0.2
Central	12	2.2	4.3
High	16	3.8	13

Source: Department of Transport and Regional Services, 1998

Notes: 1. Details of the 'low', 'central' and 'high' forecasts for Sydney basin air travel demand are given in Chapter 4 of the EIS Supplement.

2. Price elasticity of demand was assumed to be -0.8.

Table 22.7 indicates that the results are highly sensitive to the rate of future demand growth, with the viability increasing with higher demand growth. For higher rates of demand growth, the airport operator is able to recover more quickly the costs of providing facilities. This is important, as the facilities must be provided in advance of demand.

Overview of Benefit Cost Analysis

For the following reasons, it is necessary to qualify the results of the benefit cost analysis summarised in *Tables 22.3* and *22.4*:

- the results are sensitive to changes in some of the input variables which are difficult to estimate accurately (for example, the rate of demand growth and the price elasticity of demand); and
- although estimates of the costs of the noise, air quality and water quality impacts have been included, some environmental and other costs have not been included in the analysis because of methodological difficulties and lack of data.

Despite these qualifications, it is concluded that:

- both the Stage 1 and master plan proposals would have net economic benefits; the environmental and other impacts that have not been quantified would need to have a collective cost of at least $3 billion in discounted present values (under the central assumptions), or an average annual cost of more than $200 million per year, to make the master plan proposal non-viable (benefit cost ratio less than 1.0); and
- there would be major economic benefits to Australia, NSW, Sydney and the Badgerys Creek region from the proposed airport.

22.3.3 Financial Viability

To complement the economic assessment, an analysis was undertaken of the likely financial implications for a future airport operator of developing and operating the Stage 1 development of the three Badgerys Creek airport options.

The analysis included costs that are directly attributable to the airport development such as on-airport capital expenditure, as well as operating revenues and operational costs of the Second Sydney Airport. External infrastructure costs were not taken into account in the financial assessment as the airport operator typically does not fund such expenditure.

A summary of the results of the financial viability of the Stage 1 development is given in *Table 22.8*.

Table 22.8 **Financial Viability of Stage I of the Second Sydney Airport Proposal**

Second Airport Option	Sydney Airport Capacity (million passengers per year)	Net Present Value ($ million)	
		Low	High
Option A	34	-280	n/a
	38	-300	n/a
Option B	34	-620	n/a
	38	-580	n/a
Option C	34	-540	-1,200
	38	-510	-1,000

Source: Department of Transport and Regional Services, 1998.

Notes:
1. *n/a - not available*
2. *Discount rate of 7 percent (real) was assumed.*
3. *The Sydney Airport capacity figures of 34 and 38 million passengers per year, which include international transit passengers, correspond to Sydney Airport Capacity Scenarios 1 and 2 respectively.*
4. *The "central' passenger demand forecast was used (refer Chapter 4 of EIS Supplement).*
5. *Off-site infrastructure costs were not included.*
6. *Revenues were based on existing aeronautical charges at Sydney Airport.*
7. *The 'low' and 'high' values for net present value in the Table reflect alternative assumptions about the annual amount that the airport operator would need to put aside each year for the eventual replacement of airport facilities. In the analysis, this is reflected in alternative depreciation assumptions, with t*

As with the economic cost benefit analysis, the results of the financial viability study are qualified by uncertainties about some of the key inputs, including future pricing policies for the airport, the cost estimates and future demand for the airport. With this in mind, the findings indicate that:

- Stage 1 development of the Second Sydney Airport would not be financially viable if aeronautical charges were based on those which currently apply at Sydney Airport:
  - Option A is estimated to have a negative net present value of around $300 million; and
  - Options B and C would have values about $300 million less than Option A, reflecting the fact that additional land would be required for these options and the construction costs would be higher than for Option A.

The negative net present values for the Stage 1 development reflect the significant up-front construction costs, the likely low traffic volumes in the first few years and revenue projections based on existing Sydney Airport charging practices.

Relatively small increases in airport revenue or large decreases in construction costs could make the Stage 1 development financially viable. By way of illustration, a passenger charge of around $1 to $2 on passengers departing through either Sydney Airport or a Second Sydney Airport at Badgerys Creek would cover the costs of constructing and operating the Stage 1 development of Option A. An increase of $2 per passenger corresponds to 0.6 percent of the average Qantas one-way airfare in 1997-98.

22.3.4 Comparison of the Assessments of Economic and Financial Viability

The above analysis indicates that there is a substantial difference in the viability of the Second Sydney Airport when viewed from an airport operator's perspective rather than from a broader economic perspective.

The principal reason for this difference is that the airport would generate substantial benefits (and incur costs) that the airport operator cannot directly access. These benefits would include those identified in *Section 22.3.2* of this chapter which flow from the ability to cater for a higher level of air traffic in the Sydney basin than if the Second Sydney Airport was not built.

22.4 Regional Economic Impacts of the Airport Proposal

22.4.1 Methodology

Technical Paper No. 15 contained details of the regional economic analysis undertaken for the Draft EIS. The Economic Regional Analysis (ERA) Model was used to provide a profile of employment and industry effects of alternative airport developments for the region around the Badgerys Creek site.

An overview of the conceptual framework for the model is provided in *Technical Paper No. 15*. The model uses official Australian Bureau of Statistics data, rather than relying on primary data collection, which would have been time-consuming and perhaps open to challenge.

The model also uses the industry and employment characteristics of the region surrounding Sydney Airport to draw conclusions about the level and type of activity that could be generated by the Second Sydney Airport. Although not all of the activities currently carried out around Sydney Airport are likely to be duplicated for the second airport, Sydney Airport is the best available indicator of the kind of activity that a second major airport might generate. As there are no second airports in Australia of the kind or scale envisaged for the Second Sydney Airport, using experience in other capital cities as a guide would be no more conclusive. In addition, the Draft EIS covers the development of the Second Sydney Airport to a capacity of 30 million passengers. It is reasonable to expect that an airport of this scale would, over time, require and attract a similar level of activity to that at Sydney Airport.

The geographic definition of the Badgerys Creek region used for the model covered the Statistical Local Areas of Blacktown, Camden, Campbelltown, Fairfield, Liverpool, Penrith and Wollondilly. Further analysis undertaken for this Supplement (*Section 22.4.2*) extends this regional definition to include Baulkham Hills and Parramatta, but excludes Wollondilly.

While the ERA model provided estimates of employment impacts for the Badgerys Creek region from the operation of a Second Sydney Airport, an alternative methodology was used to develop the employment numbers which were presented in the Draft EIS. The key elements of this alternative approach are also outlined in *Technical Paper No. 15*, and discussed in *Section 22.4.2* below.

22.4.2 Employment Estimates

Further work was undertaken for this Supplement to estimate the regional economic and employment impacts of the Second Sydney Airport (see *Appendix J2*). The results are compared to a base case under which the industries located in the Badgerys Creek region grow at what might be considered typical growth rates.

Employment Estimates Developed for this Supplement

Consistent with the economic and financial analyses in this chapter, these estimates are based on the central demand growth forecast, and *Sydney Airport Capacity Scenario 1*.

Total employment generated in the Badgerys Creek region by the operation of the Second Sydney Airport is estimated to be 10,100 in 2016, and 18,600 by 2026. These estimates represent increases in employment in the region of two percent and three percent respectively.

Employment in the Air and Space Transport industry in the Badgerys Creek region is estimated to grow to around 6,400 in 2016 and 11,615 in 2026. If the Second Sydney Airport were not constructed, employment in the industry would be expected to be only 350 and 400 respectively.

Comparison with Draft EIS Employment Estimates

The estimates developed for this Supplement differ in a number of major respects from those which appeared in the Draft EIS in that:

ß the current estimates are based on forecasts of aviation demand in the Sydney basin which have been revised downwards since the Draft EIS (*Section* 4.3.4 of this Supplement provides an explanation of differences in passenger forecasts for the Draft EIS and Supplement);

ß the estimates are based on different demand profiles for a Second Sydney Airport. Estimates which appeared in the Draft EIS were on the basis of a passenger throughput at a Second Sydney Airport of 29.3 million per annum in 2016; the estimates for this Supplement are for an estimated throughput of 6.5 million in 2016. The latter reflects *Sydney Airport Capacity Scenario 1* which sees Sydney Airport reach maximum capacity in 2006-07, and the assumption that a proportion of passengers who cannot be accommodated at Sydney Airport choose not to fly to the Second Sydney Airport;

- while the estimates prepared for the Draft EIS and this Supplement both draw on the experience of Sydney Airport to estimate employment impacts for the Second Sydney Airport, they use two different bases for measuring employment generated by Sydney Airport;
  - the final employment forecasts presented in the Draft EIS (Section 25.5.2) used a base of 34,000 jobs in 1996 directly employed as a result of Sydney Airport. This base was derived from work undertaken by the Institute of Transport Studies in 1993 and 1996 which surveyed businesses in a relatively wide geographical area (13 local government areas proximate to Sydney Airport) and using a definition of airport employment encompassing employment in a range of airport related industries; and
  - in contrast, the estimates in this Supplement build on official employment figures for the Sydney Airport region (defined more narrowly to include only three local government areas), and consistent with the definition of the Air and Space Transport industry as defined by the Australian Bureau of Statistics (this definition is used in the Input/Output tables developed by the Bureau; the tables are a basic tool of economic modelling and are designed to measure the economic linkages between industries in the economy); and

- the estimates in this Supplement relate to employment generation in the Badgerys Creek region; those presented in the Draft EIS relate to employment generation in the Sydney basin.

Obviously, there are a number of different approaches which can be taken to estimating the employment impacts of major development proposals. Each approach has its own limitations which makes it impossible to develop definitive estimates.

The methodology used in this Supplement is generally more conservative than that which was used for estimates which appeared in the Draft EIS. It uses an employment base which reflects a narrower definition of airport-related employment and a smaller geographic area around Sydney Airport. However, this approach will understate employment to the extent that additional economic activity is generated other than through the linkages embodied in the Input/Output relationships between the Air and Space Transport industry and other industries.

The definition of Air and Space Transport used in the standard Australian Input/Output table does not represent what might be termed a 'true' airport industry (that is, an industry definition which might give a more accurate picture of employment impacts of a Second Sydney Airport). The table could be reshaped to identify such an 'airport industry', but such an exercise would be time-consuming and the results likely to be open to question.

The estimates contained in the Draft EIS (which are underpinned by a wider definition of airport related industries) give an insight into the range of outcomes possible from a different approach. Based on this different approach, the Draft EIS estimated that the proposal would generate between 52,000 and 63,000 jobs in Sydney by 2016, compared with a situation where Sydney Airport was restricted to 30 million passengers annually and no second airport was constructed.

22.4.3 Wider Economic Impacts

The benefit cost analysis and the regional economic impact analysis need to be viewed in the context of the whole economy. Impacts on the wider economy are often assessed using a tool known as general equilibrium analysis. While such analysis has not been undertaken for this Supplement, some relevant considerations are discussed below.

A major airport development would have a wide range of indirect and generally offsetting effects throughout an economy. For example, expansion of an industry in one region might see the same industry or even apparently unrelated industries decline in other regions. Similarly, the decline in some industries is likely to free resources for use by other industries, thus allowing them to expand.

It is therefore important to keep in mind the broad range of industry interactions and economic links rather than only those related to, in this case, the air transport industry. If these effects are ignored, the benefits of a major investment would usually be understated and costs also understated from an economy-wide perspective.

On the benefits side, for example, it is plausible that alternative investments would absorb the available funds for investment if the Second Sydney Airport were not constructed. If the alternative investments had a similar rate of return as the Second Sydney Airport, then income and employment for the national economy may well not vary whether the airport was built or not.

On the cost side, it has been argued that investment in the Second Sydney Airport would crowd out other investments that are potentially able to earn better returns. It is also plausible, however, that the level of national investment will be largely unaffected by the construction of the Second Sydney Airport. The maximum annual expenditure on the construction of the proposal is some $1.4 billion (1998 dollars) or some 0.3 percent of GDP. This represents only 1.4 percent of current capital expenditure.

Analysing the economy-wide impacts of a major development does not in itself provide a suitable basis for ranking alternative uses of funds. Such ranking would require a comparable analysis for all alternative proposals. There are currently few examples of the application of such analysis to competing public investment alternatives and, therefore, it is difficult to know what level of return would represent the best use of funds. It is also worth noting that the formulation and specification of general equilibrium models remains the subject of continuing debate amongst economists.

22.4.4 Other Issues

Market Forces and the Second Sydney Airport

The suggestion has been made that market forces alone should determine the timing and role of the proposed Second Sydney Airport. Taken to one extreme, this approach would mean that the capacity of Sydney Airport would not be constrained by factors such as the curfew, the *Long Term Operating Plan for Sydney (Kingsford Smith) Airport and Associated Airspace* (Airservices Australia, 1996) and the cap of 80 movements per hour. In these circumstances the capacity of Sydney Airport would only be constrained by safety considerations and the physical layout of the site, and market forces alone would determine landing charges and other prices.

This 'laissez faire' approach to capacity and price determination neglects the need for a balance between the needs of airport users and the needs of the communities which surround an airport. It also neglects the fact that there is only limited competition between major airports in Australia.

As discussed in *Section 4.4.1* of this Supplement, calculating the future capacity of Sydney Airport requires judgements concerning the capacity of the infrastructure, the capacity of the airspace management system, the commercial decisions of major users, and the effect of measures to mitigate environmental impacts. Reflecting this, *Section 22.3.2* notes that the capacity scenarios for Sydney Airport used in the benefit cost analysis for this Supplement are only two of the range of possible capacity scenarios for Sydney Airport.

Market forces could only be said to operate completely if each of the airspace management, environmental impacts and other factors was fully reflected in the price for access to Sydney Airport. Currently, this is not the case. For example, the slot system currently used to administratively manage demand for access to Sydney Airport within the 80 movement an hour cap reflects the fact that, consistent with international experience, there is no market for slots in Australia. In addition, Government policies to reduce noise impacts such as the movement cap, the curfew and the *Long Term Operating Plan for Sydney (Kingsford Smith) Airport and Associated Airspace* (Airservices Australia, 1996) in part reflect the difficulties in adequately accounting for noise costs in pricing for access to an airport.

The timing and role of the Second Sydney Airport is therefore likely to be determined by a combination of market forces and Government policy at work on the supply-side. At the same time it is acknowledged that market forces should be allowed to influence the timing, role and pricing of the Second Sydney Airport as much as possible. Changes to pricing access to Sydney Airport will be relevant in this regard.

Funding for Airport-Related Infrastructure

Adequate and timely provision of airport-related infrastructure would be critical to the viability of the proposed Second Sydney Airport. Establishing this infrastructure would require substantial planning and funding cooperation between governments. It is not a matter that can be advanced through the EIS process, nor is it a matter that could reasonably be expected to be settled in advance of a decision on the proposal.

22.5 Overview of Economics

Since the preparation of the Draft EIS, and in response to public comment, significant additional work has been undertaken on both the financial and economic viability of the Second Sydney Airport proposal.

A financial viability assessment focuses exclusively on accounting costs and revenues to provide a picture of the financial value of an asset such as an airport. Economic viability is a broader concept than financial viability. An economic viability study (or benefit cost analysis) takes account of the wider economic costs and benefits of a proposal, in order to assess whether the benefits outweigh the costs.

The results of both the financial and economic assessments must be qualified because of uncertainties about the accuracy of some of the key inputs, including future pricing policies for the airport, the cost estimates and future demand for the airport. In the case of the economic assessment, it has also not been possible to quantify some of the environmental costs because of methodological difficulties and the data limitations.

Despite these qualifications, it is concluded that both the Stage 1 and master plan proposals would be economically viable, and that there would be major economic benefits to Australia, NSW, Sydney and the Badgerys Creek region from the proposed airport.

In contrast, if aeronautical charges are based on those that currently apply at Sydney Airport, the proposed airport would not be financially viable. However, relatively small increases in airport revenue (or substantial decreases in construction costs) could make the Stage 1 development financially viable. By way of illustration, a passenger charge of around $1 to $2 on passengers departing through either Sydney Airport or the Second Sydney Airport at Badgerys Creek would cover the costs of constructing and operating the Stage 1 development of Option A.

The principal reason for the underlying difference in the two assessments is that the airport would generate substantial benefits (and incur costs) that an airport operator could not directly access. These benefits would include the flow on effects to the Sydney region, NSW and Australia from catering for a higher level of air traffic than if Badgerys Creek was not built.

Further work has been undertaken for this Supplement to estimate the regional economic and employment impacts of the Second Sydney Airport (see *Appendix J2*). Compared to a base case under which the industries located in the Badgerys Creek region grow at what might be considered typical growth rates, total employment generated in the Badgerys Creek region by the operation of the Second Sydney Airport is estimated to be 10,100 in 2016, and 18,600 by 2026. These estimates represent increases in employment in the region of two percent and three percent respectively.

About 8,400 person years of on-site labour and an additional 17,000 person years of indirect employment was projected in the Draft EIS for the regional economy over the course of the construction period.

Chapter 23

Health

Chapter 23
Health

23.1 Introduction

Health emerged as a significant issue with the community during the preparation of the Draft EIS for the Second Sydney Airport proposal. This chapter provides a background discussion of health issues in western Sydney and the impacts on health that can be caused by changes to air quality, noise levels, water quality and a number of other environmental impacts.

23.2 Air Quality-Related Health Impacts

23.2.1 General Effects of Air Quality on Health

Guidelines

The NSW Environment Protection Authority is responsible for implementing State legislation in relation to air quality, mainly through the *Clean Air Act, 1961* and the *NSW Ozone Protection Act, 1989*. Other guidelines of relevance include National Environment Protection Measures recently proposed by the National Environment Protection Council and NSW Department of Health goals for particulates and nitrogen dioxide.

Existing Air Quality in Western Sydney

Monitoring of Sydney's air quality (NSW Environment Protection Authority, Air Monitoring Data, 1992 to 1995) shows that the quality of Sydney's air is acceptable for the majority of time in most areas. However, it is recognised that the influence of local topography and air currents tend to carry pollutants towards western Sydney.

On occasions, breaches of the ozone guidelines do occur in Sydney. Summer ozone levels in western Sydney regularly approach the health goal. During the 1990s incidences of ozone goals being exceeded occurred about 10 days a year.

Monitoring shows that the maximum 24-hour concentrations of respirable particulates for regional Sydney are generally less than NSW Environment Protection Authority's goal. Elevated concentrations of respirable particulates, generally resulting from severe bushfires have been recorded in western Sydney (Bringelly).

Only once has the nitrogen dioxide goal of 16 parts per 100 million (one hour average) been exceeded in Sydney since 1990. This exceedance was at Campbelltown. Monitoring results have shown a gradual decline in the peak monthly levels of nitrogen dioxide.

The NSW Environment Protection Authority air monitoring data (1992 to 1995) shows no elevated levels of carbon monoxide or sulphur dioxide at western Sydney monitoring stations.

A more complete discussion of Sydney's existing air quality is contained in Section 15.3 of the Draft EIS.

Health Issues in Western Sydney

There is a common perception among residents of western Sydney that the prevalence of asthma is higher in western Sydney than other parts of Sydney.

However, this perception is not supported by data reviewed in *Technical Paper No. 5* (Appendix F, Section 3.2). The 1994 *Health Promotion Survey* undertaken by the Health Promotion Branch of the NSW Health Department (1994) indicated that asthma is no more common among adults in western, south-western or southern Sydney, than in other parts of Sydney or NSW.

A further concern in the community was the likelihood of increased cancer risk due to air pollution from greater numbers of motor vehicles. It has previously been estimated that about 16 cancer cases per year are associated with motor vehicle air pollution in Melbourne (Hearne, 1994). This estimate was determined by adding the assessed level of risk from exposure to individual air pollutants associated with motor vehicle emissions. Sydney statistics are likely to be similar although no specific studies have been undertaken.

There is also concern in the western Sydney community that the health of certain groups may be more at risk than the general community from the impacts of the Second Sydney Airport. These groups include individuals such as children, the elderly and the sick. Analysis of the age structure of local government areas in western and south-western Sydney, undertaken for the Draft EIS, found that some areas surrounding the airport sites have a greater number of children as a proportion of their total population than the Sydney average. Campbelltown, Penrith, Blacktown and Liverpool local government areas all have a relatively low proportion of elderly residents.

General Health Effects of Changes to Key Air Quality Indicators

Potential health effects of air pollutants can include exacerbation of respiratory problems, and long term-health problems such as increased risk of contracting cancers.

Photochemical smog can exacerbate respiratory problems. It is a near-ground mixture of ozone and other pollutants formed by a chemical reaction in the atmosphere. Ground level ozone irritates the eyes and air passages, and might interact with allergens to trigger asthma attacks. Health effects appear to be short-lived, although the long-term significance of exposure is not known.

Respirable particulates (particulates less than 10 microns in size) are capable of entering the lungs. Short term exposure to respirable particulates may cause impaired lung function. While exposure to respirable particulates may increase the frequency of asthma, there is no evidence to show that it causes people to develop asthma in the first place.

The National Health and Medical Research Council goal for nitrogen dioxide has only been exceeded once in Sydney since 1990 (refer to *Chapter 11* of this Supplement for a discussion on background air quality). Exposure to nitrogen dioxide at levels experienced under ambient conditions does not cause any change in lung function in healthy people and probably only causes concern in people with asthma or other respiratory diseases at levels above 0.25 to 0.30 parts per million. The available data do not allow quantification of the relationship between nitrogen dioxide exposure and changes in lung function at levels below 0.30 parts per million. Evidence that variation in nitrogen dioxide exposure is associated with risk of hospitalisation for respiratory disease is conflicting and there is evidence that nitrogen dioxide exposure is not linked to daily death rates. For both these outcomes it is not appropriate to attempt to quantify an association with nitrogen dioxide exposure levels.

Air toxics are a separate class of pollutants, as they are known to cause cancer in humans. Particulates such as those from diesel fumes could potentially contain air toxics, such as polycyclic aromatic hydrocarbons. They could therefore contribute to cancer risks, as well as cause respiratory problems, if inhaled.

In addition to air toxics, carbon monoxide, sulphur dioxide and lead are considered key indicators of local air quality. These pollutants are associated with a range of adverse impacts on health, namely:

- carbon monoxide can restrict or prevent the uptake of oxygen;
- sulphur dioxide is an acidic gas which, when mixed with water, forms acid capable of causing irritation to breathing; and
- high lead levels can result in dysfunction of the brain and kidney damage. At lower levels, symptoms are less obvious but can be linked with behavioural and learning disorders in children.

23.2.2 Summary of Air Quality-Related Health Impacts Identified in the Draft Environmental Impact Statement

Health Impacts identified in the Draft EIS, relating to air quality included:

- respiratory health;
- cancer risks of air toxins; and
- non-cancer impacts of air toxins

Respiratory Health

Air quality modelling predictions made in the Draft EIS showed that ozone concentrations may increase by at least one part per 100 million in those areas (including Bringelly, St Mary's, Blacktown, Liverpool and Campbelltown) already affected by elevated (in excess of the NSW goal), background concentrations of ozone. It was predicted that the increased incidence of elevated ozone levels would occur approximately six times per year. The health impacts arising from the predicted increase in ozone levels include, two or three extra hospital admissions and possibly one death each one hundred years.

The Draft EIS predicted that the maximum increase in nitrogen dioxide concentrations would be 10 parts per 100 million. Current background levels of nitrogen dioxide in areas adjacent to the airport site are below the NSW goal (10 parts per 100 million). The addition of predicted maximum increases of nitrogen dioxide to existing background levels would not cause the level of nitrogen dioxide to exceed the NSW goal. Health impacts associated with the predicted increases in nitrogen dioxide concentrations were not able to be quantified because available data do not allow quantification of changes in lung function at levels below 30 parts per 100 million.

Air quality modelling predictions made in the Draft EIS showed increases in respirable particulates due to airport operations would not result in the current NSW goal of 150 micrograms per cubic metre being exceeded. An increased exposure to respirable particulates of three micrograms per cubic meter was predicted to produce an increase of between 160 to 170 person days of reported cough. The number of additional people who would be hospitalised for respiratory disease was predicted to increase by approximately two to three people per 100 years while the projected number of additional deaths on a given day was predicted to increase by less than one per 100 years.

Health Impacts of Air Toxics

Carcinogenic air toxic compounds that would be associated with the operation of the Second Sydney Airport include benzene, 1, 3- butadiene, formaldehyde and polycyclic aromatic hydrocarbons including benzo(a)pyrene. The impacts of these emissions on projected populations in the areas surrounding the airport options was estimated in the Draft EIS to be in the order of three cases of cancer per 100 years for all three airport options.

Air toxic compounds which were assessed in the Draft EIS for non-cancer health risks included acetaldehyde, benzene, formaldehyde, phenol, toluene, and xylenes. The long term increases in concentration due to operation of the Second Sydney Airport was predicted using dispersion modelling. None of the individual, predicted long-term concentration increases exceeded the inhalation reference exposure levels for any of the airport options.

Lead was not assessed in the Draft EIS as it is expected that lead concentrations resulting from the airport operations would be below threshold levels.

23.2.3 Summary of Air Quality-Related Health Issues Raised in Submissions

Methodology

Submissions on the Draft EIS suggested that background levels of air pollution were significantly understated and as a consequence the Draft EIS significantly understated likely health impacts.

The effects of cardiovascular and prenatal health due to air pollution were stated as being uncertain in the Draft EIS because of methodological weaknesses in the studies reviewed. However, it was considered by the authors of the submissions that this uncertainty does not imply there is no effect and highlights the need for further studies to be undertaken.

Some submissions indicated that the number of people affected by increased levels of air pollutants is underestimated in the Draft EIS. In this regard, the health impact estimates of air quality changes should be reviewed using estimates of the total increase in air pollutants and the total population exposed to these increases. Further, estimates should be calculated on a regional and Sydney basin level, using an option comprising the Second Sydney Airport development and the further development of Sydney Airport.

As a result of seasonal changes in air quality that normally take place, submissions also indicated that it would be useful to discuss seasonal variations in predicted air pollution, enabling an assessment of seasonal air quality-related health impacts.

Concern was expressed in submissions that there is a high degree of uncertainty in the assessed health risks of changes to air quality, therefore it is not possible to justify the predictions made. It was suggested that recent internationally recognised studies relating to the issue of health effects of air pollution were not considered and that no assessment had been made of the cumulative impact of the airport, and its associated development, on health.

Health Impacts of Changes in Air Quality

Air pollution associated with the establishment of a Second Sydney Airport was a major concern in submissions on the Draft EIS. Many submissions considered that the health impacts of changes in air quality had not been adequately addressed in the Draft EIS. Specifically, it is claimed that the following issues had been inadequately considered:

- impacts associated with land transport;
- effects of sulphur dioxide;
- synergistic effects of exposure to multiple toxic compounds;
- health effects other than hospital admissions and death such as coughing, irritated or watery eyes and irritation of sensitive tissues;
- impacts on vulnerable groups such as children, the elderly and the sick;
- impacts of lead on children's mental health;
- potential for elevated incidences of cancers such as leukaemia;
- potential for increases in asthma; and
- absorption of air toxins through ingestion and dermal contact.

Concerns were expressed that the Draft EIS did not highlight the effects of potential air pollution levels, associated with the establishment of a second Sydney airport, on the western Sydney population. It was considered the higher than usual incidence of asthma that already exists in this region would be exacerbated even further. Submissions also stated that no mention is made of other allergic reactions which may result from exposure to airport-related pollution.

23.2.4 Summary of Air Quality-Related Health Issues Raised by the Auditor

The Auditor stated that the Draft EIS presented a mostly comprehensive review of risk estimates and the likely health impacts of increased air pollution associated with a Second Sydney Airport. The risk estimates were adequately explained and based on various valid methodologies. The Auditor, however, raised a number of issues that should be addressed including:

- a further review of the potential health impacts of sulphur dioxide;
- predicted health impacts of air pollutants and ozone on specific vulnerable groups such as children, especially with asthma, the elderly, or vulnerable community institutions such as schools, childcare and hospitals. It was also recommended by the Auditor that maps be provided of vulnerable community institutions in relation to predicted air quality emissions; and
- recommendations should be made about strategies to monitor outcomes of noise and air quality impacts.

23.2.5 Response to Air Quality-Related Health Issues

Issues Previously Analysed

A number of submissions raised concerns that certain health issues were not addressed. Those issues were addressed in the Draft EIS and *Technical Paper No. 6* as outlined below.

Analysis of Risk of Increasing Respiratory Diseases and Cancer

The Draft EIS and *Technical Paper No. 6* provided an analysis of the risk of increases in respiratory disease and cancer which might be associated with changes in air quality attributable to the Second Sydney Airport.

Technical Paper No. 6 contained (as Appendix F) a report, prepared by the Institute of Respiratory Medicine (University of Sydney), evaluating the likely respiratory health impact of predicted changes in air quality attributable to the Second Sydney Airport. This report included the following elements:

- background information about asthma and other respiratory problems of concern to the community and relevant to the discussion of air pollution;
- a systematic review of published scientific literature concerning adverse health effects of ozone, nitrogen dioxide and particulate pollution;
- quantitative estimates of the relation between levels of air pollutants and adverse health impacts including symptoms of asthma and other lung problems, impairment of lung function, hospital admissions for asthma and respiratory diseases and deaths. (These were derived where available data suggested that the air pollutant in question did have an effect on this health outcome and the data were in a form which allowed the association to be quantified); and
- synthesis of these estimates with the predictions for populations affected by specified changes in air quality, to estimate the likely health impact of the air quality changes expected with the Second Sydney Airport.

The key findings of the report were:

- exposure to ozone causes a transient reduction in breathing capacity, the extent of which is related to the ozone concentration, the duration of exposure and the level of activity undertaken during exercise. In many cases reduction in lung function is not accompanied by any symptoms, but some people (more commonly adults rather than children) experience chest discomfort or difficulty taking a deep breath in. Individuals vary in their sensitivity to ozone but the elderly and those with pre-existing respiratory diseases (including asthma) are not more susceptible than others. The population sub-group most likely to be affected by ozone exposure are those whose work or recreation entails strenuous outdoor physical activity;
- there is evidence from some studies, but not others, that slightly more people die or are hospitalised for lung problems on high ozone pollution days than low ozone days. This seems to mainly affect the elderly and those with pre-existing heart or lung problems. It is not known whether these events (deaths or hospitalisation) are truly premature or they occur just a few days earlier than they otherwise would;
- exposure to nitrogen dioxide at levels seen under ambient conditions does not cause any change in lung function in healthy people and probably only causes concern in people with asthma or other respiratory disease at levels above those found in outdoor air in Australia. The available data do not allow quantification of the relation between nitrogen dioxide exposure and changes in lung function at levels below 0.30 parts per million. Evidence that variation in nitrogen dioxide exposure is associated with risk of hospitalisation for respiratory disease is conflicting and there is evidence that nitrogen dioxide exposure is not linked to daily death rates;
- increased exposure to particulates is associated with increased symptoms and a small decrease in lung function. This has been most clearly shown in children and the effect is more marked in children with pre-existing respiratory diseases such as asthma;

- it seems likely that death rates and hospitalisation rates for lung disease are slightly higher on high particulate pollution days than low pollution days. As stated above, it is not certain whether this represents a shift in these events from one day to another, nearby day, or it signals a true increase in premature deaths and hospitalisations; and
- there are major methodological problems in assessing the long-term impact of exposure to pollutants. Some studies have shown that people who live in polluted communities have more bronchitis than those living in less polluted communities. However, since these communities probably differ in other important respects (for example, occupations, smoking prevalence and socioeconomic structure) it is difficult to know what the higher prevalence of bronchitis is due to.

Estimates for health impacts due to airport-associated changes in air quality were calculated based on the air quality predictions included in *Technical Paper No. 6*. Small infrequent increases in air pollution levels were predicted and it was noted in the report that estimated health effects based on these small changes should be treated with caution.

Health Impacts of Air Toxics

Technical Paper No. 6 addressed (Section 9.1.4) the long-term health risk of exposure to air toxics. At sufficiently high levels air toxics can cause a range of health impacts. The Draft EIS estimated that a low level of cancer risk would occur because of emissions from the airport.

Health Impacts of Lead

The effects of lead on children's health were addressed in Sections 15.2 and 15.3 of the Draft EIS. Health impacts of lead were not examined in detail because modelling indicated that increases in their concentrations due to airport operations would not result in levels that exceeded current health goals.

Results of Further Analysis of Air Quality-Related Health Impacts

Scope of Further Analysis

In response to submissions and comments by the Auditor, additional analysis of air quality-related health impacts has been undertaken. The additional analyses includes:

- an extended review of the prevalence of asthma, to include data from the Australian Bureau of Statistics 1995, National Health Survey and the NSW Department of Health 1997 Health Survey;
- a systematic review of the literature on adverse health effects of sulphur dioxide. Quantitative estimates of the relation between changes in level of sulphur dioxide and the risk of various health outcomes (hospitals admissions, and deaths) were derived. The derived risk estimates were then applied to predicted changes in the level of sulphur dioxide to determine the likely impact on the health of the community;
- a brief review of new studies published after the Draft EIS on respiratory health effects of air quality was conducted. As part of the review a general overview of the new data was prepared;
- the impact of particulates and ozone on the health of the local community was reassessed. The likely impact was reassessed by applying previously derived

risk estimates for particulates and ozone to new modelling results on expected changes in the pollutants (new air quality modelling results are reported in *Chapter 11*); and

- a range of health monitoring strategies designed to monitor adverse respiratory health effects attributable to the Second Sydney Airport is presented. Each of the monitoring strategies is discussed including the advantages and disadvantages.

Regional Variation in the Prevalence of Asthma

The Draft EIS concluded that asthma is not more common in western and south-western Sydney than other parts of Sydney. This assessment was based on a review of data from prevalence surveys, hospitalisation rates and mortality rates. At the time of the initial literature review undertaken for the Draft EIS, data from the 1995 National Health Survey and the NSW Department of Health's 1997 Health Survey were not available. These data have now been used to determine the prevalence of self-reported asthma.

Data from the 1995 National Health Survey (Australian Bureau of Statistics, 1995), shown in *Figure 23.1*, do not show any significant difference in rates of self-reported asthma and bronchitis in Western Sydney, South Western Sydney and Wentworth Area Health Service regions compared with the rest of NSW. However, it should be noted that this survey was not designed for the purposes of comparing Health Service areas and the sample sizes at this level are relatively small.

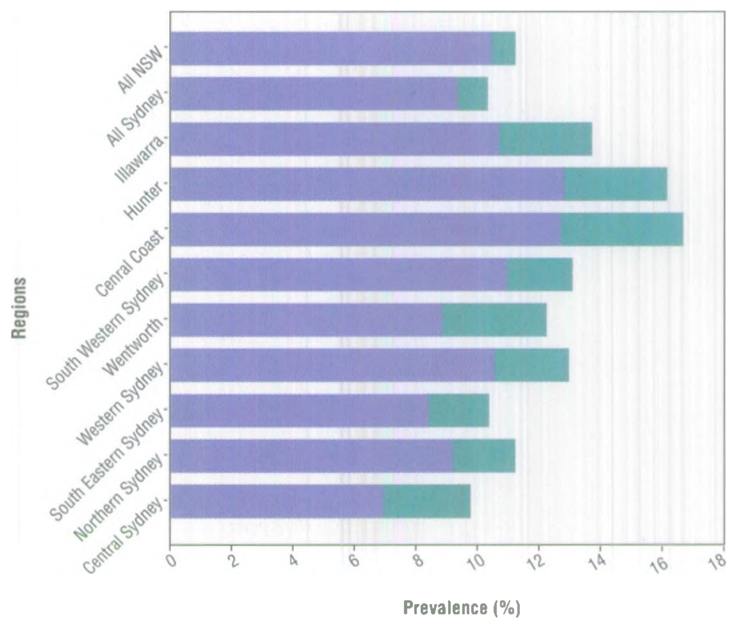


Figure 23.1
Prevalence of Self-Reported Asthma (Adults and Children Combined) by Area Health Service
Note: Upper 95% of confidence limits are shown in green
Source: Australian Bureau of Statistics, National Health Survey, 1995

In contrast, the recent NSW Health Survey (1997) was designed to allow comparisons between Area Health Service populations. The questionnaire was administered to 17,528 residents of NSW aged 16 years and over (approximately 1,000 residents in each Health Service area). The participants were asked "Have you ever been told that you have asthma by a Doctor or a Hospital" and "Have you had symptoms of asthma or taken treatment for asthma in the last 12 months".

Overall 10.3 percent of the surveyed participants (comprising 8.8 percent of men and 11.8 percent of women) answered "Yes" to both questions and were regarded as having current asthma.

The NSW Health Survey data in *Figure 23.2* shows the prevalence of current asthma in Western Sydney, Wentworth or South Western Sydney Areas was not above the average for NSW.

In summary, data from both the National Health Survey and the NSW Health Survey confirm the conclusion made in the Draft EIS that the prevalence of asthma in western and south-western Sydney was not higher than average for NSW.

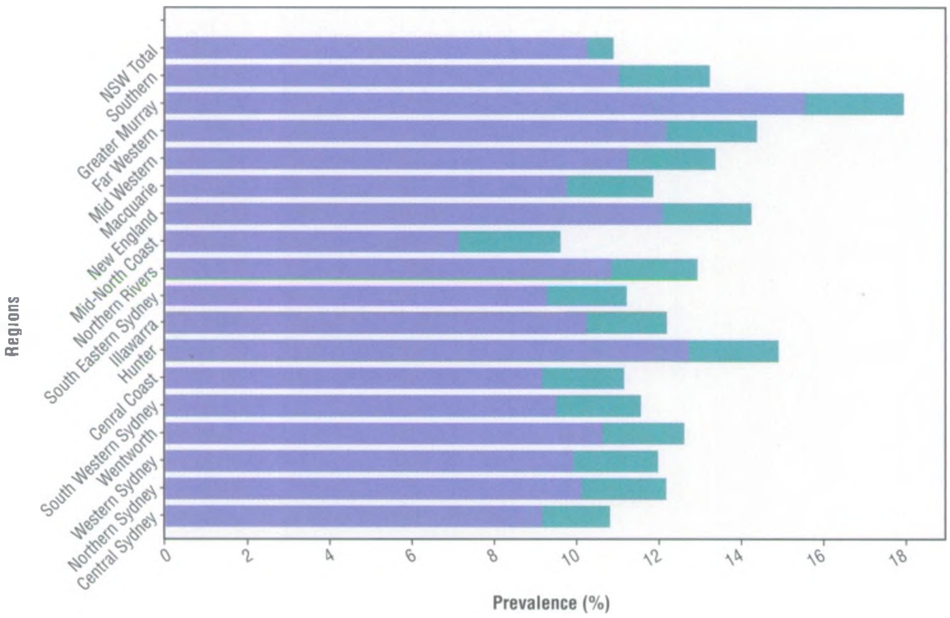


Figure 23.2
Current Doctor-Diagnosed Asthma by Area Health Service - NSW Residents Aged 16 Years and Over
Note: Upper 95% of confidence limits are shown in green
Source: Australian Bureau of Statistics, National Health Survey, 1995

Health Effects of Sulphur Dioxide

Sulphur dioxide is an irritant gas produced by the combustion of sulphurous fossil fuels. Unlike Europe and North America, sulphur dioxide pollution is not a major problem in Australia as most of the Australian coal does not contain high levels of sulphur.

The environmental air quality standard for sulphur dioxide, as prescribed by the NSW Environment Protection Authority (1998a) includes a maximum average of 0.2

parts per million (not to be exceeded more than once per year) and a maximum annual average of 0.02 parts per million. These standards are consistent with the recently agreed *National Environment Protection Measure for Air Quality* (National Environment Protection Council, 1998) which provides three standards for sulphur dioxide. In addition to the maximum one hour average standard and the maximum annual standard, a maximum 24-hour average of 0.08 parts per million (not to be exceeded more than once per year) is prescribed (Commonwealth of Australia, 1998b). The World Health Organisation (1994) has set a goal of 12 parts per hundred million as a maximum one hour concentration.

Inhalation of high concentrations of sulphur dioxide in a controlled experimental setting causes airway narrowing and chest tightness in patients with asthma. This is a predictable effect which is also produced by a wide range of other irritant exposures.

The health effects produced by exposure to lower levels of sulphur dioxide in ambient air have been investigated in a number of epidemiological studies. A systematic review of these studies has been conducted and is included in *Appendix K1*.

The epidemiological evidence is difficult to interpret due to the strong correlation between sulphur dioxide and particulate pollution in Europe and North America, where many of these studies were conducted. The correlation between these pollutants means that it is difficult to be sure whether the observed effects are attributable to sulphur dioxide or to particulate pollution. In summary, the epidemiological evidence shows that exposure to particulates and/or sulphur dioxide, over a wide range of exposure levels, is associated with adverse health effects including increased daily mortality and hospital admission rates. At this stage, the adverse health effects cannot be positively attributed to one or the other of these pollutants.

The data from these studies were combined to examine the level of effect on risk of hospitalisation and risk of premature death that might be attributable to 0.005, 0.01 and 0.02 parts per million (five, 10 and 20 parts per billion) increase in the one hour concentration of sulphur dioxide. Data on risk of symptoms and changes in lung function were also abstracted. These risk estimates, together with data on the baseline daily prevalence of these outcomes in Sydney, were used to calculate the absolute increase in daily rates of various health outcomes as indicated in *Table 23.1*.

Table 23.1 Potential Sulphur Dioxide Related Health Outcome Based on European and United States Studies (Refer *Appendix K1*)[1]

	NSW Daily Rate (per 100,000 person per day)	% Increase in Daily Rate			Absolute Increase in Daily Rate (per 100,000 persons per day)		
		5 ppb[2]	10 ppb[2]	20 ppb[2]	5 ppb[2]	10 ppb[2]	20 ppb[2]
Mortality							
All causes	2.02	0.73	1.46	2.95	0.0147	0.0296	0.0596
Cardiovascular diseases	0.91	0.35	0.71	1.42	0.0032	0.0064	0.0129
Hospital Admissions							
Respiratory diseases	4.26	0.85	1.71	3.45	0.363	0.0728	0.1469
Asthma[3]	0.56	1.45	2.92	5.92	0.0071	0.0163	0.0331

Notes:
1. *The interpretation of the impact of sulphur dioxide is especially problematic. The data on which these calculations are based is derived from European and North American settings where sulphur dioxide and particulate pollution are closely related. An unknown proportion of effects attributed to sulphur dioxide would actually be due to particulate pollution (and have been taken into consideration in the estimates of the impact of particulates). For this reason the estimated impact of sulphur dioxide is overestimated.*
2. *Parts per billion.*
3. *5-54 year olds.*

In this analysis, the effect of projected increases in sulphur dioxide on daily rates of mortality and admission to hospital with respiratory disease have been quantified. This analysis uses estimates of the effect of sulphur dioxide derived from European and North American studies where the mix of pollutants is different from that observed in Australia. It is likely that some of the effects attributed to sulphur dioxide in those studies are actually caused by particulate pollution. If this is the case then the estimates for increases in death and hospitalisations associated with sulphur dioxide pollution in this chapter are likely to be over-stated. However, there is no way of confirming this over-estimation or quantifying its extent.

Health Effects of Ozone, Nitrogen Dioxide and Particulates

Additional studies on the health effects of ozone, nitrogen dioxide and particulates published since the Draft EIS was prepared, have been reviewed to establish whether any of the conclusions from that report should be altered.

The review included three recently published meta-analyses of data from the European APHEA studies (Anderson et al, 1997; Katsouyanni et al, 1997; and Sunyer et al, 1997). For the most part, these analyses summarise data which was reviewed in the Draft EIS and therefore do not affect the conclusions of that report.

The APHEA studies predict that exposure to an increase of three micrograms per cubic metre of respirable particulates (particulates less than 10 microns in size) will produce 0.13 percent increase in daily mortality rates (Katsouyanni et al, 1997). This estimate is similar to the estimate derived in the Draft EIS of 0.17 percent increase in daily mortality rates. The meta-analysis of the APHEA studies did not identify a significant association between particulate levels and hospital admissions for asthma in adults or children (Sunyer et al, 1997), but did find a small effect (0.14 percent increase) on admissions for chronic obstructive pulmonary disease (Anderson et al, 1997). The latter finding conflicts with the Draft EIS which estimates a larger effect (0.46 percent for three micrograms per cubic metre increase in respirable particulates less than 10 microns) on hospital admissions for respiratory diseases.

A recent systematic review of data from five cohort studies of children with asthma has found that an increase of three micrograms per cubic metre in respirable particulates less than 10 microns is associated with a 0.8 percent increase in risk of sustaining a clinically important reduction (10 percent) in lung function measured as peak flow (Hoek et al, 1998). This effect of particulate pollution was not quantified in the Draft EIS.

A study of school children living in the Hunter and Illawarra regions of New South Wales recently reported that children who lived in areas with high annual average levels of particulate pollution were more likely to report symptoms of night cough and chest colds than those living in areas with lower levels of pollution (Lewis et al, 1998). This is a cross-sectional study, estimating the long-term impact of his form of pollution, rather than the impact of day-to-day changes in pollution levels. The authors took account of potentially important confounding factors such as the presence of unflued gas heating and parental smoking. The findings of this study are consistent with other studies from the United States (Dockery et al, 1989) and Europe (von Mutius et al, 1994) which found that "bronchitis" symptoms (mainly cough) were more common in communities with higher levels of particulate pollution. Unfortunately, the interpretation of these studies is not straight-forward. The relatively small number of communities studied differ in many important respects other than pollution levels (for example, socio economic status). It is possible that the observed differences are not due to particulate pollution.

The APHEA studies found no significant association between exposure to the one hour maximum ozone or nitrogen dioxide levels and hospitals admissions for asthma in either children or adults (Sunyer et al, 1997). These studies identified a significant association between ozone and hospital admissions for chronic obstructive pulmonary disease (Anderson et al, 1997). A study of the health effects of ozone in ten Canadian cities has found considerable variation between the cities in the effect of maximum hourly ozone concentrations on risk of hospitalisation. The average effect was a three percent increase in hospital admissions for a 0.01 parts per million increase in ozone (Burnett et al, 1997). By comparison, the Draft EIS assumed a 1.4 percent increase in hospital admissions for respiratory disease associated with a 0.01 parts per million increase in ozone and concluded that the evidence linking nitrogen dioxide to increased hospital admissions remained conflicting.

Recent data from Brisbane (Simpson et al, 1997) and Sydney (Morgan et al, 1998) confirm the finding of others linking ozone to daily mortality rates. The Brisbane investigators estimated that 0.01 parts per million increase in ozone was associated with a 1.6 percent increase in mortality, while in Sydney this change in ozone concentration was predicted to cause a 0.7 percent increase in mortality. These values are similar to the one percent estimate in the Draft EIS. The findings about the relation between nitrogen dioxide and daily mortality rate in the Sydney study were complex. However, after taking into account the effects of other pollutants, there was no evidence that nitrogen dioxide levels were significantly related to death rates.

The above review of recent studies does not substantially alter the conclusions of the Draft EIS. It does, however, allow episodes of decline in peak flow among children with asthma on high particulate pollution days to be estimated.

Eye, Nose and Throat Irritations Caused by Pollutants

The term upper respiratory tract refers to the breathing passages above the larynx (voice box). This includes the nose, the mouth and the throat. A wide range of physical and biological stimuli, including irritants, extremes of heat or dryness, infections and allergens, may cause discomfort in these sensitive tissues. Studies of the adverse health effects of air pollutants have tended to focus on the lungs (that is, the lower respiratory tract). However, some investigations have measured subjects' reports on upper respiratory tract and eye symptoms including sore or dry throat, runny or stuffy nose and eye irritation. These studies have been reviewed for this Supplement (refer *Appendix K2*).

The review concluded that there is consistent evidence that day-to-day variation in the level of particulate pollution is related to the daily prevalence of upper respiratory tract symptoms. On the basis of the published evidence it is estimated that a three microgram per cubic metre increase in respirable particulates less than 10 microns would be expected to cause a one percent increase in the prevalence of upper respiratory tract (nose and throat) symptoms on that day.

There is conflicting evidence concerning the effect of ozone, nitrogen dioxide and sulphur dioxide on upper respiratory tract and eye symptoms. For each of these pollutants there are some studies (cited in *Appendix K2*) which do show an association but several other studies are negative. The reason for this inconsistency in the published data cannot be identified with certainty. However, it may relate to the complex mixture of pollutants to which subjects are exposed and the consequent difficulty in attributing effects to specific pollutants.

It is not possible to draw a definite conclusion about the effect of predicted, airport-associated changes in ozone, nitrogen dioxide and sulphur dioxide levels on upper respiratory tract and eye symptoms. However, based on the existing evidence it seems unlikely that they would have a major effect at, or around, existing ambient levels.

Impacts on Vulnerable Groups and Community Institutions

The analysis of air quality-related health impacts contained in the Draft EIS, *Technical Paper No.* 6 and this Supplement highlights existing knowledge of health impacts on vulnerable groups such as children and the elderly. The Auditor also requested that potentially vulnerable community institutions be mapped.

Figures 23.3 and *23.4* show existing schools and childcare centres located in areas that might experience exceedance of air quality goals for nitrogen dioxide and particulates. Under Options A and B only the Luddenham Primary School would be situated within the area predicted to exceed the relevant National Environment Protection Council (1998) one hour nitrogen dioxide (12 parts per 100 million) and 24-hour particulate (50 micrograms per cubic metre) goals. It should be noted that for each option the Luddenham Kindergarten and the Holy Family Catholic School would be situated close to, but outside the area of affectation. Under Option C no schools or childcare centres would be situated within the area predicted to exceed the relevant goal for either pollutant.

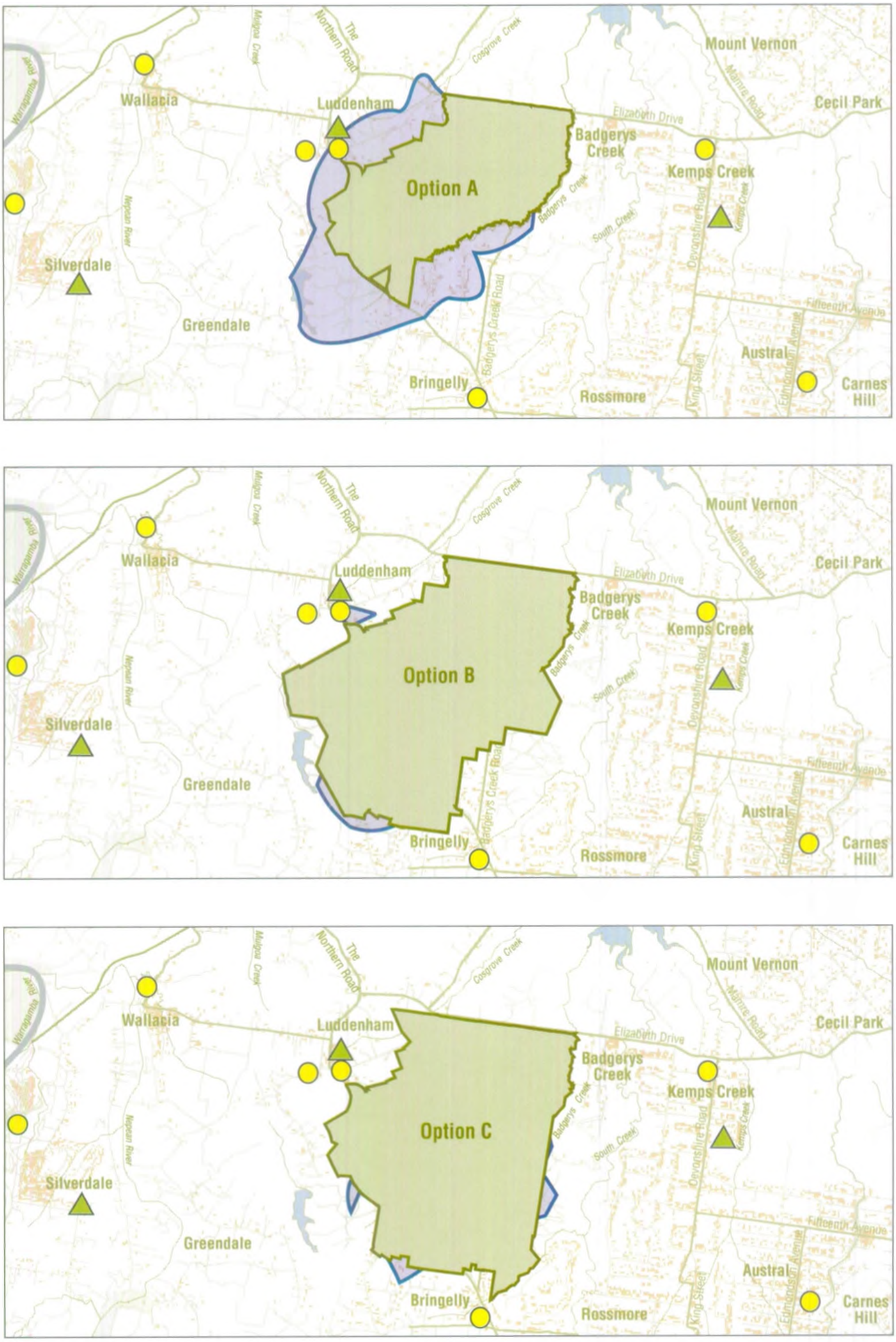
No exceedances of the relevant goal for sulphur dioxide is predicted to occur outside the boundaries of the airport sites (refer *Chapter 11*).

23.2.6 Quantifiable Air Quality-Related Health Impacts Using Revised Air Quality Data

Section 15.6.4 of the Draft EIS, Chapter 9 of *Technical Paper No.* 6 and Appendix F of *Technical Paper No.* 6 provided the results of an analysis undertaken to quantify the air quality-related health impacts of the Second Sydney Airport proposal. This analysis, while acknowledging the limitations in the methodology used, provided quantifiable rates for hospitalisation and mortality resulting from increased levels of ozone and particulates that would be caused by the Second Sydney Airport. An estimation of the increased lifetime risk of cancer as a result of predicted air toxic emissions from the airport was also provided.

Chapter 11 of this Supplement contains details of further air quality modelling carried out using new data obtained from the NSW Environment Protection Authority and the Bureau of Meteorology. Quantifiable health impacts based on the revised air quality modelling, which includes the impacts of vehicular traffic to and from the airport, have been re-calculated. In addition, based on further research undertaken for this Supplement, the health effects of sulphur dioxide emissions have also been calculated.

The EIS has adopted two complementary strategies for assessing the health impact of predicted changes in air quality attributable to the Second Sydney Airport. The first is to estimate the expected frequency of exceedances of air quality guidelines (National Environment Protection Council, 1998). The advantage of this approach is that it is based on reference to well established threshold levels derived from a consensus of experts. However, it has limited value for the purposes of assessing the health impact of airport-associated changes in air quality. Air quality guidelines are designed as a basis for assessing the outcome of measures to control pollution sources. They are established on the basis of a variety of inputs of which health effects is only one. Ecological, economic, social and political factors also influence the setting of air quality guidelines. The other limitation of air quality guidelines is that they do not



Child care

Primary school

Area predicted to experience exceedence of goal of 12 parts per 100 million (National Environment Protection Council, 1998)

Indicates density of dwellings in 1996

Figure 23.3

Location of Educational Facilities Relative to Area Predicted to Exceed Peak One Hour Nitrogen Dioxide Goal for Options A, B and C (30 million passengers per year)

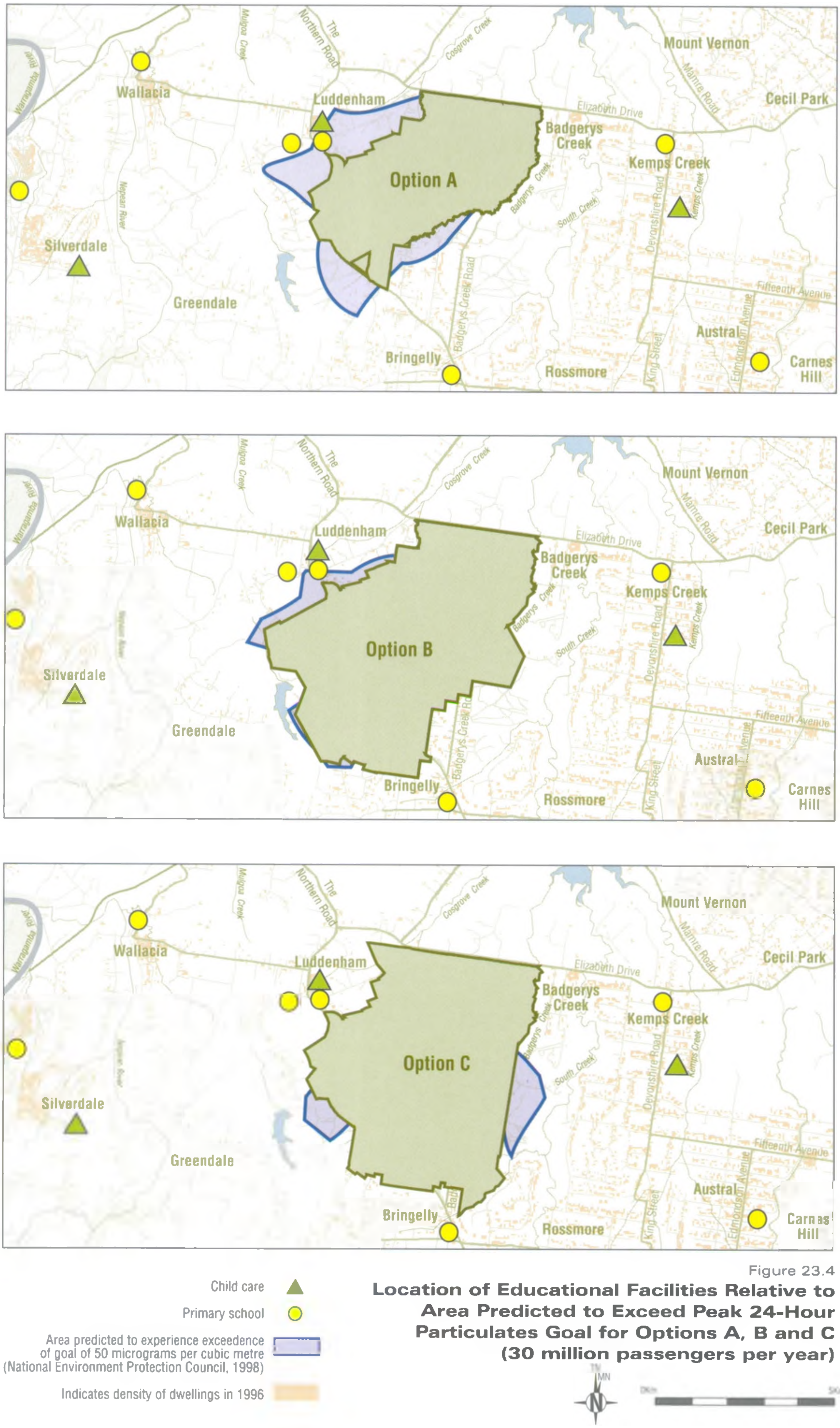


Figure 23.4

Location of Educational Facilities Relative to Area Predicted to Exceed Peak 24-Hour Particulates Goal for Options A, B and C (30 million passengers per year)

allow any quantification of health effects. In reality adverse health effects occur in proportion to the level of exposure to pollutants; they do not begin and end at the threshold level chosen for the air quality guideline.

For these reasons the EIS has sought to quantify the health impacts of air quality changes by estimating the relation between pollution levels and various adverse health effects directly from published evidence on this subject. *Appendix K3* summarises the methods and results of this analysis.

Methodology

There are two ways in which changes in air quality attributable to the airport may have an impact on illness:

- long-term exposure to increased levels of pollutants may have a cumulative adverse effect on health leading to more chronic illness in the affected community. This would be expected to cause more symptoms of illness, more hospitalisations due to severe episodes, and a greater rate of premature mortality due to specific chronic diseases within the affected community; and
- short-term increases in pollutants may have an immediate, but short-lived (that is, acute), effect on health within the community. This would be expected to cause higher rates of symptoms, hospitalisations and deaths on the days when pollution levels were high.

This report provides a limited level of quantification of the impacts of projected changes in air quality predominantly in terms of the second (acute effects) mechanism. The long-term effects have not been quantified because of uncertainty about whether there are long-term effects, and also due to the absence of any data which would allow them to be quantified.

The increased risk of cancer associated with exposure to air toxics is a quantifiable long-term health effect. This impact has been modelled separately based on the application of published risk thresholds.

Some data on long-term health effects of specific pollutants are presented in Appendix F of *Technical Paper No.* 6 (Sections 5.4, 6.4 and 7.4) and in *Section 23.4.2* of this Supplement. While some investigations have shown that people living in communities with high levels of exposure to particulates have more problems with bronchitis than less polluted communities, others have shown that there is less asthma and allergy among people living in heavily polluted eastern European cities than in less polluted western European cities. The interpretation of these data is hampered by the fact that they are derived from comparison among small numbers of communities which are likely to differ in many respects (for example, socioeconomic status, employment, smoking prevalence, and diet) apart from pollution exposure. This makes it difficult to be certain that observed differences in illness between communities are, in fact, attributable to differences in pollution levels. In summary, its is not known whether small changes in air quality have any long-term impact on health.

There are several sources of information on the short-term impact of changes in air quality on illness. Information on the effect of ozone, and to a limited extent, sulphur dioxide and nitrogen dioxide, on symptoms and objective measures of lung problems is available from two types of investigation:

- exposure chamber studies, in which volunteers breath various concentrations of specific pollutants for a limited time (one to six hours) and the effects are recorded; and

- panel studies, in which subjects record symptoms and breathing capacity each day and this record is compared with daily measures of ambient pollutants.

Although each of these methods has some limitations related to interpretation, the combined information has allowed a number of quantitative conclusions to be drawn about the anticipated impact of increases in pollutants on respiratory symptoms and breathing capacity. These are summarised below.

Numerous studies have examined the relation between pollution levels on a given day and the number of people who die or are hospitalised on that day (or the following few days). These studies have been comprehensively reviewed in Appendix F of *Technical Paper No. 6* and *Appendix K1* and *K3* of this Supplement. Combining information from these studies has resulted in answers to the following questions for specific pollutants:

- is there consistent evidence that changes in pollution levels, within the range anticipated with the Second Sydney Airport, would influence hospitalisation or death rates on a given day? and
- if there is consistent evidence what is the magnitude of the relation between levels of air pollution and rates of hospitalisation or death on a given day?

These data were used to assess the likely impact of airport-associated changes in air quality on rates of hospitalisation and death. However, the interpretation of these data for this purpose is problematic and it is critically important that this interpretation be made in the context of the exact meaning of the original data. The data are derived from counts of hospitalisations and deaths on single days. It is not known, however, what would have happened, over the following days, weeks or months, to the affected person if the pollution levels had been lower on that particular day. In other words, it is possible that some or all of the extra hospitalisations and deaths on high pollution days would have occurred anyway over the next short period, irrespective of the pollution levels. This scenario is supported by the observation that the elderly and those with pre-existing heart or lung disease are most at risk for these events. On the other hand, it is also possible that some or all of the extra hospitalisations would not have occurred at all and the deaths would not have occurred for many years, if the high pollution event had not happened. Unfortunately, there is no method of analysis which allows these two alternative explanations to be tested. Clearly, the truth lies somewhere between these two ends of the spectrum of possibilities. The interpretation of the findings needs to take both these possible scenarios into account.

Appendix K3 provides details of how the total impact of expected changes in specific pollutants was estimated from the data described above. These estimates provide the number of persons per year who would be expected, due to increases in air pollution associated with the Second Sydney Airport, to:

- experience cough symptoms on one additional day;
- be hospitalised one or more days earlier than otherwise;
- die one or more days earlier than otherwise; or
- have an increased risk of contracting cancer.

These estimates give a guide to the likely impact on health of changes in air quality associated with the Second Sydney Airport. It is important they are interpreted as described above and that the following sources of uncertainty about the data are acknowledged:

- there is uncertainty in the estimates of the extent of the air quality changes;

- long-term adverse impacts of air pollutants have not been taken into account. This is because it is uncertain whether long-term adverse impacts exist in the range of exposure levels under consideration. Furthermore, there are no data on which to base a quantitative estimate of these effects if they do exist;
- the estimates of the acute health effects of short-term changes in pollution are derived from a summary of a range of conflicting research results. The summary measures need to be treated with caution;
- the analysis used here assumes that changes in daily rates of symptoms, hospitalisations and deaths, which were observed in association with spontaneous fluctuations in pollution levels, can be extrapolated to airport-induced increases in pollution. This assumption has never been tested; and
- from a public health perspective it is difficult to judge the importance of the predicted changes in the absence of any information about how premature the deaths are (that is, how many days, months or years of life are lost) and whether the additional hospitalisations are ones which would have occurred anyway and, if so, how premature they are.

Summary of Quantifiable Air Quality-Related Health Impacts

The projected increases in ozone, nitrogen dioxide, sulphur dioxide and particulate pollution associated with all the airport options are relatively small compared to total emissions in the Sydney Basin. The health effects estimates employed in this report are based on extrapolation from studies in which spontaneously occurring day-to-day variations in pollution levels were observed affecting large populations. Their use in this report relies on the assumption that interventions (such as the Second Sydney Airport) which alter pollution levels would have the same effect as that observed with day-to-day variation in pollution levels. This assumption has never been tested.

The estimates of the health impacts of sulphur dioxide suggest that approximately one additional hospital admission per year and one additional death each two years one or more days earlier than expected could be attributable to increased levels of sulphur dioxide from the operation of the Second Sydney Airport. As this data is derived from European and North American settings where sulphur dioxide and particulate pollution are closely related, an unknown proportion of effects attributed to sulphur dioxide would actually be due to particulate pollution. Furthermore, most of the impact of sulphur dioxide is attributable to a very small increase in risk experienced by a very large number of people who would be exposed to a five parts per billion increase in sulphur dioxide. It is important to note that the certainty of the estimates of effect of sulphur dioxide at this very small level of increment is low.

The above limitations of existing research, the substantially higher levels of health impacts of sulphur dioxide compared to particulates and ozone, and the prediction that emissions of sulphur dioxide generated by the Second Sydney Airport would not exceed National Environmental Protection Measure goals (refer *Section 11.4.4* of this Supplement) indicate that the above calculated impact of sulphur dioxide is over-estimated.

Overall the health impacts documented in this Supplement are higher than those stated in the Draft EIS. This is due to the use of recently available Bureau of Meteorology data revealing more frequent occurrence of poor dispersion conditions in air quality modelling and also the inclusion of airport related motor vehicle emissions in that modelling. The approach adopted for air quality modelling for this Supplement provides a more conservative appraisal of air quality impacts.

A summary of quantifiable air quality-related health impacts is provided in *Table 23.2*. The figures cited in the table give a quantitative guide to the likely adverse health impact of air quality changes attributable to the airport. To assist in understanding the scale of health impacts estimated it is useful to compare them to the overall level of deaths or hospitalisations in the general community. For example, *Table 23.3* provides the number of corresponding health events in the general population, compared to the impacts of particulates generated by the airport.

Table 23.2 Revised Air Quality-Related Health Impacts for Second Sydney Airport Operating at 30 Million Passenger Per Year

	Population Affected[1]					
	Option A		Option B		Option C	
Predicted Impact	Draft EIS Estimate	Revised Estimate	Draft EIS Estimate	Revised Estimate	Draft EIS Estimate	Revised Estimate
Short Term Health Effects of Ozone						
Deaths per year (one or more days earlier than expected)	0.009	0.031	0.009	0.031	0.009	0.031
Hospitalisation for respiratory disease per year (additional or one or more days earlier than expected)	0.024	0.092	0.024	0.092	0.026	0.092
Short Term Health Effects of Particulates Below 10 Microns in Size						
Deaths per year (one or more days earlier than expected)	0.008	0.029	0.006	0.024	0.008	0.028
Hospitalisation for respiratory disease per year (additional or one or more days earlier than expected)	0.040	0.159	0.034	0.130	0.042	0.151
Coughing (additional person-days per year)	162	585	136	479	172	552
Clinically important decrements in lung function (additional person-days per year)	-	78	-	64	-	73
Health Effects of Air Toxics						
Number of cancer cases per year	0.028	0.087	0.027	0.087	0.025	0.084

Notes: 1. *Based on population estimates for 2016.*

A further comparison can be made between the estimated health impacts of the airport and the general effects of daily temperature changes. Several studies have adjusted for the effects of meteorological factors on mortality and hospitalisations in the course of constructing models to measure the impact of daily air pollutant levels on these outcomes. In most cases, the data are not presented in a format which enables estimation of the effect of temperature on mortality. However, some do allow this calculation to be made. For example, Simpson et al (1997) in analysing a time series of mortality data in Brisbane, Australia, estimated that for each one degree Celsius the maximum daily temperature was above 28 degrees, the daily mortality rates increased by 2.2 percent. A similar analysis was undertaken in the Netherlands, Mackenbach et al (1993). After adjusting for temperature on preceding days, humidity, rainfall and sulphur dioxide levels, for each one degree Celsius greater than 16.5 degrees in observed mean daily temperature, the total mortality rate was two percent higher.

It should be noted that the presentation of these findings is not the result of a systematic literature search, although they do provide a basis for comparison. Investigations undertaken for this Supplement found that a 0.01 parts per million increase in ozone was estimated to cause a one percent increase in mortality, a five parts per billion increase in sulphur dioxide was estimated to cause a 0.73 percent increase in mortality and a three micrograms per cubic metre increase in particulates was estimated to cause a 0.18 percent increase in mortality.

Table 23.3 Comparison of Health Impacts of Particulates Generated by the Airport and Corresponding Health Events in the General Population

	Short-Term Health Effects of Particulates Below 10 Microns in Size[1]	Overall Annual Health Events in General Population of Study Area[2]
Deaths per year	up to 0.029	1,200[3]
Hospitalisation for respiratory disease per year	up to 0.159	2,600[3]
Coughing (person-days per year)	up to 585	1,830,000[4]
Clinically important decrements in lung function (person-days per year)	up to 78	730,000[5]

Notes:
1. *Refer Table 23.2. Based on population projections for 2016.*
2. *Based on a population projection for 2016 of 167,000 persons within the study area of population potentially affected by particulates generated by the airport.*
3. *Derived from baseline data obtained from NSW Health, 1990 to 1994*
4. *Derived from Schwartz et al, 1994.*
5. *Derived from Peat et al, 1995 and Hoek et al, 1998.*

Table 23.2 indicates that the probability of any serious adverse events (hospitalisations and deaths) attributable to air quality changes arising from the Second Sydney Airport is low. Less serious events such as episodes of coughing or episodes of decline in lung function in people with asthma are projected to occur rarely within the affected population.

23.2.7 Management and Monitoring of Air Quality-Related Health Impacts

Background

Many of the public submissions identified the need to implement a management plan that included monitoring health impacts after the Second Sydney Airport was established. Essentially, the monitoring strategy would involve measuring the effects of the airport on the health of local residents.

This chapter contains predictions of likely adverse health effects which might be expected to occur as a result of the predicted changes in air quality. As described elsewhere, the two stage prediction process used carries substantial uncertainty.

Should the Second Sydney Airport proceed, it would be desirable to monitor its effects on the health of local residents.

While the implementation of a health monitoring strategy is regarded as desirable it does have limitations. The types of air quality-related health problems which might be expected to occur as a result of the airport, such as breathing problems, need for hospitalisation and premature deaths, normally occur in all communities. Moreover, there is no way of knowing what would have happened if the airport had not been built.

It is possible to estimate whether or not the airport may be responsible for specific adverse health outcomes by observing similar populations not affected by the airport or by using data from the same population before the airport was built. However, neither of these comparisons is entirely satisfactory. It is likely that there would be several important differences between communities, other than the presence of the Airport. Since health problems are often complex and multi-factorial in origin it would be possible that one or more of these other differences could have caused any observed variation in health status.

Further difficulties may be experienced when attempting to identify health impacts attributable to the airport by comparing the population near the airport with a comparison population. Many of the severe health effects, such as the new onset of asthma, hospitalisation for respiratory disease, and deaths would be relatively rare in the small populations most affected by changes in air quality. The likely impact of airport-related changes in air quality would be small. Unless there is a very large increase in the rate of these events, it would not be possible, over a short time interval, to know whether any observed increase is real, and hence likely to be maintain over time, or simply a chance finding, and likely to disappear during further observation.

Notwithstanding these limitations, the following monitoring options are worthy of consideration.

Monitoring Options

Monitoring Mortality and Hospitalisation Data

Monitoring mortality and hospitalisation data would involve comparing mortality and morbidity rates collected from areas surrounding the Second Sydney Airport (before and after it begins operating) with other areas remote from the Airport. These data are routinely collected for specific diseases and could be analysed by local government area of residence of the affected person.

The advantages of this method are that it uses routinely collected data and that it measures important health outcomes. The disadvantages are the problems associated with attributing the adverse health effects to the Airport discussed above, and being able to distinguish real events from chance events.

Health Surveys

State-wide telephone interview surveys are currently conducted by the NSW Department of Health annually to assess the health status of the population of NSW. It would be possible to extend the survey to include a sample of subjects from the population surrounding the intended airport site. Providing the extended survey commenced before the airport is built it would be possible to make comparisons before and after the airport and also with other regions of NSW.

The main advantage of this approach is that it encompasses a broad range of health outcome measures and it builds on data collection which is already established. Disadvantages of this method include the previously discussed uncertainties in interpretation–difficulty attributing health problems to the airport and the problem of chance events. Additional problems may be encountered with biased reporting as people living near the airport who are aware of the possible health risks may be more likely than others to report experiencing these problems.

Cohort Study

A cohort or panel study involves recruiting a susceptible group of adults or children with asthma and elderly people with chronic lung disease living near the airport and a cohort of similar individuals suffering similar diseases from another region of Sydney unaffected by airport-related changes in air quality. The cohorts would be monitored closely over time with detailed records of symptoms, episodes of illness and changes in lung function. Between-group differences identified in their health status might imply that the differences are related to the airport. This association could be further strengthened by relating day-to-day and long-term changes in health status with fluctuations in air pollution levels around the airport and around the area of the comparison group.

Compared to the other options, this approach has the advantage of being able to detect relatively subtle health effects. The main disadvantage with this approach is the substantial cost of conducting this type of study and the potential burden it may place on participants.

Summary

All three options complement each other: providing information on acute, severe adverse events and on more subtle or long-term effects. However, all suffer from limitations which are likely to complicate the interpretation of findings. Hence, it is possible that adverse effects may be incorrectly attributed to the airport or that, conversely, airport-related health effects may not be detected.

With respect to the effects of changes in air quality, an alternative to conducting health studies would be to rely on monitoring air quality. Considerable effort has been expended in the development of National and International health-based guidelines and standards for air quality. The most recent guidelines developed in Australia are the National Environment Protection Measures (National Environment Protection Council, 1998). The level of compliance with the National Environment Protection Measures for air quality in the areas surrounding the proposed airport would provide some evidence concerning the likelihood of adverse health effects.

23.3 Noise-Related Health Impacts

23.3.1 General Effects of Noise on Health

Guidelines

The primary guidelines which at least partly address the relationship between noise and health are:

- Australian Standard 2021–1994 Acoustics–Aircraft Noise Intrusion - Building Siting and Construction; and
- Australian Standard 1269–1989 Acoustics–Hearing Conservation.

The Draft EIS also references noise criteria released by the NSW Environment Protection Authority in relation to maximum permitted noise levels on construction sites (Environment Protection Authority, 1994a) and road and rail noise.

Existing Noise Environment in Western Sydney

Existing noise levels were measured in an area extending about 20 kilometres from the airport sites as part of the preparation of the Draft EIS (refer Appendix D for background noise levels in Community Assessment Areas). Background noise levels (LA90) measured during the day were less than 45 dBA at all but one location. Background noise levels measured during the night were generally less than 35 dBA (recommended night-time background noise level).

Overall the area surveyed is generally typical of quiet rural and residential areas.

General Health Effects of Changes to the Noise Environment

Numerous methods have been used to study the effects of noise on people, including both laboratory and field studies. Notwithstanding the vast number of studies, many of them suffer from flawed methodologies, which limit the applicability of their findings. While it is possible to quantify the impacts of the Second Sydney Airport on sleep, communications, learning and general reactions; the specific health effects of these impacts cannot be quantified. Despite these research problems, it is possible to draw some reasonable conclusions regarding the non-specific health effects of noise on people, and the current state of knowledge on this subject is summarised below.

Technical Paper No. 3 (Volume 2) of the Draft EIS contains a complete literature search and discussion of the potential health effects of aircraft noise.

Effects on Hearing

Relatively high noise levels can cause hearing loss after an extended period of exposure. This is particularly relevant in the work place, where some work personnel are exposed to high noise levels for much of their working day.

Australian Standard 1269-1989 provides information which allows an assessment of the effects of noise exposure over a period of time on hearing performance. A constant level or an LAeq level of 80 dBA during eight hours of each working day over a lifetime, is likely to result in a hearing impairment of approximately two decibels in five percent of the population.

The level of 80 dBA during an eight hour day is equivalent (in terms of hearing loss prediction) to a level of 75 dBA over a 24-hour day. It would therefore follow that, to substantially avoid hearing loss in the population, an overall LAeq, 24-hour level less than 75 dBA (approximately equivalent to 40 ANEC) would be required. Such a level is very unlikely to be exceeded by aircraft noise in a residential setting.

Sounds may be uncomfortable at levels of 80 to 100 dBA, while the threshold for aural pain is around 110 to 130 dBA, with large individual differences in sensitivity. Thus, residents close to airports may experience discomfort but are not likely to experience pain. Susceptible people such as those with certain abnormalities including inflammation or hearing aids not adjusted to limit the sound pressure level, may experience discomfort or pain at lower levels.

Psychological Health

Evidence of the effects of noise on psychological health is not consistent and is methodologically difficult to obtain, but suggests that aircraft noise may be harmful to mental health.

Individuals with pre-existing tendencies to mental illness are more likely to demonstrate psychiatric illness as a result of exposure to noise. It is not clear whether mental illness is exacerbated and/or whether some new mental illness is initiated. Research indicates that certain groups (for example, highly anxious residents) may be more susceptible to mental illness associated with noise. However, it is not clear whether these anxious people should be regarded as having an illness that is exacerbated, or being predisposed to mental illness by their underlying anxiety. Noise sensitivity has also been found to be a risk factor for noise induced psychiatric illness, but may itself be a marker of depression. Individuals who perceive the noise as uncontrollable may be at increased risk of feelings of helplessness and depression.

Other health effects that are sometimes linked to aircraft noise include balance and visual effects; startle and orienting responses; heart and circulatory systems effects; and hormonal effects. The conclusions of the literature search in regard to these potential effects are summarised below.

Aircraft overflight noise is unlikely to affect people's balance, although some effects may be experienced by people with pre-existing damage to their hearing system. Effects on vision are also considered unlikely.

A startle response can be elicited by a noise which is sufficiently sudden, or which somehow indicates danger. In the context of aircraft noise, such noises could include sonic booms (Rylander et al, 1974). More sensitive subjects show higher levels of startle reaction (Stansfeld, 1992; Stansfeld and Shine, 1993). For meaningless noises, this response may be elicited only at the beginning of a series of signals, indicating that the startle response diminishes over time as people become accustomed to the noise.

Sonic booms from aircraft can startle people. Sonic booms are caused by a very small number of aircraft capable of going faster than the speed of sound such as Department of Defence aircraft and the Concorde. Very few of these aircraft would use the Second Sydney Airport and they are restricted to sub-sonic speeds over the Sydney region.

Noise may evoke a number of reflexive responses through that part of the nervous system which regulates bodily functions. Repetition of these responses may result in permanent changes such as elevated blood pressure and coronary heart disease. Noise produces acute (short term) narrowing of the blood vessels (vasoconstriction), increased blood pressure and increased heart rate. In children vasoconstriction may occur with aircraft noise of 70 dBA.

Noise generally causes an acute increase in blood pressure (see for example, Carter, 1998). Community studies of aircraft noise (for example, Cohen et al, 1986; Ising et al, 1980; Knipschild, 1977a, 1977b; Knipschild and Oudshoorn, 1977) suggest elevated blood pressure in children and possible elevations and greater antihypertensive medication use in adults exposed to aircraft noise. Claims of other cardiovascular effects of aircraft noise generally are limited by poor methodology. Recent studies of blood pressure in children at schools near Sydney Airport have to date produced only equivocal results (Morrell et al, 1998).

Type A personalities are regarded as being more susceptible to heart and circulatory system effects generally characterised by hostility and aggression. This effect may also be evident for women, those with a family history of elevated blood pressure, people with additional exposure to non-aircraft noise (workers in noisy industries for example) and those who perceive aircraft noise to be uncontrollable or to be a signal of danger.

Noise causes increases in endocrine hormones such as catecholamines, which influence the heart and circulatory system and immune systems. Noise is a stressor, and stressors depress immune system functioning. Evidence of effects of noise on immunity, other than through sleep loss, are inconclusive.

Suggestions of increased mortality as a result of aircraft noise are based on poorly controlled investigations. Similarly, effects of noise on the health of unborn or newly born infants cannot be determined with confidence from the reported investigations, which suffer from confounding factors.

Finally, no studies have determined whether the effects of noise on people in hospitals or nursing homes are greater (for example, because they are already old or ill) or lesser (for example, because they are able to rest more throughout the day or night) than the general population.

23.3.2 Summary of Noise-Related Health Impacts Identified in the Draft Environmental Impact Statement

A summary of the modelling results for aircraft overflight noise provided in the Draft EIS can be found in *Section 8.1* of this Supplement. These results and the general analysis contained in the Draft EIS responded to widespread community concern expressed during the preparation of the Draft EIS that noise impacts could lead to a range of health impacts, such as loss of hearing, stress and heart disease.

The Draft EIS found that prolonged noise exposure of approximately 40 ANEC would be required to cause hearing loss. No residents would be exposed to this level of noise. Nevertheless, some people might experience discomfort if exposed to relatively high noise events (80 to 100 dBA), especially those who may have hearing problems and require hearing aids.

The Draft EIS found that existing knowledge of the extent of noise-related health risk does not make it possible to quantify impacts on psychological health. It was also not possible to estimate the number of people who may be frightened or otherwise inconvenienced by aircraft noise. This is because research studies examining these health issues lacked sufficient rigour to allow noise-related health impacts to be quantified.

23.3.3 Summary of Noise-Related Health Issues Raised in Submissions

Methodology

Concerns were expressed in submissions that the methodology used in the Draft EIS to assess the impact of noise on health was misleading. Some submissions suggested the forecasting techniques were flawed and should have been based on 360,000 annual aircraft movements rather than 245,000 annual aircraft movements. As a result, noise impact and annoyance factors were thought to be significantly understated and the Sleep Disturbance Index virtually meaningless.

Uncertainty in relation to potential noise impacts is raised as an issue in submissions, and is related to methodological weaknesses in determining the health impacts of noise. Consideration should be given to estimating health impacts of the noise exposure levels based on quantifiable relationships found in the literature search.

Health Impacts of Noise

A large number of submissions expressed concern regarding the potential health risks of aircraft noise exposure. These included concerns regarding cardiovascular disease, emotional stress, an increase in the use of prescription drugs, and in one case, damage to hearing. While in most cases it was acknowledged that these risks may not be quantifiable, many submissions suggested that the precautionary principle should be adopted in the absence of reliable data.

Concerns were raised in submissions that the Draft EIS failed to address adequately the impact of aircraft noise on vulnerable groups, such as children, the elderly and hearing impaired persons.

Submissions also claimed that the Draft EIS did not attempt to quantify the health effects of noise and little information was provided about actual hearing loss.

The impact of aircraft overflight noise on the concentration of students and workers was considered to have been inadequately addressed in the Draft EIS. Increased injuries and absenteeism levels were also considered to be obvious impacts, yet no mention was made of either in the Draft EIS.

Submissions suggested that the assessed impact of noise on sleep was inadequate and significantly underestimated in the Draft EIS. The method used in the Draft EIS only considered awakenings and did not assess health impacts caused by disturbance to other stages of sleep.

Noise-related health effects such as tiredness, irritability, anxiety, stress and frustration were considered to be inadequately addressed in the Draft EIS. These effects are commonly associated with sleep disturbance and can result in increased absenteeism levels.

Submissions suggested that the Draft EIS either ignored or understated the harmful effects of noise, nor did it address psychological impacts that could result in increased violence and suicides. Insufficient information is provided about the impacts on relaxation, particularly outside residential dwellings.

23.3.4 Summary of Noise-Related Health Issues Raised by the Auditor

In the opinion of the Auditor, the issue of aircraft-related noise effects and impacts on health was adequately addressed in the Draft EIS. The Auditor stated that the assessment of noise impacts on vulnerable groups (sick, elderly and children) and sensitive institutions, such as schools, hospitals and childcare facilities was inadequate, and conclusions made in relation to hypertension and cardiovascular disease over-stated.

23.3.5 Response to Noise-Related Health Issues

As outlined in the Draft EIS and discussed in detail in *Technical Paper No. 3* the principal potential noise-related health risks resulting from the operation of the Second Sydney Airport are:

- changes to the normal hearing functions of individuals exposed to aircraft noise, including hearing damage and disturbance to sleep, communication and performance of tasks;
- changes to the psychological health of individuals exposed to aircraft noise such as anxiety and lifestyle loss; and

- changes to normal physiological functions such as balance and visual effects, startle and orienting responses, heart and circulatory effects, and hormonal responses.

The health risk attributed to increases in noise levels from the Second Sydney Airport was examined in the Draft EIS. The study was undertaken by developing a comprehensive literature review using a variety of sources including work undertaken in relation to Sydney Airport, and generally comparing these likely health impacts against predicted noise levels.

Broadly, the following categories of issues were raised in submissions and by the Auditor in regard to noise-related health issues:

- the impact of noise on health was misleading as modelling was based on 245,000 annual aircraft movements rather than 360,000 annual aircraft movements outlined by the Commonwealth Government in the original proposal for the Second Sydney Airport;
- inadequate assessment was made of noise impacts on vulnerable groups and sensitive institutions such as schools;
- inadequate assessment of the effects of sleep state changes;
- noise-related health impacts should be quantified;
- inadequate consideration has been given to the impact of aircraft overflight noise on the concentration of students and workers and the potential for increased injuries and absenteeism levels;
- the method used in the Draft EIS to consider sleep disturbance was inadequate and in particular did not consider the effect of changes in sleep stage;
- the consideration of health effects such as tiredness, irritability, anxiety, stress and frustration was inadequately considered in the Draft EIS; and
- inadequate consideration was given to psychological impacts of aircraft overflight noise.

Level of Airport Operations

Concern about the number of aircraft movements adopted for impact assessment purposes was raised in many submissions and by the Auditor in regard to a number of issues. A response to this concern is provided in *Chapter* 6.

Noise-Related Health Impacts on Vulnerable Groups and Institutions

The potential for specific impacts of aircraft overflight noise on vulnerable groups has been identified in the Draft EIS and *Technical Paper No. 3*. Generally, however, a non-specific vulnerability may be assumed for people with reduced adaptability or reserved capacity such as the sick, people with impaired sleeping functions, those who are more sensitive to noise, or those who are subject to other environmental pressures. The potential for noise-related health impacts on certain groups within the community identified in the Draft EIS included:

- the potential for aircraft noise to contribute to permanent hearing loss would increase when aircraft overflight noise was combined with exposure to other residential, recreational or occupational noise exposures or with ototoxic drugs or chemicals;

- community studies of aircraft noise suggest elevated blood pressure in children, and possible elevations in greater anti-hypertensive medication use in adults, exposed to aircraft noise;
- individuals with pre-existing tendencies to mental illness are more likely to demonstrate psychiatric illness as a result of exposure to noise. It is, however, not clear whether mental illness is exacerbated and/or whether some new mental illness is initiated. Research indicates that certain groups (for example, highly anxious residents) may be more susceptible to mental illness associated with noise;
- people who are more sensitive to noise are more likely to be startled, although this response does tend to diminish over time as people become accustomed to the noise;
- aircraft overflight noise is unlikely to affect people's balance, although some effects may be experienced by people with pre-existing damage to their hearing system; and
- type A personalities are more susceptible to cardiovascular effects of noise, as may be women, those with a family history of hypertension, people with additional exposure to non-aircraft noise (workers in noisy industries) and those who perceive aircraft noise to be uncontrollable or to be a signal for danger.

As with the general community, numerous methods have been used to study the effects of noise on certain groups of people. Notwithstanding the extent of these investigations, many of them suffer from flawed methodologies and differing conclusions, which limit the applicability of their findings. It is therefore only possible to draw broad conclusions regarding the affects of noise on vulnerable groups, rather than quantify specific impacts.

Section 8.6.3 and *Appendix C2* of this Supplement provides an indication of aircraft overflight noise impacts on specific sensitive land uses.

Methodology Used to Assess Effects of Aircraft Overflight Noise on Health

The NSW Government submission suggests that some studies (not referenced in the submission) have demonstrated quantifiable relationships between aircraft noise exposure and health outcomes, noting use of non-prescription medication as one example. Discussion in the *Technical Paper No. 3*, (Section 5.2.10 of Volume 2), however, indicates that whereas some studies may show a relationship between noise exposure and certain non-specific health outcomes, others find no relationship, or a different relationship.

Psychological Stress

One very recent study (Evans et al, 1998), published after preparation of the Draft EIS, does show relatively strong evidence for an increase in the production of urinary catecholamines among school children exposed to an increase in levels of aircraft noise. These markers have previously been found to be related to various manifestations of psychological stress. A significant effect was found among children whose noise exposure at school increased from 53 to 62 dBA LAeq, 24-hour, compared with a control area where the LAeq, 24-hour level changed only from 53 dBA to 55 dBA over the study period. It should be carefully noted that these noise levels represent the LAeq, value (a type of average noise level) and not the maximum noise levels commonly quoted for aircraft noise.

Around Second Sydney Airport, for Option A, the highest predicted LAeq, 24-hour noise exposure at any school is 56 dBA at Luddenham Public School. Five other schools - Holy Family Catholic School, Luddenham; Kemps Creek Public School; Warragamba Public School; Horsley Park Public School; and Marion Primary School, Horsley Park - have a maximum predicted noise exposure of approximately 55 dBA LAeq, 24-hour

For Option B, Kemps Creek Public School has a maximum predicted noise exposure of 59 dBA LAeq, 24-hour. No other schools have maximum predicted noise exposure exceeding 55 dBA LAeq, 24-hour under this airport option.

For Option C, Bringelly Public School has a maximum predicted exposure of 66 dBA LAeq, 24-hour. At this school, options for noise attenuation or relocation would need to be considered. No other schools have predicted noise exposure exceeding 55 dBA LAeq, 24-hour under Option C.

Heart Disease

Another very recent paper (Babisch, 1998), also presented after the publication of the Draft EIS, suggests that in the case of road traffic noise, a relationship between noise level and the prevalence of ischaemic heart disease may exist for noise levels above approximately 65 to 70 dBA LAeq, 24-hour, with an increase of 10 to 50 percent in the prevalence of this condition being found at these noise levels. No equivalent dose-response information is available for aircraft noise, and extension of these results to equivalent levels of aircraft noise must be treated with caution.

Nevertheless, the number of residents predicted to experience aircraft noise levels of 65 dBA LAeq, 24-hour and higher from a Second Sydney Airport is relatively small. Under worst-case airport operating conditions, the number of residents is less than 50 for Airport Option A, approximately 100 for Option B and approximately 300 for Option C. The majority of the dwellings within these areas would have mitigation measures available, either insulation or voluntary acquisition.

Hearing Damage

In the case of hearing damage, the potential impact of aircraft noise on auditory health is discussed in the *Technical Paper No. 3* (pp 5-1 to 5-17 of Volume 2). The general conclusion of the analysis is that exposure to aircraft noise at levels less than approximately 70 dBA LAeq, 24-hour is unlikely to result in any significant permanent hearing loss. At higher levels, it is possible that some effect may exist for specific susceptible groups, particularly those exposed to high noise levels at work or at other times.

Only for Option C are any existing residents predicted to be exposed to noise levels exceeding 70 dBA LAeq, 24-hour under the worst-case Air Traffic Forecast and Airport Operations. Approximately 120 residents are involved, and in all cases the dwellings are within the 35 ANEC contour, and would therefore be subject to voluntary acquisition under Government policy as applied previously at Badgerys Creek.

Impacts on Concentration of Students and Workers

Section 8.3.1 of this Supplement contains a further review of studies on the impacts of aircraft noise on children and students. The research indicates that aircraft noise can affect activity within the classrooms. Such noise can cause interference to speech communication, and can also affect task performance. Tasks that demand continuous and sustained attention to detail, or that require large working memory capacity, tend to be adversely influenced by noise.

The studies also appear to confirm the conclusion of the Draft EIS that significant impacts on schools would begin to occur when noise levels exceed 10 events per school day exceeding 65 dBA. *Appendix* C2 provides a list of schools that would be impacted by this level of noise or greater.

While it is possible to identify schools and associated students that may be significantly impacted by the operations of the airport options, existing data does not allow a dose-response relationship to be established thereby enabling specific effects on the learning abilities of individuals or groups of students to be established.

The most significant impact on people in a working situation would be the potential for disruption to communication. This would most significantly occur when noise levels exceed 60 dBA for workers in an outdoor setting and 70 dBA for people working in buildings. Reference can be made to Appendix D, Volume 2 of *Technical Paper No. 3* of the Draft EIS to determine the number of noise events exceeding these levels for each community assessment area. Specific impacts on actual work performance and safety would depend on the nature of the activity, characteristics of the work environment including background noise levels and the level of noise intrusion from sources other than aircraft. Given appropriate design of safety equipment, aircraft noise levels of even up to 100 dBA should not result in significant risk of workplace injury due to inability to hear warning signals.

Of course, apart from the specific impacts discussed in this section, noise at school or in the workplace, at sufficient levels, may also contribute to the more general health impacts described above.

Sleep Disturbance

Chapter 8 of this Supplement provides an extensive discussion on methodologies for identifying potential impacts of noise from the Second Sydney Airport on sleep. This includes detailed responses to comments related to the methodology for assessment of sleep disturbance, as well assessments using a number of alternative suggested methodologies. The discussion in *Chapter 8* is related to quantifiable effects, including awakenings and changes in sleep state. The discussion below summarises these results, and provides comments on other, non-quantifiable effects which may be related to noise-induced sleep disturbance.

Volume 2 of *Technical Paper No. 3*, provides a review of the known primary impacts of noise on sleep, and includes discussion of the following impacts:

- effects on sleep latency;
- body movements;
- changes in sleep stage distribution;
- awakening;
- vegetative responses during sleep; and
- use of sedatives, sleeping pills and earplugs.

Of these, only awakenings and specific changes in sleep state are currently amenable to quantitative prediction. Both can be reasonably adequately predicted from knowledge of the number and maximum noise level of overflights during the night, using the Sleep Disturbance Index or similar methodologies. However, views as to what may represent an appropriate criterion level for defining the acceptability of impacts on sleep vary widely, and hence the predicted number of people "impacted" under various criteria differs significantly (see *Appendix C1*).

Effects on sleep latency (time to get to sleep) can be observed even at relatively low maximum noise levels, and appear to depend more strongly on the number of events during the critical time period than on the level of those events (Ohrstrom, 1991; Ohrstrom and Rylander, 1990). Body movements are often associated with noise events, but there is some evidence that the total number of movements during a night may be the same under noisy and quiet conditions (Carter and Ingham, 1995).

Vegetative responses, including increases in heart rate and respiration rate in response to individual noise events during sleep, have been found in a number of studies. Some studies (for example, Babisch et al, 1996) have also found increases in the release of urinary catecholamines which appear to be associated with night-time noise exposure. The consumption of tranquillisers and sedatives also appear to be increased in areas of high noise exposure (Lercher, 1996).

Other Noise-Related Health Impacts

Submissions also raised concern regarding a number of secondary broad health effects of noise such as tiredness, irritability, anxiety, stress and frustration. As identified in the Draft EIS, *Technical Paper No. 3* and sections of this Supplement, such effects could occur with the operation of the Second Sydney Airport, probably as a response to sleep disturbance, impairment of communication and reductions in the ability to perform tasks. Individuals may also experience impacts on psychological health due to anxiety and concern over impact on lifestyle values.

The Draft EIS and this Supplement provides detailed analysis of the extent of noise-related impacts on a number of normal daily functions of individuals, including communication, sleep, learning and general performance of tasks. Existing data does not allow specific and quantifiable health related responses to be identified.

23.4 Water-Related Health Impacts

23.4.1 General Effects of Water Quality on Health

Changes to water quality can impact on health through the harvesting of fish or shellfish, primary contact recreation or contamination of drinking water. South Creek is generally considered unsuitable for harvesting fish or shellfish, or for primary contact recreation. Potential health impacts arising from the various uses of the Hawkesbury Nepean River is an ongoing community issue.

Guidelines

The Draft EIS referred to the Australian Drinking Water Guidelines, (National Health and Medical Research Council/Agricultural and Resource Management Council of Australia and New Zealand, 1996). These guidelines provide the minimum requirements for drinking water of good quality and are based primarily on the latest World Health Organisation recommendations for drinking water quality.

The Australian Water Quality Guidelines for Fresh and Marine Waters (Australia and New Zealand Environment Conservation Council, 1992) are used in the Draft EIS for comparative purposes in assessing water quality for human and aquatic health.

Existing Water Quality in Western Sydney

Surface Water

Water quality of streams in the Badgerys Creek area are generally nutrient rich and contain elevated levels of nitrogen and phosphorus.

Water quality in South Creek is currently poor. Elevated levels of suspended solids, dissolved solids, total phosphorus and faecal coliforms recorded during and immediately after wet weather indicate it is also unsuitable for primary contact.

The Hawkesbury Nepean River downstream of South Creek frequently exceeds water quality criteria for nutrients and, at times produces blue green algal blooms. The river is often turbid and at times exceeds the primary contact criteria for faecal coliforms.

Drinking Water

Lake Burragorang is the major water supply for Sydney and beyond the Blue Mountains, and provides approximately 70 percent of the water for over 3.7 million people. The waters within Lake Burragorang and the Kowmung River are classified as specially protected waters under the Clean Waters Act 1970, which prohibits the discharge of any waste into these waters.

At the time of preparing the Draft EIS, water quality at the dam wall abstraction point within Lake Burragorang consistently achieved compliance with regulatory guidelines with the exception of iron, aluminium, manganese, faecal coliforms and turbidity. Elevated levels of iron, aluminium and manganese are associated with run-off from the surrounding geological strata and soils. Elevated levels of faecal coliforms, and turbidity generally occur after flood events but are removed through filtration and disinfection processes before entering the drinking water supply.

Prospect Reservoir operates as an emergency supply of water when the water supply from Lake Burragorang is either of poor quality or interrupted for maintenance. It has not been used for routine supply since the Prospect water filtration plant was connected directly to Lake Burragorang via the Sydney water supply pipeline.

Many people in the rural areas surrounding Badgerys Creek rely on rainwater tanks for drinking water. There is potential for particulates and associated pollutants from various sources to accumulate in rainwater tanks located on the fringes of urban areas. Limited data is available on the current quality of water within rainwater tanks used in Sydney. General recommendations have previously been made suggesting it would be desirable for all rainwater tanks, used as a source of drinking water, to have appropriate filtration or other treatment prior to use.

23.4.2 Summary of Water-Related Health Impacts Identified in the Draft Environmental Impact Statement

Adverse health impacts caused by water discharges from the airport to the South Creek systems were considered unlikely as the catchment is presently not considered suitable for harvesting, fish or shellfish, or primary contact recreation.

Options A and B would be likely to have a number of flight paths directly over Lake Burragorang and Prospect Reservoir. An assessment of potential pollution of these water storages by air emissions from aircraft was undertaken in the Draft EIS by predicting concentrations of dissolved pollutants and comparing these against drinking water guidelines and ecosystem protection guidelines.

Benzene and benzo(a)pyrene (a polycyclic aromatic hydrocarbon) were chosen as representing the more toxic of constituents potentially generated by an airport. Benzene would also typically represent the behaviour of such gaseous emissions as formaldehyde, toluene and xylene. Benzo(a)pyrene is an indicator of non-gaseous compounds capable of attaching to particles in the atmosphere.

On the basis of concentrations of benzene in air predicted by air quality modelling, levels of benzene predicted in Lake Burragorang and Prospect Reservoir for Options A and B were more than 10,000 times lower than the drinking water guideline of one microgram per litre and more than 10 million times lower than ecosystem protection guidelines. The impacts of Option C on the reservoirs would be lower because of the limited number of flight paths likely to occur over the reservoirs.

Compounds that adhere to particulates are of concern, due to the potential for accumulation of deposits in the environment. Likely benzo(a)pyrene concentrations in Lake Burragorang and Prospect Reservoir could not be predicted due to a lack of data on aircraft emissions of benzo(a)pyrene, and to uncertainty about incorporation of this compound into water by partitioning or adsorption to particulates. Airports have not been identified as a major source of benzo(a)pyrene.

The potential risk to domestic rainwater tanks could not be fully quantified in the Draft EIS. For gaseous emissions, the equilibrium concentrations of benzene determined for reservoirs would also apply to rainwater tanks. These are well within guideline values. The situation for particulate emissions, such as polycyclic aromatic hydrocarbons, is more complex. There is a lack of data on the likely concentrations of these compounds in aircraft emissions, and the effects of microclimatic factors in transferring particles into water are not well understood. Further data would need to be collected and modelling undertaken into the transfer of particulate emissions into water tanks to assess the relative importance of these types of aircraft emissions. However, given the potential for particulates and associated pollutants from various existing sources to accumulate in rainwater tanks it would be desirable for any rainwater tanks, used as a source of drinking water to have appropriate filtration or other treatment prior to use.

The Draft EIS concluded that significant impacts on water supply from fuel dumping or venting are unlikely, given the rarity of such incidents. If fuel did reach the surface of a reservoir it would float. To reduce potential impacts, water could be drawn off at a lower depth to minimise any risk of contamination of drinking water supplies.

23.4.3 Summary of Water-Related Health Issues Raised in Submissions

Methodology

The health risk assessments conducted on the likely impacts of aircraft overflights on Sydney's drinking water were considered in submissions to lack scientific credibility and failed to assess secondary risks, such as those associated with aircraft fuel venting.

It was suggested in submissions that the method used in the Draft EIS (based on two compounds) to estimate fuel derived pollutants in water storage was flawed. Consideration should have been given to the impact of a complete suite of gaseous emissions from aircraft operations and the deposition of contaminants onto catchment areas. In addition, it was claimed in submissions that their transportation into water storages was not considered.

Health Impacts of Changes in Water Quality

Concerns were expressed in submissions that insufficient information is provided in the Draft EIS about the likely impacts of airborne pollutants on domestic drinking water supplies. Concerns were also expressed about the impact on drinking water quality from increased run-off and stormwater drainage associated with the proposed Second Sydney Airport, and the potential impact on health associated with the recreational use of water supplies polluted by the proposed airport.

23.4.4 Summary of Water-Related Health Issues Raised by the Auditor

The Auditor recommended that further study be undertaken to quantify the potential impact of establishing a Second Sydney Airport on domestic rainwater tanks. In the opinion of the Auditor, it was not satisfactory to cite a "lack of available data" as a reason for not attempting to quantify the impact.

23.4.5 Response to Water-Related Health Issues

Methodology Used to Assess Water Quality-Related Health Risks

Health Risks Associated with Reductions in Water Quality

Health risks associated with reductions in water quality derive from the deposition of aircraft emissions, including fuel venting, into water storage reservoirs and domestic rainwater tanks, and reductions to ground and surface water quality (and subsequent impacts on recreation and harvesting fish) from stormwater and sewerage treatment discharges.

Chapter 13 of this Supplement contains further detailed analysis of the impacts of stormwater run-off from the airport sites, both during construction and operation of the airport, and the impacts of discharges from any proposed sewage treatment plant. This analysis allows more definitive conclusions to be drawn about the health impacts of changes to surface water quality.

An assessment of the potential health impacts of air pollutants in relation to drinking water in reservoirs and domestic rainwater tanks was undertaken for the Draft EIS. Based on the predicted air pollutant levels calculated, the predicted deposition of pollutants was considered in addition to the existing water quality and compared against relevant water quality guidelines.

Subsequent to comments made in both the submissions and by the Auditor, further investigation into the potential health risks from air emissions associated with the operation of the Second Sydney Airport was undertaken as described in *Appendix E5*.

Contamination of Surface Water

The airport development has the potential to contaminate surface waters flowing into South Creek, that in turn flow into the Hawkesbury Nepean River. South Creek and its tributaries generally have poor water quality and are not used for any purposes which might impact on community health. In the Hawkesbury River, oyster farming is well established and fish are taken by both commercial and recreational fisherman. Contamination of waterways could place at risk the health of people consuming oysters and fish. The Hawkesbury Nepean River is also used for a wide range of recreational activities, many of which, including swimming, involve direct contact with water.

Strictly controlled water cycle management at the proposed airport, including the re-use of sewage effluent within the airport and treatment of stormwater in water quality control ponds, would result in improvements to the quality of water currently being discharged from the sites. Water discharged from the Second Sydney Airport would meet the Australia and New Zealand Environment Conservation Council (1992) Australian Water Quality Guidelines for Fresh and Marine Waterways. Water quality management is addressed in detail in *Chapter 13*.

It is expected that the airport development would result in a slight improvement in the quality of downstream waterways. This reduction in contamination of surface waters would contribute to an associated reduction in any health risks.

Contamination of Drinking Water

Water Reservoirs

Aircraft exhaust consists of organic compounds that can be broadly classified into particulate and volatile components. Polycyclic aromatic hydrocarbons are representative of the particulate compounds. Volatile emissions include benzene, butadiene, formaldehyde, phenol and xylene.

The United States Environmental Protection Agency lists sixteen polycyclic aromatic hydrocarbons that are especially relevant to environmental and human health. Of these ten have been attributed to aircraft turbines, including benzo (a) pyrene, which has been confirmed as an appropriate indicator of polycyclic aromatic hydrocarbons (refer *Chapter 13*).

The sites of the airport options are located approximately 10 kilometres east of Lake Burragorang, the main source of water supply for Sydney. Further studies carried out in response to submissions on the Draft EIS and detailed in *Chapter 13* have shown that the concentration of aircraft emitted particulates in the water of Lake Burragorang would be approximately equal to the permitted health related levels in drinking water quality guidelines. Further, the Prospect Water Filtration Plant, which treats water from Lake Burragorang before it is delivered to consumers, is designed to remove 99 percent of particulates in the size range expected from aircraft emissions.

Benzene is considered to be a satisfactory indicator of the impact of volatile emissions. In dry weather the concentrations of benzene and other volatile compounds would be lower than the relevant guideline values. In wet weather, benzene would also combine with rainfall and enter waterways. However, even with this additional conduit, levels of benzene would be less than the drinking water guideline.

In summary, it is considered that the conclusion of the Draft EIS that the absence of threats to human health as a consequence of deposition of emissions from aircraft engines in water supply reservoirs remains valid.

Rainwater Tanks

As polycyclic aromatic hydrocarbons are found in the atmosphere and in rain, it is likely that they would also be found in rainwater tanks. This would occur both by direct run-off of contaminated rainwater to tanks, as well as by the washing off of any particulate associated dry deposition on roofs. The high levels of polycyclic aromatic hydrocarbons occurring in urban areas are attributable to emissions from automobile engines. In areas removed from major traffic sources these are likely to be considerably lower.

The first flush concentration would be the major carrier of these contaminants. Natural settling of particulates in the tanks would also effectively remove most of the contaminants from the bulk water.

Similarly, it can be expected that volatile compounds would be present in rainwater tanks. However, since predicted concentrations of benzene and other volatiles generated from the airport are below drinking water guidelines, it can be reasonably assumed that there would be no threat to human health.

Appendix E5 predicts an absence of threats to human health as a consequence of deposition of emissions from aircraft engines in rainwater tanks should an airport be built at Badgerys Creek. As stated in the Draft EIS, there are other contaminants from a variety of sources that need to be avoided in roof run-off. These may have health impacts that are more serious. First flush diversion options are probably a desirable means of overcoming the problem; otherwise the use of a suitable filter would effectively trap particulate associated polycyclic aromatic hydrocarbons concentrations.

23.5 Other Health Issues and Impacts

23.5.1 Summary of Other Health Impacts Identified in the Draft Environmental Impact Statement

Hazards and Risks

Perhaps the most obvious of the additional hazards and risks associated with the establishment of the Second Sydney Airport would be that of an aircraft crashing into a populated area. The predicted fatality rate for Option A ranges from 1.8 to 2.5 persons per 100 years, depending on how the airport might operate. For Option B it ranges from 1.5 to 2.2 persons per 100 years, and for Option C from four to five persons per 100 years.

The impact of an aircraft crash, may also be expressed in terms of societal risk that is the probability of a certain number of people being killed as a result of an aircraft accident in a one year period. Societal risk calculations take into account the density of population in the study area. Generally the societal risks which would occur from the operation of any of the Second Sydney Airport options would be lower than the societal risks for Sydney Airport.

Social and Economic Impacts

Various social and economic impacts would be caused by the establishment of the Second Sydney Airport. Major social and economic impacts associated with the operation of the Second Sydney Airport include changes to population redistribution, community severance and instability, property devaluation and displacement of businesses. Collectively, these issues may impact on the psychological adjustment and health of individuals. The extent to which individuals might suffer from any of these adverse effects cannot be quantified. Potentially vulnerable groups would include the mentally and physically ill, children and the elderly.

The Second Sydney Airport would also result in several significant benefits such as employment growth and infrastructure provision which would contribute to the general well-being of certain individuals and groups within the community.

23.5.2 Other Health Issues Raised in Submissions and by the Auditor

The Auditor and some submissions stated that it would be beneficial to include some health monitoring strategies in relation to the key issues of air quality and noise including:

- community complaints and concerns;
- prospective surveys of physical and mental health;

- prospective surveys of the impacts on educational, child care and other vulnerable institutions; and
- prospective surveillance of specific health problems such as asthma, respiratory illness, sleep disturbance, hypertension and cardiovascular mortality.

Submissions suggested that risk perception and its affect on health was not investigated or discussed sufficiently.

Concern was also expressed that health issues are not discussed separately in the Draft EIS. Discussions on health are scattered throughout the Draft EIS under various headings which was considered to prevent a comprehensive analysis of health issues.

Submissions considered that the cumulative impact of air, noise and water pollution on people's health should be discussed separately and collectively in the Final EIS. Furthermore, cumulative health impacts should be assessed for the entire Sydney population as well as the western Sydney sub-region.

23.5.3 Response to Other Health Issues

Psychological Effects of Hazards and Risks

How people react to a risk will depend on their perception of the level of that risk. The perception of risk by individuals is generally subjective and not easily defined.

Perceptions of risk relating to hazardous development can involve a substantial gap between the "popular" perception of risks held by the community and "scientific" perceptions, being the level of risk that is based on technical analysis.

Research to date suggests that there are differences in risk perception in different social groups for each hazard source (Rohrmann, 1994; Rugby, 1992; and Sandman, 1991). Some of the factors that may influence people's perception of risks include:

- whether the risk is familiar or unfamiliar;
- whether the risk is voluntary or imposed;
- whether the risk is natural or man-made;
- the benefits of the source of the risk; and
- the type of publicity generated by the risk.

An Australian study investigating risk perceptions (Rohrmann, 1994) involved 339 interviews with people from a variety of societal sub-groups. The respondents were asked to rate the risk of several different hazards with regards to 11 characteristics of risk. A ranking of the magnitude of the perceived risk was then formulated (10 for highest risk and one for lowest risk) as shown in *Table 23.4*. The study also provided ratings on feelings of anxiety about risks for the study group. Rankings are also shown in *Table 23.4*.

Table 23.4 Summary of Perceived Risk and Anxiety for Various Hazard

Hazard	Perceived Risk Magnitude	Feelings of Anxiety About Risk
Parachuting	6.4	6.8
Car racing	7.0	6.4
Skiing	5.3	5.0
Asbestos production	8.6	7.7
X-ray lab	6.0	5.3
Compressor tools	5.9	4.9
Smoking	9.0	7.9
Tranquillisers	8.0	7.5
Overeating	7.4	6.3
Fire-fighter	6.0	5.7
Blaster	5.9	5.6
Emergency helicopter	5.0	5.4
Coal power plant	5.6	4.8
Metal production	5.6	4.9
Airport	4.2	4.3
Avalanche area	7.0	6.2
Earthquake area	6.8	6.4
Electrical Storms area	4.5	3.8
Explosives factory	5.8	5.6
Nuclear power plant	7.7	8.2
Chemical industry	6.8	6.7
Polluted urban area	6.6	5.9
Unhealthy climate	5.8	5.4
Natural radiation	6.9	5.8

Source: Rohrmann, 1994.

The risk of living near an airport had the lowest ranking in regard to perceived risk and second-lowest ranking in regard to feelings of anxiety about risk.

While it may be concluded that generally people have a relatively low perceived risk of airports and that the psychological effects of airport-related risk would also be low, no studies have been able to be sourced which would enable the relationship between health and people's perception of risk to be established.

Cumulative Health Impacts

The expected adverse health effects of specific air pollutant events have been quantified. It has been suggested in submissions on the Draft EIS that this may not be an adequate reflection of the total pollution experience of the affected population and as a consequence cumulative health impacts should be considered.

It is acknowledged that there may be occasions when some members of the population would be exposed to increased levels of several or all of the pollutants generated by the operation of the airport simultaneously. Epidemiological evidence would suggest that the effects of the pollutants are not independent of each other. In other words, the total of the effects of the pollutants is less than the sum of their individual effects. For example, it may be concluded that on a day when sulphur dioxide levels increase by 10 parts per billion and particulate matter less than 10 microns increase by three micrograms per cubic metre, the net effect on health outcomes would be less than the sum of the effects of sulphur dioxide and the particulate matter as presented in this Supplement. Conversely, laboratory studies have shown that exposure to ozone may increase the effect of subsequent exposure to sulphur dioxide on people with asthma. However, the clinical importance of this interaction is difficult to estimate.

In summary, the adverse respiratory health effects attributable to changes in air quality associated with the airport are best estimated by examining data on specific pollutants. The effect of combined exposures is difficult to quantify because of complexity in describing the exposures and in assessing the simultaneous impact. Overall, it is likely the combined effect would be less than the sum of the parts. However, there may be occasions where sequential exposure to two pollutants may lead to an enhanced effect.

As outlined above, existing scientific knowledge does not allow specific noise-related health impacts to be quantified. While it is reasonable to suggest that an adverse health outcome would be likely from increased noise-related stress levels for sick individuals or other vulnerable groups, it is not possible to quantify the extent of these cumulative impacts.

23.6 Overview of Health Impacts

Investigations carried out for the preparation of the Draft EIS and Supplement have included detailed reviews of studies undertaken into the health-related impacts of noise, changes to air quality, changes to water quality and perceptions of hazards and risks. These reviews have enabled some health impacts of the Second Sydney Airport to be quantified and broad conclusions to be drawn in other areas where existing data does not allow the relationship between a particular impact and a health response to be specifically identified.

23.6.1 Air Quality-Related Health Risks

The operation of the Second Sydney Airport would create potential risks to the health of individuals due to the emissions of pollutants from aircraft and vehicular traffic travelling to and from the airport. Quantifiable air quality-related health risks are discussed in *Appendix K3*.

Data from both the National Health Survey and the NSW Health Survey confirm the conclusion made in the Draft EIS that the prevalence of asthma in western and south-western Sydney was not higher than average for NSW.

The Draft EIS contained an analysis of the air quality-related health impacts of the Second Sydney Airport proposal. This analysis, while acknowledging the limitations in the methodology used, provided quantifiable rates for hospitalisation and mortality resulting from increased levels of ozone and particulates that would be caused by the Second Sydney Airport. An estimation of the increased lifetime risk of cancer as a result of predicted air toxic emissions from the airport was also provided.

Chapter 11 of this Supplement contains details of further air quality modelling carried out using new data obtained from the NSW Environment Protection Authority and the Bureau of Meteorology. Quantifiable health impacts based on the revised air quality modelling, which includes the impacts of vehicular traffic to and from the airport, have been re-calculated for this Supplement. In addition, based on further research undertaken for this Supplement, the health effects of sulphur dioxide emissions have also been calculated.

Interpretation of the data on adverse health effects must be guided by the limitations of the methods of analysis. In particular, the following considerations are important:

- there is some imprecision inherent in the methods of modelling both air quality projections and health risk assessments;
- some of the published information on adverse health effects of pollutant exposures is conflicting;
- it was not possible to model the effects of long-term exposure to pollutants. However, there is some doubt as to whether there are clinically relevant long-term effects in the range of exposures under consideration;
- the method of analysis of short-term effects of pollution on rates of hospitalisation does not provide any information on whether the additional hospitalisations on a given day represent a net increase and, if not, how much earlier than otherwise the admission occurred. Hence, the increase in hospital admissions is best described as the "number of admissions which are additional or which occur one or more days earlier than expected over the period of a year"; and
- similarly, the information on additional deaths is limited. Clearly the deaths are not actually additional (since all people are destined to die) but premature. The important issue is how premature the death is and a model cannot give this information. The increase in deaths is best described as the "number of deaths occurring one or more days earlier than expected over the period of a year".

A summary of quantifiable air quality related health impacts is provided in *Table 23.5*. The figures cited in the table give a quantitative guide to the likely adverse health impact of air quality changes attributable to the airport. They indicate that the probability of any serious adverse events (hospitalisations and deaths) attributable to air quality changes arising from the Second Sydney Airport is low. Less serious events such as episodes of coughing or episodes of decline in lung function in people with asthma are projected to occur rarely within the affected population.

Table 23.5 Air Quality-Related Health Impacts of the Second Sydney Airport Operating at 30 Million Passengers Per Year

Predicted Impact	Population Affected[1]		
	Option A	Option B	Option C
Short Term Health Effects of Ozone			
Deaths per 100 years (one or more days earlier than expected)	3	3	3
Hospitalisation for respiratory disease per 100 years (additional or one or more days earlier than expected)	9	9	9
Short Term Health Effects of Particulates Below 10 Microns in Size			
Deaths per 100 years (one or more days earlier than expected)	3	2	3
Hospitalisation for respiratory disease per 100 years (additional or one or more days earlier than expected)	16	13	15
Coughing (additional person-days per year)	585	479	552
Clinically important decrements in lung function (additional person-days per year)	78	64	73
Health Effects of Air Toxics			
Number of cancer cases per 100 years	9	9	8

Note: 1. Based on population estimate for 2016.

The estimates of the health impacts of sulphur dioxide suggest that up to approximately one hospital admission per year and one death each two years one or more days earlier than expected could be attributable to increased levels of sulphur dioxide from the operation of the Second Sydney Airport. As this estimate is derived from European and North American settings, where sulphur dioxide and particulate pollution are closely related, an unknown proportion of effects attributed to sulphur dioxide would actually be due to particulate pollution. For this and other reasons, the above calculated impact of sulphur dioxide is considered to be over-estimated.

23.6.2 Noise-Related Health Risks

Aircraft overflight noise generated by the operation of the Second Sydney Airport would disturb sleep, and interfere with communication and performance of tasks. There is concern among some members of the community that these impacts could lead to a range of health impacts such as loss of hearing, stress and heart disease.

Prolonged noise exposure of approximately 40 ANEC would be required to cause hearing loss. No residents would be exposed to this level of aircraft noise. Nevertheless some people may experience discomfort if exposed to relatively high noise events (80 to 110 dBA), especially those who may have hearing problems and require hearing aids.

Existing knowledge of the extent of noise-related health risks does not make it possible to quantify impacts on psychological health. It is also not possible to estimate the number of people who may be frightened or otherwise inconvenienced by aircraft overflight noise.

Recent research suggests that relatively high levels of aircraft overflight noise might result in the potential for increased incidence of heart disease and increased stress among school children. These levels of noise would generally occur in areas close to the airport boundary, and in which homes would either be insulated or voluntary Commonwealth Government acquisition would be available. For each airport option, one school would be subject to noise levels that could lead to increased stress for the students.

23.6.3 Water Quality-Related Health Risks

Strictly controlled water cycle management at the Second Sydney Airport, including the re-use of sewage effluent within the airport and treatment of stormwater in water quality control ponds, would result in improvements to the quality of water currently being discharged from the airport sites. Water discharged from the Second Sydney Airport would meet the Australia/New Zealand Environmental Conservation Council Guidelines for the protection of fresh waterways.

It is expected that the airport development would result in a slight improvement in the quality of downstream waterways. With this reduction in contamination of surface waters there would be an associated reduction in surface water related health risks.

Aircraft exhaust consists of organic compounds that can be broadly classified into particulate and volatile components. Polycyclic aromatic hydrocarbons are representative of the particulate compounds. Volatile emissions include benzene, butadiene, formaldehyde, phenol and xylene.

The sites of the airport options are located approximately 10 kilometres east of Lake Burragorang, the main source of water supply for Sydney. The concentration of aircraft emitted particulates in the water of Lake Burragorang would be approximately equal to the permitted health-related levels in drinking water quality guidelines. Further, the Prospect Water Filtration Plant, which treats water from Lake Burragorang before it is delivered to consumers, is designed to remove 99 percent of particulates in the size range expected from aircraft emissions.

Benzene was chosen as an indicator of the impact of volatile emissions. This selection was confirmed appropriate through a review by CSIRO. It is estimated that in dry weather the concentrations of benzene and other volatile compounds in Lake Burragorang would be lower than the relevant guideline values. In wet weather, benzene would also combine with rainfall and enter waterways. However, even with this additional conduit, levels of benzene would be less than the drinking water guidelines.

It is predicted that there would be an absence of threats to human health as a consequence of deposition of emissions from aircraft engines in rainwater tanks should an airport be built at Badgerys Creek. As stated in the Draft EIS, there are other contaminants from a variety of sources that need to be avoided in roof run-off. These may have health impacts that are more serious. First flush diversion options are probably a desirable means of overcoming the problem; otherwise the use of a suitable filter would effectively trap particulate associated polycyclic aromatic hydrocarbons concentrations.

23.6.4 Other Health Impacts

Generally people have a relatively low perceived risk of airports and feelings of anxiety regarding the perceived risk are also low compared to other hazards such as car racing, skiing, or being located near a coal power plant, a nuclear power plant or chemical industry. No studies have been identified which enable the relationship between health and people's perception of risk to be established.

There may be occasions when some members of the population would be exposed to increased levels of several or all pollutants simultaneously, leading to a potential cumulative health impact. Epidemiological evidence suggests that the total of the effects of the pollutants is less than the sum of their individual effects and that adverse respiratory health effects attributable to changes in air quality associated with the airport are best estimated by examining data on specific pollutants. However, there may be occasions where sequential exposure to two pollutants may lead to an enhanced effect.

Three options exist for monitoring the effects of the airport on the health of local residents: monitoring mortality and hospitalisation data, health surveys and cohort studies. While all three options complement each other, all suffer from limitations which are likely to complicate interpretation of the findings and possibly incorrectly attribute or not detect airport or airport-related health effects. The level of compliance with the National Environment Protection Measures for air quality in the areas surrounding the airport would also provide some evidence concerning the likelihood of adverse health effects.

Chapter 24

Social and Cumulative Impacts

Chapter 24
Social and Cumulative Impacts

24.1 Summary of the Draft Environmental Impact Statement

24.1.1 Methodology

The Draft EIS assessed the regional social characteristics of 13 local government areas (social impact assessment region) in the vicinity of the airport sites and compared these characteristics to the Sydney region as a whole. This quantitative analysis was supplemented by extensive community consultation conducted during the preparation of the Draft EIS.

Cumulative impacts (that is, impacts of the Second Sydney Airport and other major existing or proposed developments in western Sydney) were assessed by reference to the combined effects of this additional development, and the extent to which they complied with the principles of ecologically sustainable development. Adverse and beneficial community impacts were identified and their combined effects noted.

24.1.2 Social Impacts

The Draft EIS identified key social impacts arising from the construction and operation of an airport at Badgerys Creek as including:

- *changes to population distribution* – principally arising from the relocation of existing population, situated on the site of the airport or within the 35 ANEC, or else through changes to future populations because of perceived urban development opportunities and pressures;
- *changes to access patterns* – at a local level, through restricted access to local roads and individual properties, and at a regional level, resulting from the need to upgrade main access routes;
- *changes to residential amenity and character* – arising from the increased urbanisation of the immediate area and from the loss or undermining of local and regional facilities that currently contribute to the character of the area;
- *community severance and instability* – arising from the loss of the Badgerys Creek community and owing to the effects of associated infrastructure provision (for example road and rail) on adjoining communities;
- *displacement and effects on individual properties* – arising from acquisition, potential reduction and increases in property values, and loss in agricultural production; and
- *effects on health* – potential or perceived adverse effects on the health of individuals.

24.1.3 Cumulative Impacts

When considered individually, many development activities have relatively minor impacts; however, when considered collectively these same activities can cause significant impacts on the environment. The potential consequences arising from the additive effects of incremental development can be termed cumulative impacts.

The EIS Guidelines recommended that the Draft EIS provide sufficient conceptual information, including a preliminary environmental assessment, to allow the identification of the cumulative impacts of the Second Sydney Airport proposal. Issues considered in the Draft EIS relating to this aspect of the proposal included:

- cumulative impacts of the airport development and major support infrastructure, including new road and rail links and major utility services (Chapters 10 and 22);
- the likely influence of the proposal in attracting other developments/airport-related industries, including any impacts (adverse or beneficial) associated with additional developments that otherwise would not have occurred (Chapters 10 and 25);
- cumulative impacts on the Sydney metropolitan area in terms of net changes to noise, risk and air quality (Chapters 12, 13, 15 and 19);
- cumulative impacts on the biodiversity of the site and region, with reference to the Hawkesbury Nepean catchment (Chapter 17);
- consistency with local and regional environmental plans, other planning instruments and strategic planning policies (Chapter 10); and
- whether the proposal would prevent, inhibit or improve the development of other forms of transport now or in the future, or affect the viability of other transport modes (Chapter 22).

Many factors already influence the environmental quality of the region in which it is proposed to site the Second Sydney Airport, often to its detriment. If developed, the Second Sydney Airport would bring positive benefits, such as providing employment and services, and possibly, offering opportunities to improve journey to work travel times. In addition, given the uncertainty about the airport proposal during the past 10 years, a decision to develop the airport at Badgerys Creek would provide greater definition to the planning process and an impetus for close co-ordination of local and regional planning. If the benefits of an airport are accepted and its development desired then an opportunity exists and should be taken to co-ordinate environmental management of major developments in the region to reduce adverse cumulative impacts.

24.2 Summary of Social and Cumulative Issues

24.2.1 Issues Raised in Submissions

Methodology and Scope of the Assessment

Many of the issues raised in submissions from the Western Sydney Alliance and NSW Government, among others, regarded the methods used in the assessment of social impacts as too generalised or failing to adhere to recognised social impact assessment methodologies and therefore as being inadequate. The NSW Government considered that no reference was included in the Draft EIS to the extent to which community consultation had informed the results of the social impact assessment. The extent of the assessment region was questioned by Blacktown City Council, the Council of the City of Greater Lithgow and Penrith City Council, among others, all of whom suggested that it should have included a wider geographical base, to include, for example, Blacktown and new urban release areas at Glenmore Park.

The NSW Government was concerned that the Draft EIS had failed to address impacts on potential native title claimants. The NSW Government was also concerned, as were the NSW Teachers Federation and the Camden Residents Action Group, that the impacts on radio and television reception had not been assessed as required by the EIS Guidelines.

No specific issue was raised in regard to the methods used to assess cumulative impacts, with submissions in general failing to specify the nature of the concern requiring assessment.

Social Impact Issues

Other issues raised relating to the social impact assessment included the understatement of population projections, the need and responsibility for additional social services and the failure to recognise cumulative impacts relating to noise, air quality and water pollution. Concerns regarding impacts on neighbouring communities, within new urban release areas, in rural communities and in more distant growing communities were also cited. More specifically, social dislocation caused by the closure or excessive use of off-site roads, especially during construction, and changes to lifestyle from increased urbanisation, were stated as issues requiring closer attention.

Consideration of social and economic impacts on recreational opportunities in western Sydney was noted as having been omitted from the Draft EIS assessment. In this regard it was considered that the adverse impacts on tourism, and the impacts on industries supported by tourism in the Blue Mountains, were also not considered.

Individuals from non-English speaking backgrounds were considered to have been poorly represented in the social impact assessment and, in particular, little recognition was considered to have been given to the social characteristics of these communities.

Cumulative Impacts

The Western Sydney Alliance and the NSW Government, among others, considered that the cumulative impacts of support infrastructure and new urban development should be addressed.

The discussion in the Draft EIS on the cumulative impacts on local and regional biodiversity and other indirect impacts, relating to the effects on flora, fauna and water quality, was also noted in submissions as being deficient. These concerns also related to the impacts of air pollution on people's health as a result of the operation of the airport and associated infrastructure, including the urban expansion of this part of western Sydney and the additional vehicle kilometres travelled due to the increased numbers of passengers.

A diverse range of organisations, including the Holroyd Association Against Airport Noise, the Australian Business Chamber, the Western Sydney Alliance and the NSW Government, among others, were concerned that ambiguity in relation to the airport options prevented an adequate assessment of the combined effects of both Sydney Airport and the Second Sydney Airport.

24.2.2 Issues Raised by the Auditor

The Auditor concluded that while the methodology used for the social impact assessment was acceptable, the deficiencies identified in relation to the land use and planning assessment (as described in *Section 7.2* of this Supplement) also affected the social impact assessment. The Auditor considered that social impacts experienced during operation of the airport could be greatly affected by the ultimate urban form around the airport. Accordingly, the Auditor found that the social impact assessment was both very general and heavily qualified.

In relation to the cumulative environmental impacts of support infrastructure, related developments and industry, the Auditor found that these had not been addressed. The Auditor considered that the net changes to noise, risk and air quality in the Sydney Metropolitan Area (including the community around Sydney Airport) were not assessed and the manner in which the two airports could operate together to minimise the impact of aircraft noise in Sydney were not identified. The Auditor also found there was no analysis of cumulative impacts on biodiversity in the Hawkesbury Nepean catchment.

24.3 Further Analysis of Direct and Cumulative Impacts

The EIS Guidelines require that the EIS provide sufficient conceptual information, including a preliminary environmental assessment, to identify the cumulative impacts of the Second Sydney Airport proposal. This conceptual information and preliminary environmental assessment were provided in Chapter 27 of the Draft EIS, while social and economic impacts were addressed in Chapter 25. More detailed assessment of cumulative impacts of specific issues has been undertaken for this Supplement, in:

- *Chapter 14,* which discusses the cumulative impacts on flora and fauna of western Sydney;
- *Chapter 17,* which discusses the cumulative impacts on Aboriginal cultural heritage;
- *Chapter 18,* which discusses the cumulative impacts on non-Aboriginal cultural heritage within the Liverpool Local Government Area; and
- *Chapter 20,* which discusses the interaction between the operation of Sydney Airport and the potential operation of the Second Sydney Airport.

Concerns were raised in submissions regarding the scope of the cumulative impact assessment in the Draft EIS, however, few specific issues were raised. In response to this general concern, the following sections provide a summary of both the direct impacts from the construction and operation of the airport and the cumulative impacts that might indirectly arise from the development of the airport or other major developments in the region. The aim of this analysis is to consolidate and better communicate the results of the various assessments carried out in the Draft EIS and this Supplement.

24.3.1 Defining and Assessing Cumulative Impacts

Types of Cumulative Impacts

The construction and operation of the Second Sydney Airport at Badgerys Creek would have a range of direct environmental impacts, which have been examined in the Draft EIS and in this Supplement. The more obvious direct environmental impacts include noise and dust generation during construction, aircraft overflight noise, changes to water and air quality, increased hazards and risks, increased motor vehicles on roads, and increased economic activity and employment.

Most activities, especially an activity of the scale of the Second Sydney Airport proposal, would influence and change a variety of other human activities. These changes to other human activities would also result in a variety of environmental impacts, both adverse and beneficial. For example, the construction of the master plan stage of the airport would require approximately eight million tonnes of construction material (refer Table 9.3 of the Draft EIS). To supply this demand, existing extractive industries might be expanded or new extractive industries established. These consequential activities would result in a range of adverse and beneficial environmental impacts.

Table 24.1 identifies how the Second Sydney Airport proposal would influence or even provide the impetus for a number of subsequent activities. The range of cumulative impacts that might result from those subsequent activities are also identified. These include adverse or beneficial biophysical impacts and adverse or beneficial socioeconomic impacts.

It is only possible to identify in general terms the type of cumulative impact that may arise from these consequential activities related to the development of the airport. For example, while it might be possible to identify generally the areas from which construction materials may be sourced it is not possible to identify which extractive industries might be expanded and where new extractive industries might need to be developed. The need for such expanded activities would depend on the overall demand for materials including the demand from developments other than the airport.

Specific environmental assessment of these consequential activities would be undertaken in accordance with relevant local, State or Commonwealth Government environmental legislation. A general objective of all this legislation is to ensure that activities proceed only where it can be demonstrated that beneficial impacts would outweigh adverse impacts.

In addition to the cumulative impacts that might arise from consequential activities related to the development of the airport, cumulative impacts also arise from the collective impacts of both the airport proposal and the many other developments that are unrelated to the airport, but are planned to occur in the region surrounding the airport sites. When considered individually, many of these activities would have relatively minor impacts; however, when considered collectively they might cause significant regional impacts on the environment.

Strategic planning for Sydney suggests that 53,000 new houses will be constructed in western Sydney by 2002 (Department of Urban Affairs and Planning, 1998b). Development of the suburbs and other infrastructure to support such development would have many influences on the environmental quality of the region. The additive effects of these many incremental developments, including the possible airport development, would be significant. In addition to individual environmental management measures that should be placed on each development, a regional environmental management response is required from all levels of government to adequately deal with the additive cumulative impacts that would arise from this level of development. Social and economic issues that require adequate management include the adequacy of social and community services, access to employment and other equity issues, the adequacy of public and private transport systems, the loss of agricultural productivity, sterilisation of resources, loss of heritage and scenic values, and access to recreational opportunities. Biophysical issues include regional air quality, water quality and biodiversity impacts.

Assessing Cumulative Impacts

To assist in the understanding of the types of cumulative impacts that might arise from the Second Sydney Airport proposal, the following sections provide a summary of the most significant direct impacts of the Second Sydney Airport combined with

Table 24.1 Potential Cumulative Impacts from Activities Arising as a Consequence of the Development of the Airport

Influence of Proposal	Consequential Activity/ Response	Range of Cumulative Impacts			
		Adverse Biophysical Impact	Beneficial Biophysical Impact	Adverse Socioeconomic Impact	Beneficial Socioeconomic Impact
Land Use	• Restricted land use because of environmental impacts			✓	
Modifications	• Increased demand for commercial lands	✓			✓
	• Increased demand for residential lands	✓	✓	✓	✓
	• Displacement of population from the airport sites and adjoining areas	✓		✓	✓
Urban Utilities	• Changes to land values			✓	✓
	• Construction and operation of utility infrastructure	✓		✓	✓
	• Supplying demand for electricity, gas, water and telecommunications services	✓	✓	✓	✓
Resource Usage and Sterilisation	• Use of extensive construction materials	✓	✓	✓	✓
Agriculture, Energy	• Sterilisation of mineral resources			✓	
and Wastes	• Loss of agricultural production and productive land			✓	
	• Energy consumption and supply	✓		✓	✓
Land Transport	• Disposal of wastes from the proposal	✓		✓	✓
Demands	• Construction and operation of new roads	✓	✓	✓	✓
	• Upgrading of existing roads	✓		✓	✓
	• Increased traffic on existing and upgraded roads	✓		✓	
	• Construction of rail line	✓		✓	✓
	• Operation of rail line		✓	✓	✓
Aviation	• Upgrading of other public transport systems	✓	✓	✓	✓
	• Changes to operation of Sydney Airport	NK[1]	NK	✓	NK
	• Changes to operation of Camden, Richmond and Bankstown Airports	NK	NK	NK	NK
	• Closure of Hoxton Park Airport		✓	✓	✓
Economic Activity	• Changes to flight training areas	✓	✓	✓	✓
	• General increase/change in economic activity	✓	✓	✓	✓
	• Increased demand for development of employment-generating activities	✓	✓	✓	✓
Health	• Demand on health system				

Note: 1. Not known at this stage.

an identification of the types of cumulative impacts that might also occur. These are described at both a local and regional level.

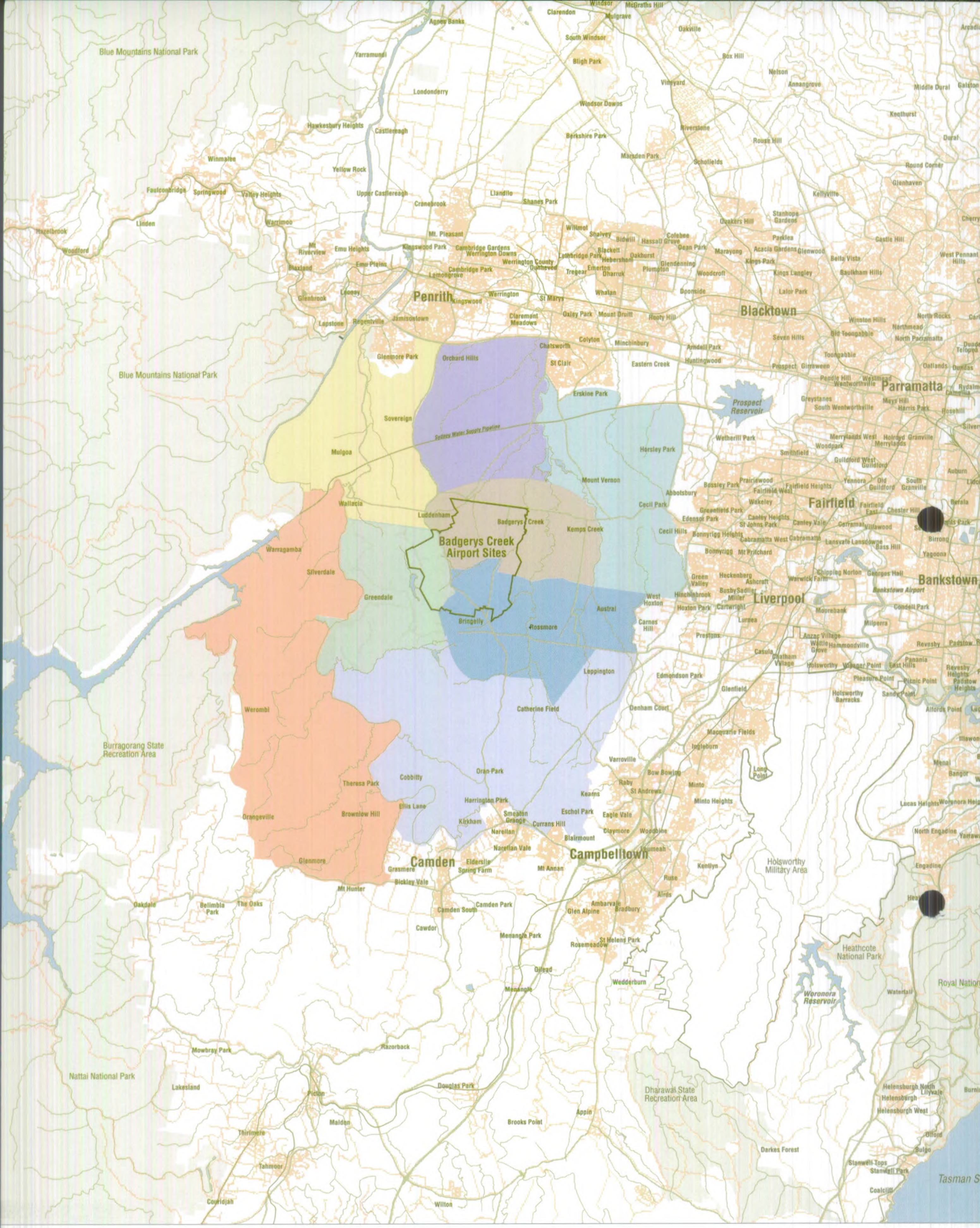
The extent to which cumulative impacts occur varies, dependent on the issue and the environment's ability to absorb or accommodate defined impacts. For example, the cumulative impacts arising from some issues are likely to be more regionally based (that is, extend over a larger area) than others. An example of this is air quality, whereby the cumulative impacts are likely to extend well beyond the local assessment areas. Cumulative impacts relating to other issues can be more precisely defined; they apply to a more limited local area.

Local assessment areas have been defined immediately surrounding the sites of the airport options and are shown in *Figure 24.1*. Existing characteristics of these areas are described in terms of their social characteristics (demographic composition and profile) and in relation to their character, by reference to land use, development density, access to community services and facilities and provision of open space. Potential modifications to these characteristics are then discussed. These modifications could be caused either by the direct impacts of the airport options or the cumulative impacts arising either from consequential activities related to the development of the airport or the impacts of other unrelated developments.

The likely modifications to the community characteristics of the local assessment areas have been used to develop environmental management measures and a process for ongoing monitoring and review.

Regional environmental impacts are identified and discussed on the basis of the pressure on a range of environmental resources that might be exerted by the development of the airport, consequential activities related to the development of the airport or other activities that are planned for the western region of Sydney. The resources considered are land and social structures, air, water and biodiversity.

The consequences of the biophysical and socioeconomic changes that would result from the operation of the Second Sydney Airport would not only be dependent on the scale and nature of the direct and cumulative impacts, but also the overall timing and rate of change. The environmental impacts assessed in both the Draft EIS and this Supplement are primarily based on the airport accommodating approximately 30 million passengers a year. It has been assumed that this level of operation might be reached in the year 2016. This date was chosen because the new airport could be handling a substantial volume of air traffic by this time and it provides the most reliable point in the future at which populations and land uses can be predicted with an acceptable level of accuracy. *Chapter 4* of this Supplement provides a revision of air traffic forecasts for the Sydney basin. It also identifies ways in which the aircraft movement capacity of Sydney Airport could be extended from approximately 2006-07 to at least 2010-11. The consequence of these revisions is that it is unlikely that the Second Sydney Airport would reach its planned operating limit of approximately 30 million passengers per year until at least the third or possibly the fourth decade of the next century. Therefore, many, but not all, of the direct and cumulative impacts of the airport proposal would result in gradual changes to the human and biophysical environments, with such change potentially occurring over a period of 20 to 30 years. Such a rate of change would improve the capacity of both Government and the community to manage adverse consequences and take advantage of potential benefits.



Local Assessment Areas:

- Badgerys Creek/ Kemps Creek/Luddenham
- Bringelly/ Rossmore/ Austral
- Camden Rural Lands
- Greendale
- Urban areas (indicated by local roads)
- Mount Vernon/ Cecil Park/Horsley Park
- Orchard Hills
- Wallacia/ Mulgoa/ Sovereign
- Warragamba/ Silverdale/ Werombi/ Mount Hunter

Figure 24.1

Extent of Sub-Regional and Local Assessment Areas

TN MN

0Km 10Km

24.3.2 Regional Direct and Cumulative Impacts

Land Use and Social Structure

The consequences arising from the operation of the Second Sydney Airport would result in a number of impacts on the way land in the surrounding region is presently used and managed, and on planning for land use in the future. These include (refer *Table 24.1*):

- increased demand for commercial and industrial lands;
- increased demand for residential lands in the region surrounding the airport sites;
- displacement of population from within and adjoining the airport site;
- construction of utility infrastructure;
- loss of agricultural production and productive land;
- construction and upgrading of new and existing roads;
- increased traffic on existing and upgraded roads;
- potential construction and operation of a new rail line;
- upgrading of other public transport systems; and
- closure of Hoxton Park Airport.

Land Use Modifications

These consequential activities would result in a range of adverse and beneficial biophysical and socioeconomic impacts.

Regional land use modifications directly associated with the Second Sydney Airport might not necessarily be significant. Increased demand for commercial or industrial lands could be accommodated either on the airport site or within presently zoned or planned employment lands throughout the region. Displacement of residents from within and adjoining the airport site because of the land requirements for the airport (displacement of up to 1,200 people) or the direct environmental impacts such as aircraft overflight noise would create increased demand for semi-rural housing on the outskirts of Sydney should the residents choose to relocate to a similar environment. This type of housing is becoming scarce in the Sydney basin. Agricultural activities would be displaced and there would be some loss of productive land resulting from the development of the airport. The production value of these agricultural activities are, however, not significant in regional terms (up to 0.23 percent of total regional agricultural production) and the activities and losses would probably be taken up by other regions.

Responses to the land transport demands created by the airport could create significant changes to the structure of urban development in the region surrounding the airport sites. Construction of new roads, upgrading of other roads, the construction of a new rail line and the upgrading of other public transport systems would create a range of adverse biophysical and socioeconomic impacts at a local level for the areas surrounding the individual transport infrastructure improvements. Regional cumulative impacts would include impacts arising from a general increase in motor vehicle usage in the region especially air quality impacts, occasions of potential decreases in the level of access and service at various times of the day and at various parts of the transport network, and potential improvements in access and level of service in various parts of the region due to improved public transport and road facilities.

Regional Planning Response

The NSW Government's recently released *Planning Strategy for the Greater Metropolitan Region of Sydney, Newcastle, Wollongong and the Central Coast* (Department of Urban Affairs and Planning, 1998a) and the accompanying *Planning Strategy for Western Sydney* (Department of Urban Affairs and Planning, 1998b) acknowledges the potential for the development of the Second Sydney Airport at Badgerys Creek by stating:

> *The most significant of these* [unresolved issues] *may be the Commonwealth Government's decision on the proposed Second Sydney Airport at Badgerys Creek. The decision will have a direct impact on Western Sydney and could alter the key strategies and priorities for Western Sydney. Key trends and strategy implementation will be monitored so that decisions and actions remain relevant in this ever changing environment.* (Department of Urban Affairs and Planning, 1998b)

Potentially, the most significant modification to the way land is used in the region surrounding the airport sites and the subsequent cumulative impacts arising from such modifications, would relate to the overall planning response made to the Second Sydney Airport. As discussed in Chapter 10 of the Draft EIS and *Chapter 7* of this Supplement, it is not possible to precisely predict the planning response to the Second Sydney Airport due to the extent of strategic planning and environmental investigation required and the need to involve all levels of government in the planning process.

The planning response to the Second Sydney Airport would need to examine how the airport and associated development could best achieve the strategic planning outcomes identified by the NSW Government for western Sydney (Department of Urban Affairs and Planning, 1998b). In some areas, it can be argued that the Second Sydney Airport proposal would clearly enhance some of the NSW Government's intended outcomes for western Sydney, while various regional environmental management measures would need to be implemented to ensure that the achievement of other outcomes was not compromised. Examples of outcomes that might be enhanced include:

- growth in employment opportunities across all sectors;
- improved access to employment; and
- the development of a central industrial/warehousing/employment zone as a major employment and freight centre.

Examples of outcomes that potentially could be compromised include:

- improved air quality through better transport, industry and housing practice creating a more compact city that is less reliant on car use;
- improved water quality through improved stormwater management, urban design and sewage systems;
- protection and management of waterways and riverine corridors on a sustainable basis;
- protection of biodiversity outside of the reserve system; and
- protection of Aboriginal and European heritage.

The Second Sydney Airport proposal would not require significant changes to regional land uses in order to function adequately. Restrictions on the further development of residential land uses immediately surrounding the airport would be required and should at least satisfy the guidelines set down in *Australian Standard 2021*. Provided adequate land transport links are established to the airport, existing and proposed employment and residential lands would be likely to satisfy commercial and employee needs generated by the airport. Nevertheless, it must be recognised that the significant level of infrastructure investment and the economic attractions and benefits of the airport, both to individuals and to businesses, would create significant motivation to re-examine current strategic plans for the future development of western Sydney. Preliminary strategic planning work undertaken as a response to the 1985 airport proposal at Badgerys Creek suggested that further residential and commercial development of the South Creek Valley might be desirable to take advantage of the investment in public transport and urban services. The identified advantages of such a strategy included:

- the establishment of new residential suburbs adjacent to rail transport and the consequential decrease in reliance on private motor vehicles;
- the development of employment-generating activities in western Sydney, thereby improving access to jobs for local residents, improving social equity and reducing the length of journey to work trips; and
- the potential for new suburbs in South Creek Valley to support the viability of a rail link to the airport.

Both the extent of the benefits of such a strategy and the ability for environmental impacts to be managed have yet to be fully examined. Furthermore, there might be other planning strategies that could be implemented and provide a similar range of benefits.

Should the Second Sydney Airport proceed it would be appropriate for a regional planning co-ordination body to initiate extensive strategic planning and regional environmental investigations as described in *Chapter 25* and *Appendix M* of this Supplement. The aim of these investigations would be to take full advantage of the public investment and the economic benefits of the airport while identifying measures to manage consequential regional cumulative impacts such as degradation of air and water quality and loss of biodiversity.

Air

Sydney's major air quality problems are photochemical smog and brown haze. Currently, the quality of Sydney's air complies with the NSW Environment Protection Authority guidelines most of the time. However, due to the influence of the local topography and air currents, western Sydney is affected by emissions generated both in the region and elsewhere in the Sydney basin.

The NSW Government has a 25-year strategy for improving air quality called *Action for Air* (NSW Environment Protection Authority, 1998a). A key element of this action plan is to reduce car use and increase public transport use. The NSW Government has adopted the ambitious goal of stopping per capita growth of vehicle kilometres travelled by 2011 and stopping the growth in total vehicle kilometres travelled by 2021. A range of actions are proposed to achieve this including the upgrade of public transport systems. Also related to these actions are strategies to increase job opportunities in western Sydney, strengthen the commercial and employment roles of existing centres and improve public transport access to these centres. The NSW Government has also imposed a moratorium on new urban development in south-western Sydney. It is not proposed to lift this moratorium until a detailed environmental assessment has been undertaken on the potential impacts of such development on air and water quality (Department of Urban Affairs and Planning, 1998b).

The results of air quality dispersion modelling (refer *Chapter 11* of this Supplement) suggest that the operation of the Second Sydney Airport would result in exceedences of relevant goals for nitrogen dioxide, particulate matter and ozone levels. For nitrogen dioxide and particulate matter, these exceedences would be restricted to the immediate vicinity of the airport (within one to two kilometres). In the case of ozone, the adversely affected area is predicted to be to the west of the airport site. No exceedences of relevant goals are predicted for carbon monoxide and sulphur dioxide. Annual greenhouse gas emissions from the airport are predicted to be equivalent to 0.3 percent of total NSW greenhouse gas emissions on the basis of current NSW projections extrapolated to 2016.

While the emissions of pollutants from the operation of the airport and motor vehicle traffic associated with the airport would result in relatively localised exceedences of air quality goals based on existing background levels, the airport, together with many other forms of development within Sydney, would contribute to the need to successfully implement actions to improve air quality in Sydney.

At its peak level of activity (30 million passengers per year) the airport and generated motor vehicle traffic would emit approximately 6.2 percent, 3.1 percent, 1.5 percent, 2.0 percent and 3.0 percent of all Sydney's existing emissions of oxides of nitrogen, carbon monoxide, sulphur dioxide, hydrocarbons and total suspended particulates respectively (emissions of airport handling 30 million passengers per year compared with 1992 estimate of emissions in Sydney derived from MAQS study). The percentage contribution of the airport to the total of Sydney's emissions when handling 30 million passengers per year would be likely to be less than these figures. While the Second Sydney Airport would be a significant single contributor to pollutant emissions in Sydney, the management of air quality is appropriately dealt with on a metropolitan-wide basis and requires a diverse range of strategies and actions to be implemented. Motor vehicles are a major source of pollutants in Sydney. They contribute 82 percent of oxides of nitrogen, 41 percent of reactive organic compounds and 31 percent of total suspended particulates (Environment Protection Authority, 1998a). The NSW Government has identified a range of transport initiatives to reduce motor vehicle emissions, along with various actions to reduce industrial and household emissions. *Action for Air* also contains technology, education and regulatory initiatives.

While the development of the Second Sydney Airport would result in direct emissions of air pollutants to the Sydney basin, its development would also assist in the Government meeting some key objectives of its action plan for improving air quality, namely:

- encouraging a shift from private cars to public transport through the potential provision of a rail link and other public transport improvements to and from the Second Sydney Airport;
- reducing the need for travel by creating a significant number of jobs in western Sydney;
- reducing length of trips travelled by vehicles by improving the ratio of the number of jobs available in western Sydney compared to the number of workers living in the region (in 1996 there were 779 jobs per 1,000 workers in western Sydney compared to 1,122 jobs per 1,000 workers in eastern Sydney - Department of Urban Affairs and Planning, 1998b); and
- better managing freight movements by providing western Sydney businesses, both industrial and rural, with better access to a high standard air freight facility.

Water

Key cumulative impacts of the airport proposal and other activities in western Sydney on water resources would include impacts on groundwater and impacts on the water quality in the South Creek Valley and the Hawkesbury Nepean River system.

Investigations carried out for this Supplement (refer *Chapter 13*) indicate that the airport proposal would not result in any discernible regional impacts on groundwater, surface water or drinking water supplies.

The most significant cumulative impact on water resources would arise from any strategic planning response that would result from further urban development of the South Creek Valley. It is difficult to provide effective water management measures to the variety of individual activities and developments that occur with the establishment of new suburbs. An extensive regional water cycle management investigation would be required to demonstrate, if possible, that urban development could proceed in South Creek Valley without jeopardising the regional goals for improving surface and groundwater quality in the South Creek and Hawkesbury Nepean River system.

Adverse impacts on water arising from the provision of infrastructure to service the airport and the additional motor vehicle traffic generated by the airport would potentially extend to other water catchments in the region. These issues would increase, if only marginally, the presently recognised need to adequately manage the quality and the quantity of stormwater run-off from construction sites and existing urban activities such as roads.

Biodiversity

Loss of habitat for native flora and fauna represents the most significant influence on species' survival and extinction rates in western Sydney (National Parks and Wildlife Service, 1997a). From the early days of European occupation, western Sydney was extensively cleared for agriculture and grazing (Benson and Howell, 1990; National Parks and Wildlife Service, 1997a). Clearing for agriculture still remains a significant threat to biodiversity in western Sydney. However, the greatest pressure on remaining habitat is the demand for housing and associated infrastructure and services (National Parks and Wildlife Service, 1997a).

A number of major developments are proposed or currently in progress in western Sydney. Most notably, the development of the site for the Sydney 2000 Olympics at Homebush Bay, the Penrith Lakes Scheme, the upgrading of the M4 and M5 motorways, the proposed Western Sydney Orbital and the urban development of the former Australian Defence Industries site at Penrith/Blacktown. Each of these proposals, as well as activities associated with the proposed Second Sydney Airport and their ongoing urban development, contribute to the increasing pressures on natural resources in the region.

The predominant vegetation communities of conservation significance at the sites of the airport options are Cumberland Plain Woodland and River-flat Forest, both of which are considered to be endangered ecological communities in western Sydney (National Parks and Wildlife Service, 1997a). Remnants of Cumberland Plain Woodland and River-flat Forest in western Sydney support a large number of significant plant species and represent a significant habitat resource for fauna. However, the habitat quality of these communities is generally poor; many remnants are small and degraded by weed invasion, feral animals and dieback (National Parks and Wildlife Service, 1997a). Many of the original fauna have been replaced by ecological generalists that can utilise a wide variety of habitat resources, and edge specialists, which occupy the boundaries between vegetated and open areas. Bushland corridors, particularly riparian corridors, have become important habitat refuges for native fauna, owing to the extensive clearing of woodland in western Sydney.

Approximately seven percent, equivalent to 8,550 hectares, of the original distribution of Cumberland Plain Woodland remains in western Sydney (National Parks and Wildlife Service, 1997a). At present only 4.4 percent of the remaining Cumberland Plain Woodland remnants are protected in conservation reserves.

The Second Sydney Airport would involve the removal of up to 149 hectares of this community, representing two percent of its current total area in western Sydney. Development of the airport would contribute in the short term to the ongoing clearance of Cumberland Plain Woodland in western Sydney and would therefore constitute an activity considered to threaten the long-term survival of this community. However, as discussed in *Section 14.8* of this Supplement, in the long term the development of the airport and proposed management of vegetation would involve rehabilitation and preservation of up to 152 hectares of Cumberland Plain Woodland. In addition, it is proposed to revegetate a minimum of 83 hectares with Cumberland Plain Woodland and River-flat Forest species to link the currently fragmented remnants (refer *Table 14.8*). The minimum area proposed for long term conservation at the sites of the airport options represents more than two percent of the remaining Cumberland Plain Woodland in western Sydney. The protection and long-term management of this community within the airport sites would contribute to the conservation of Cumberland Plain Woodland within the region.

According to the *Western Sydney Urban Bushland Biodiversity Study* (National Parks and Wildlife Service, 1997a), River-flat Forest is considered to be amongst the most threatened vegetation communities in western Sydney, although it is not currently listed under the *Threatened Species Conservation Act*. Approximately nine percent of its original area, equivalent to 3,825 hectares, remains in western Sydney. Current threats to this community include clearance of riparian vegetation, modification of natural flow regimes, grazing, mowing and competition from weed species. Up to 3.1 hectares of this community would be removed by the proposal, representing less than 0.1 percent of the area remaining in western Sydney. Although the area of River-flat Forest to be removed is relatively small in a regional context, the proposal represents an activity that contributes in the short term to the ongoing degradation of River-flat Forest in western Sydney.

The rehabilitation and long-term protection of up to 16.4 hectares of River-flat Forest is proposed for the airport site. The proposal also includes additional areas for revegetation with River-flat Forest species to continue and enhance existing riparian corridors at the airport site (refer *Section 14.8*). The development of the airport would therefore contribute to the long-term conservation of this vegetation community in western Sydney.

Aquatic ecosystems in western Sydney are also under pressure from development, pollution inputs and degradation. Proposed stormwater management at the airport sites has been designed to minimise impacts on the quality and quantity of water returning to adjacent creeklines. However, construction of the airport would require removal of some sections of natural creek line. The partial removal of Badgerys Creek under Options B and C would contribute to the ongoing pressure on the aquatic system within the region.

Activities such as road and rail construction, creation of utility corridors, road re-alignments and widening can contribute to vegetation clearance, habitat loss and fragmentation and creation of barriers to fauna movement. The provision of such infrastructure to support the airport would be subject to separate assessment processes, which would need to consider specific and overall flora and fauna impacts.

The urban expansion of Sydney has and will continue to exert pressure on biodiversity within the Sydney basin. The introduction of legislation to require more stringent assessment and provide protection for threatened species and vegetation communities will assist in maintaining and possibly enhancing biodiversity. Should the development of the Second Sydney Airport proceed, urban activity and development would increase, primarily because of the regional economic benefits created by the investment in the airport and its operation. The level of that activity and its specific characteristics are impossible to define precisely. Rigorous application of development assessment procedures and the implementation of regional measures to protect and enhance the biodiversity of the Sydney basin would be required to effectively manage the cumulative impacts of the Second Sydney Airport and other urban development on biodiversity.

24.3.3 Local Direct and Cumulative Impacts

Key Community Characteristics

In order to assess direct and cumulative impacts of the local assessment areas, an understanding of the communities that are likely to be affected is required, based on the existing situation or 'baseline' conditions. Key factors contributing to the character of each area are shown in *Table 24.2*.

These factors provide insight into the operation and interrelationship of land uses and population, as a means of identifying the character of those areas. Along with the demographic profile of the population within these areas, an understanding of the degree to which direct and cumulative impacts are likely to affect each of the assessment areas can be made.

Demographic Characteristics

The demographic characteristics of the local assessment areas have been described using statistics from the *1996 Census of Population and Housing* (Australian Bureau of Statistics, 1996). Characteristics relating to age composition of the population, occupation, household income, profession, labour force status, household tenure, occupancy and ethnic composition have been ascertained. These characteristics have been compared to the region surrounding the airport sites (local government areas of Blacktown, Camden, Campbelltown, Fairfield, Liverpool and Penrith) and the Sydney Statistical Division which comprises the Sydney Metropolitan Area, the Blue Mountains and Wollondilly local government areas.

Statistics for the local assessment areas are a combination of the statistical results for each collector district within these areas. Most collector district boundaries fit accurately into the boundaries of the assessment areas, however for some this was not possible. Consequently, statistics are representative of the key characteristics of each area, described as a percentage of the total population. The results of this are included in *Appendix L*.

Generally, the profile and composition of the population within the local assessment areas are broadly similar, exhibiting the following key characteristics:

Table 24.2 Local Assessment Areas: Population and Land Use Characteristics

Local Assessment Area	Localities	1996 Population	Distance from Second Sydney Airport Site[1]	Main Land Uses
Badgerys Creek/ Kemps Creek/ Luddenham	• Badgerys Creek • Kemps Creek • Luddenham	2,303	• Badgerys Creek - 0 kilometres • Kemps Creek - 4 kilometres • Luddenham - 2 kilometres	• Agricultural • Rural Residential • Village Residential • Recreational
Bringelly/ Rossmore/Austral	• Bringelly • Rossmore • Austral	6,164	• Bringelly Village - 5 kilometres • Rossmore Village - 7 kilometres • Austral Village - 7 kilometres	• Agricultural • Telecommunications • Rural Residential • Village Residential
Greendale	• Greendale • Luddenham	752	• Greendale - 6 kilometres	• Open Space • Agricultural • Rural Residential
Mount Vernon/ Cecil Park/ Horsley Park	• Mount Vernon • Horsley Park • Cecil Park • Erskine Park • Hoxton Park	4,209	• Horsley Park - 13 kilometres • Hoxton Park - 11 kilometres	• Urban • Open Space • Rural Residential • Agricultural • Education
Wallacia/ Mulgoa/ Sovereign	• Wallacia • Mulgoa • Sovereign • Regentville	3,035	• Mulgoa - 9 kilometres • Wallacia - 8 kilometres	• Agricultural • Rural Residential • Village Residential • National Park • Open Space • Education
Orchard Hills	• Orchard Hills	1,543	• RAAF Rifle Range - 8 kilometres	• Military • Agricultural
Camden Rural Lands	• Cobbitty • Oran Park • Leppington • Catherine Field • Ellis Lane • Harrington Park • Kirkham • Smeaton Grange • Currans Hill	5,835	• Cobbitty - 14 kilometres • Leppington - 11 kilometres • Catherine Field - 12 kilometres	• Agricultural • Rural Residential • Village Residential • Open Space and Recreation • Education
Warragamba/ Silverdale/ Werombi/ Mount Hunter	• Warragamba • Silverdale • Wallacia • Werombi • Mount Hunter	6,090	• Warragamba - 11 kilometres • Mount Hunter - 20 kilometres	• Village Residential • Rural Residential • Agricultural • Water Catchment Area • Recreation • Industrial

Note: 1. Measured from the centre of the airport sites.

- the proportion of persons in the younger age groups (0 - 20 years old) is higher than that of the Sydney Statistical Division but less than that for the surrounding region;
- there is a slightly higher proportion of persons within the local assessment areas in the older age group categories than that of the surrounding region;
- there is a higher proportion of blue-collar workers and a lower proportion of white-collar workers within the local areas than in the Sydney Statistical Division. The exception is the proportion of managers and administrators, which exceeds both that found in the Sydney Statistical Division and in the surrounding region;
- the weekly household income within the local assessment areas is similar to that in the Sydney Statistical Division, although there is a slightly higher proportion of lower income earners (less than $700 weekly household income) in the assessment areas of Greendale, Camden Rural Lands, Warragamba/ Silverdale/Werombi/Mount Hunter, Badgerys Creek/Kemps Creek/ Luddenham and Bringelly/ Rossmore;
- there is a higher proportion of unemployed persons within the surrounding region than in the Sydney Statistical Division, although unemployment within the local assessment areas is generally lower, the exception being Badgerys Creek/Kemps Creek/Luddenham. The local assessment areas also have a higher proportion of the population aged 15 and over in the labour force than both the Sydney Statistical Division and surrounding region; and
- the proportion of home ownership in the local assessment areas is much higher than in the Sydney Statistical Division or the surrounding region, with the exception of Badgerys Creek/Kemps Creek/Luddenham, where the proportion of persons renting accommodation is higher. This is partly due to the number of people renting property on the existing Commonwealth-owned airport site.

This assessment demonstrates that the characteristics of the local assessment areas reflect the rural residential nature of much of these areas, with higher levels of home ownership and higher numbers of persons working in the agricultural industry. The age characteristics of these areas also reflect those of emerging suburbs on the fringe of Sydney, which are characterised by a generally younger household composition than the general population of the Sydney Statistical Division.

Modifications to Community Characteristics

The local assessment areas would be those most significantly impacted by many of the direct environmental impacts of the airport described in the Draft EIS and the preceding chapters of this Supplement. A number of consequences of the development and operation of the airport would also impact on the local assessment areas (refer *Table 24.1*), namely:

- restricted land use because of environmental impacts;
- increased demand for commercial and residential lands;
- displacement of population from and adjoining the airport site;
- changes to land values;
- construction and operation of utility infrastructure;
- sterilisation of mineral resources;

- loss of agricultural production and productive lands;
- construction and operation of new roads;
- upgrading of existing roads;
- increased traffic on existing and upgraded roads;
- construction and operation of a potential rail link to the airport;
- upgrading of other public transport systems;
- closure of Hoxton Park Airport;
- changes to flight training areas;
- general increase or change in economic activity;
- increased demand for development of employment-generating activities; and
- demand on health system.

Badgerys Creek/Kemps Creek/Luddenham

General Character

The Badgerys Creek/Kemps Creek/Luddenham area is characterised as semi-rural with rural industry and agricultural production (market gardens) and rural residential development and small rural villages. The environment is relatively quiet and peaceful, the exception being areas adjacent to Elizabeth Drive, where traffic noise can be high, especially from heavy vehicles servicing extractive industries and other rural industries. Village centres are located in Badgerys Creek, Kemps Creek and Luddenham, where limited services and facilities are provided. These villages contain primary schools, as well as two child care centres (in Luddenham and south of Kemps Creek), a church and a range of other local services.

Major roads are two-lane rural roads, with some other roads being single-lane roads or tracks, many of which are unsealed. Public transport is limited to bus services on the major roads; there is a dependence on private vehicles for transportation to and from the area.

Description of Impacts

This assessment area would undergo significant change as a result of the influence of all airport options and the provision of off-site infrastructure to service the airport.

The most immediate impact on the communities within this local assessment area would be the displacement of people who presently live on the site selected for the airport. Approximately 500 people who rent property from the Commonwealth within the site of Option A would need to relocate and an additional 500 to 700 people would need to relocate from acquired property for the expanded area of Options B and C. As it is likely that the airport would be constructed in stages, it would be possible for some residents to remain for a period of time if their properties were not required as part of the Stage 1 development. Under present Commonwealth policy, voluntary acquisition would also be offered to residents who would live within 35 ANEC noise levels. Some residents might also choose to relocate because of their individual reaction to the changes to the environment that would occur.

Construction of the airport, most likely in stages, would be a major activity resulting in the potential for impacts on properties surrounding the airport site. Construction work at the airport site would be undertaken between the hours of 7.00 a.m. and 5.00

p.m. daily, Monday to Saturday. Sunday work and work outside of these hours may be necessary on occasions for urgent activities. During the day, Luddenham village and surrounding areas and properties fronting Lawson and Martin Roads might experience noise levels exceeding guidelines established by the NSW Environment Protection Authority (refer *Figure 9.2* of this Supplement). Should construction work occur at night, residents living west of Kemps Creek village and within Luddenham village may experience disturbances (refer *Figure 9.3* of this Supplement).

Dust emissions during construction could potentially result in deposition of dust on surrounding properties, for example on washing being dried and in swimming pools and rainwater tanks. The amount of dust would depend on the weather conditions for each particular day of construction and the effectiveness of dust control measures used on the site. There would be potential for dust deposition to occur on areas within one kilometre of the airport boundary at rates in excess of the generally allowable limit of two grams per square metre per month. Potential impacts would also arise from the generation of particulate matter during construction (refer Figures 15.7 to 15.9 of the Draft EIS).

Local roads would experience increased traffic during the construction of the airport. This would mainly consist of workforce vehicles (up to 200 vehicles per day) and heavy vehicles (up to 900 vehicles per day) carrying quarry products and building materials. Major routes would be The Northern Road and Elizabeth Drive. The section of The Northern Road between Elizabeth Drive and Adams Road would need to be widened to a four-lane carriageway to maintain existing levels of services. The intersection of Elizabeth Drive with Devonshire Road would require upgrading, while traffic signals would be required at the intersection of The Northern Road-Adams Road and Bringelly Road with Cowpasture Road and Camden Valley Way. Additional noise would be generated by the construction traffic, but generally this additional noise would represent less than a two dBA increase above existing levels of traffic noise (refer *Section 9.3.2* of this Supplement).

The construction of the airport would create the opportunity for employment, mainly for skilled workers. Local services such as shops and service stations would benefit from the increased activity.

Once the airport is operating, a range of significant impacts would occur on this local assessment area. Levels of aircraft noise would vary significantly depending on the airport option selected, the operating scenario of the airport and location of individual properties. Some areas could receive less than one overflight on an average day exceeding 70 dBA (the level at which indoor conversations would be disturbed) while other areas might receive up to approximately 170 overflights on an average day exceeding 70 dBA when the airport reached 30 million passengers per year. Ground operation of aircraft could result in Luddenham village experiencing noise levels in excess of 60 dBA. Areas of Kemps Creek to the east of the airport site would experience ground operation noise levels of between 40 to 50 dBA (refer *Figure 9.1* of this Supplement).

It is estimated that the operation of the airport would generate approximately 63,000 motor vehicle trips a day. While these trips would be dispersed through the road network, all would travel via either Elizabeth Drive or The Northern Road, both of which run through this local assessment area. It is estimated that these roads would experience an increase in traffic of 149 percent and 156 percent respectively (comparison of with and without airport in 2016). Both of these roads would need to be upgraded, Elizabeth Drive to partly four lanes and partly six lanes and The Northern Road to four lanes. Devonshire Road would also need upgrading. The upgrading and increased traffic on these roads would change the character of the surrounding environment. Access to and across the roads might be restricted to maintain efficient traffic flows, and traffic noise levels would increase. Noise mitigation measures would be available to reduce the extent of this impact (refer Section 13.4 of Draft EIS).

Infrastructure for the provision of electricity, telecommunications, aviation fuel, natural gas and water to service the airport would be required. It is, however, likely that these services would be provided within The Northern Road and Elizabeth Drive road corridors, with the exception of the requirement to realign a 330 kilovolt electricity transmission line that presently runs through the airport site. Significant environmental impacts are likely to be limited to the relocation of the transmission line, which would be subject to a detailed environmental assessment carried out under State legislation.

Significant direct biophysical impacts of the airports operation on the Badgerys Creek/ Kemps Creek/Luddenham local assessment area would include potential exceedences of peak 24-hour particulate matter concentrations and peak one-hour nitrogen dioxide concentrations in the area surrounding Luddenham Village (refer *Figures 11.2* and *11.3* of this Supplement). There would also be degradation of air quality in other parts of the local assessment area from both the airport's operation and motor vehicle traffic generated from the airport, although relevant air quality goals are not predicted to be exceeded in these areas.

As noted in *Section 24.3.2*, the most significant biophysical cumulative impacts would arise if the strategic planning response to the airport encouraged further urban development of the South Creek Valley. In this area, such development would probably involve commercial/industrial development within noise affected areas, possibly to the north of Elizabeth Drive. Such development would add to the scale of air, water and biodiversity impacts.

The most significant social issues for this local assessment area would arise from the effects on residential amenity and character, community severance and instability and displacement of populations and effects on individual properties. Residential amenity is characterised by a range of factors including lifestyle, accessibility, visual appearance and access to open space. The Badgerys Creek/Kemps Creek/Luddenham local assessment area is likely to become more urbanised as a result of increases in population, the amount of through traffic and increasing pressure for development on land adjoining or within the airport site. The present lifestyle of many residents would change as a consequence.

Badgerys Creek would cease to exist as a community under all of the airport options, resulting in the severance of family and business networks. Major severance to other communities such as Kemps Creek and Luddenham would be caused by the upgrading of roads. Conversely, these transport improvements also offer the potential for improved access and infrastructure within the area, to the benefit of residents within these communities.

Displacement and major effects on properties would be caused by:

- acquisition of properties on the airport site;
- potential reduction in value of properties, arising from increased noise and an overall reduction in amenity; and
- loss in agricultural production.

Some residents may choose to relocate because of their individual reaction to increased noise. Linked to this are secondary effects of displacement including:

- diminished demand for services;
- potential closure of services and facilities;
- social change; and
- lower morale and community spirit.

Should urban development occur, some benefits would also arise, including:

- increases in some land values;
- upgraded roads and other services that would also benefit local communities;
- increased economic activity; and
- improved access to jobs.

Community Modifications

The village of Badgerys Creek would cease to exist. The character of Kemps Creek and Luddenham villages would change significantly, primarily due to the upgrading of The Northern Road and Elizabeth Drive and increases in traffic, noise levels and economic activity.

The rural character of the area would change; the extent of such a change would depend on the proximity of properties to the airport boundary or major roads and the extent of aircraft overflight and ground operation noise experienced.

More fundamental change to the character of the area would occur should urban development be allowed in the vicinity of the airport. This would most likely take the form of commercial/industrial development within noise affected areas. Such development would result in a range of significant biophysical and social cumulative impacts.

The extent of these impacts would be greatest on those persons who place high values on their current rural lifestyles. Economic benefits would flow to the communities within this local assessment area; the extent to which residents would gain from such benefits would depend on individual circumstances.

Bringelly/Rossmore/Austral

General Character

The character of the Bringelly/Rossmore/Austral area is similar to Badgerys Creek/Kemps Creek/Luddenham, with agriculture uses, such as poultry, horse stables, cattle and market gardening predominating. A large proportion of this area is used for rural residential purposes, which are serviced by the villages of Rossmore, Bringelly and Austral. These villages accommodate basic community services and facilities, including bush fire brigades, community centres, recreational facilities and stores. This area also accommodates three churches, three primary schools (at Bringelly, Rossmore and Austral), two child care centres and a retirement village. This area accommodates some significant infrastructure, including the Kemps Creek Electrical Substation, the Austral telephone exchange, a water supply canal, electrical transmission lines and the Bringelly telephone exchange.

Public transport provision is poor. Bringelly Road and The Northern Road are the principal routes linking the area to the north, south and east.

Description of Impact

Similar to the Badgerys Creek/Kemps Creek/Luddenham area, this assessment area would undergo significant change from the influence of airport options due to its proximity to the airport site and the impacts of the provision of off-site infrastructure to service the airport. There would be an immediate impact on communities, especially the northern Bringelly area, through the displacement of people who presently live within the proposed airport site. As previously described, depending on the airport option selected between 500 to 1,200 people would be displaced. As it is likely that the airport would be constructed in stages, it would be possible for some residents to remain for a period of time if their properties were not required as part of the first stage development. Further displacement would occur due to voluntary acquisition of properties situated within 35 ANEC noise contours. Some additional residents might also choose to relocate because of their individual reaction to the changes to the environment.

Areas of Bringelly would also experience construction noise levels which would exceed both day time and night-time noise goals set by the NSW Environment Protection Authority (refer *Figures* 9.2 and 9.3 of this Supplement). Bringelly could also experience rates of dust deposition from construction activities in excess of the generally allowable limit of two grams per square metre per month. Potential impacts would also arise from the generation of fine particulate matter during construction (refer Figures 15.7 to 15.9 of the Draft EIS).

Bringelly Road and The Northern Road would experience increased traffic during the construction of the airport. However, no local roads would require upgrading (refer *Section* 19.6.2 of this Supplement) and the additional traffic noise generated would generally represent less than a two dBA increase above existing levels of noise (refer *Section* 9.3.2 of this Supplement).

The construction of the airport would create the opportunity for employment, mainly for skilled workers. Local services such as shops and service stations would benefit from the increased activity.

Once the airport is operating, a range of significant impacts would occur on this local assessment area. Levels of aircraft noise would vary significantly depending on the airport option selected, the operation of the airport and the location of individual properties. Under Option C, parts of Bringelly would experience significant aircraft overflight noise impacts. Parts of Rossmore would also be affected by aircraft overflight noise under both Options B and C. Up to approximately 180 overflights on an average day in these areas could be expected to exceed 70 dBA. Details of the area of impact and the number of people affected is contained in Chapter 12 and Appendix D of the Draft EIS and *Chapter* 8 of this Supplement. In contrast, the Austral area would receive between less than one and 14 overflights on an average day exceeding 70 dBA, depending on the airport option and the operating scenario.

Ground operation of aircraft could result in areas of Bringelly experiencing significant noise levels of over 60 dBA. Areas of Rossmore would experience between 50 and 55 dBA and areas of Austral would experience between 45 and 50 dBA (refer *Figure* 9.1 of this Supplement).

It is estimated that the operation of the airport would generate approximately 63,000 motor vehicle trips a day. It is estimated that The Northern Road (north of Bringelly Road) and Bringelly Road (between The Northern Road and Camden Valley Way) would experience an increase in traffic of 156 percent and 362 percent respectively (comparison of with and without airport in 2016). Both roads would require upgrading to four lanes by 2006. The upgrading and increased traffic on these roads would change the character of the surrounding environment. Access to and across the roads might be restricted to maintain efficient traffic flows and traffic noise levels would increase, although noise mitigation measures would be available to reduce the extent of this impact (refer Section 13.4 of Draft EIS).

Other off-site infrastructure requirements likely to impact this local assessment area would be the potential provision of a rail link. Two alignments have previously been investigated (Taskforce on Planning for the Sub-Region Surrounding the Sydney West Airport, 1996a) one runs through the Bringelly area and the other through the Rossmore area. Other alignment options would also be potentially available. There would be a range of impacts arising from both the construction and operation of the rail link. These would include issues such as community severance, operational noise, biophysical impacts during construction and visual impacts. Perhaps of more significance would be the land use changes that might accompany the construction of a rail link to the airport. As described in Chapter 10 of the Draft EIS and *Chapter 7* of this Supplement, there would be significant social, economic and environmental advantages of developing new residential communities in conjunction with the development of the rail line. These would primarily relate to the improved public transport access provided to the new residents. Existing property owners would also realise benefits through improved access and, for some properties, improved land values. Allowing further urban development in South Creek Valley raises a number of biophysical environmental issues which are discussed in *Section 24.3.2*.

In terms of air quality impacts, exceedences of peak 24-hour particulate matter concentrations and peak one-hour nitrogen dioxide concentrations are predicted to occur in parts of this local assessment area. The exceedences would affect areas located within approximately two kilometres of the boundary of the airport site (refer *Figures 11.2* and *11.3* of this Supplement). Air quality in other parts of the local assessment area would be degraded by the operation of the airport and the generation of motor vehicle traffic, however, exceedences of relevant air quality goals are not expected.

Similar to the Badgerys Creek/Kemps Creek/Luddenham local assessment area, the most significant social issues for this area would arise from effects on residential amenity and character, community severance and instability and displacement of populations and affects on individual properties. Potential impacts include:

- degradation of residential amenity resulting from to the direct impacts of the airport's operation;
- changes to the character of the area resulting from increased activity and urbanisation;
- community severance resulting from the upgrading and increased traffic on Bringelly Road and The Northern Road and the potential development of a rail link;
- displacement of populations from within and adjoining the airport site; and
- loss of agricultural production.

Again, from these changes some benefits would also arise. Some property owners would benefit from improved access and the potential for future urbanisation. Economic activity would increase and access to jobs would significantly improve.

Community Modifications

The character and amenity of the Bringelly area would change significantly. It would experience adverse environmental impacts both during the construction and operation of the airport. To a lesser extent Rossmore would also experience these impacts.

The rural character of the area would change. The extent of this change would depend on the proximity of properties to the airport boundary, major roads or the potential rail link and the levels of aircraft overflight noise and ground operation noise experienced.

A more fundamental change to the character of the area would occur should urban development proceed to take advantage of the improvement in transport infrastructure, especially the potential provision of the rail link. Under such a circumstance the Bringelly and Rossmore areas could be transformed from having a semi-rural character to a low to medium density urban character surrounding new rail stations. The management of the biophysical environmental impacts that would arise from such urban development would need to be resolved prior to any decision to proceed.

Similar to the Badgerys Creek/Kemps Creek/Luddenham area, the extent of these impacts would be felt most significantly by people who place high values on their current rural lifestyles. Conversely, economic benefits would flow to local communities and to individuals.

Greendale

General Character

The Greendale assessment area is located to the south-west of the airport options and is characterised by a rural environment with dominant land uses being agricultural and rural residential. A large part of this area is occupied for farming research purposes by the University of Sydney. Development is relatively low density, and there are no major services or facilities located within this area. Major commercial farming interests are located in this assessment area. Also located within this area is the Bents Basin State Recreation Area, which is a regional recreational resource located on the Nepean River. There are no village or community centres within this assessment area and there are no schools, churches, hospitals or retirement villages.

Description of Impacts

As with the other local assessment areas adjoining the airport sites, the Greendale area would experience significant direct impacts from the airport. These would include the gradual displacement of populations from within and immediately adjoining the airport site, the potential for disturbance from construction noise at night (refer *Figure* 9.3 of this Supplement) and the deposition of dust and particulate matter on areas close to the airport boundary (refer Figures 15.7 to 15.9 of the Draft EIS). The Northern Road would experience significant increased traffic during construction, which would generate additional traffic noise, but this would likely represent less than a two dBA increase above existing levels (refer *Section* 9.3.2 of this Supplement).

Aircraft overflight noise impacts on this local assessment area would arise from the operation of Options A and B and the operation of the cross wind runway for Option C. Up to 179 overflights on an average day generating noise in excess of 70 dBA might be experienced by properties close to the airport boundary. In contrast, for some combinations of airport options and operating scenarios, some areas would receive, on average, less than one overflight exceeding 70 dBA.

The Bents Basin State Recreation Area, which is located within this local assessment area, would be subject to a significant number of aircraft overflights, particularly from Options A and B. It is expected that up to 137 overflights with noise levels greater than 70 dBA could occur, on average, each day. The recreation area comprises 400 hectares of forest and woodland on the Nepean River. It has a deep waterhole forming part of the Nepean River gorge surrounded by grassy areas used for recreation and camping. An educational centre features displays and videos on the unique wildlife, scenery and history of the area and its importance to the Aboriginal culture of the Gandangara people. It is used as a field study centre for school and community groups (NSW Standing Committee on Public Works, 1995).

The impacts of aircraft overflight noise on the Bents Basin State Recreation Area would diminish its recreational and educational value. These impacts were examined by the NSW Standing Committee on Public Works (1995) when examining the State infrastructure requirements for the airport. The Committee recommended that camping at the recreation area be terminated once the airport opens and that the NSW National Parks and Wildlife Service reviews the role of the area as a community education centre.

A significant direct biophysical impact of the airport's operation on the Greendale local assessment area would be air quality impacts. Exceedences of peak 24-hour particulate and peak one-hour nitrogen dioxide concentrations are predicted to occur in parts of this local assessment area. These exceedances would affect areas located within approximately two kilometres of the boundary of the airport site (refer *Figures 11.2* and *11.3* of this Supplement). Air quality in other parts of the local assessment area would be degraded by the operation of the airport and the generation of motor vehicle traffic, however, exceedences of relevant air quality goals are not expected.

The Greendale local assessment area would be unlikely to experience significant changes in land use owing to its remoteness from existing urban centres, and the fact that some parts of the area are subject to flooding. The most significant impact from the provision of infrastructure to service the airport would be the possible relocation of an electricity transmission line from within the airport site to an area west of the airport site and within the Greendale local assessment area. A range of environmental impacts would result from such a relocation, and the proposal would be subject to a detailed environmental assessment carried out under State legislation.

The Northern Road would experience a significant increase in traffic (up to 156 percent) due to the operation of the airport. The road would require upgrading to four lanes by 2006. Access to and across the road might be restricted to maintain efficient traffic flows and traffic noise levels would increase. Noise mitigation measures would be available to reduce the extent of this impact (refer Section 13.4 of Draft EIS).

The most significant social issues for this local assessment area would arise from the effects on residential amenity, change in the rural character of the area primarily as a result of aircraft overflight noise, increased traffic and upgrading of The Northern Road, displacement of populations within the airport site and immediately adjacent to the airport site, and potential reductions in land values. The value of the Bents Basin State Recreation Area as a recreational resource would also be diminished.

Community Modifications

It is considered unlikely that the Greendale local assessment area would experience significant changes in land use because of the development of the airport. There would be some construction-related direct environmental impacts, however, the most significant impacts would occur from aircraft overflight noise, especially if either Options A or B were selected. The recreational values of the Bents Basin State Recreation Area would be diminished because of the impacts of aircraft overflight noise. An existing 330 kilovolt electricity transmission line could be relocated from within the airport site to within the Greendale local assessment area resulting in a range of environmental impacts.

Mount Vernon/Cecil Park/Horsley Park

General Character

The Mount Vernon/Cecil Park/Horsley Park local assessment area borders new urban release areas to the north (Erskine Park) and south-east (Cecil Hills and West Hoxton Park). Residential density is low, although this assessment area has a more suburban character. A small community exists at Horsley Park and includes two primary schools, a church and community facilities such as the Horsley Park Catholic Club, Community Hall and Bush Fire Brigade. Limited services also exist, such as the Horsley Park Tavern. A concentration of facilities also exist off Mamre Road and include the Mamre Christian College, Trinity Catholic School, Emmaus Catholic College and Emmaus Retirement Village.

Several major transmission lines traverse this assessment area, which is a result of this assessment area being located immediately south of the Sydney West Sub-Station (Pacific Power Central Regional Centre). Two major quarries are also located in this assessment area, with associated industry (Austral and PGH Bricks).

This area is characterised by a growing community, with the recent development of high quality, low density housing, especially in the Mount Vernon area. Due to its location adjoining the urban area, it is likely that many people residing here travel out of the area for employment.

Description of Impacts

The Mount Vernon/Cecil Park/Horsley Park area would not be significantly affected by construction impacts. Some increase in traffic on roads such as Wallgrove Road and Elizabeth Drive would be experienced; however, it is unlikely that the increase in traffic would be readily discernible by local residents.

The major direct impact from the operation of the airport would be aircraft overflight noise, especially from the operation of Options A and B. There would be a significant range of impacts depending on the option and the operating scenario used at the airport. For example, under Options A and B areas around Mount Vernon would receive up to 124 overflights on an average day exceeding 70 dBA. Under Option C this area would receive as little as less than one overflight, on average, above 70 dBA a day. Areas further from the airport, such as Erskine Park, Horsley Park and Cecil Park, would experience lower levels of noise. For example, Erskine Park would receive between less than one and 23 overflights exceeding 70 dBA on an average day, depending on the airport option and operating scenario. Some areas of Mount Vernon and Horsley Park might experience noise from ground operations of aircraft of between 40 and 45 dBA (refer *Figure 9.1* of this Supplement).

While the operation of the Second Sydney Airport would increase emissions of air pollutants in western Sydney, modelling carried out for the Draft EIS and this

Supplement indicates that relevant air quality goals would not be exceeded in the Mount Vernon/Cecil Park/Horsley Park local assessment area.

The Western Sydney Orbital is planned to generally follow the alignment of Wallgrove Road through this assessment area. It is noted, however, that the State government believes that this Motorway is needed regardless of whether or not the airport proceeds (Roads and Traffic Authority, 1998). An environmental impact statement is presently being prepared by the NSW Roads and Traffic Authority.

The NSW Department of Urban Affairs and Planning does not favour the expansion of urban development west of Wallgrove Road. There is, however, likely to be increasing pressure to allow such development as the available vacant urban development program lands diminish and to take advantage of the benefits provided by improved transport links such as the development of the Western Sydney Orbital.

Elizabeth Drive would be upgraded along with the provision of infrastructure services to the airport within that corridor. Impacts would arise both from the construction of the upgraded road and services and the impacts of increased traffic flow.

A range of influences would occur on property values. Decreases might occur in the Mount Vernon/Horsley Park/Cecil Park area due to aircraft noise, while some properties would benefit from improved services, especially improved road access to the area.

Community Modifications

The Mount Vernon/Cecil Park/Horsley Park local assessment area has undergone significant change over recent years with the introduction of formal rural residential developments and various other pressures on land uses. It will continue to undergo such changes in the future and the pressures are likely to increase due to the economic activity generated by the airport and the investment made in off-site public infrastructure. The most significant direct impacts from the airport would be increases in noise and reductions in air quality. Aircraft overflight noise from Options A and B would impact on the amenity of many localities within the area.

Wallacia/Mulgoa/Sovereign

General Character

The Wallacia/Mulgoa/Sovereign local assessment area is located to the north-east of the airport options adjoining Glenmore Park urban release area to the north and bounded to the west by the Nepean River. The villages of Mulgoa and Wallacia are located within this assessment area and accommodate a range of services and facilities including three churches, one retirement village, three primary schools and two child care centres. Also located within this area is part of Luddenham to the west of The Northern Road, which includes three churches, a community hall, park and the Luddenham Showgrounds (Bringelly Racing Pigeon Club).

Other commercial interests are also located in this area, including boarding kennels, a waste disposal depot and Notre Dame, a theme park. Several recreational facilities are also located within this area including the Glenmore Heritage Valley Golf Course, the Wallacia Golf Club and several local parks and reserves.

This assessment area is traversed by some major items of infrastructure, including a electricity transmission line, and a water supply pipeline, both of which connect to Warragamba Dam. The assessment area borders on the Blue Mountains National Park, a major regional and national recreational resource.

Most residential development is concentrated at Mulgoa and Wallacia, although rural residential development is scattered throughout the assessment area. The environment is generally quiet and rural in nature.

Description of Impacts

The construction of the airport would impact on localities within this local assessment area located east of Wallacia and also properties fronting The Northern Road. Properties located east of Wallacia would experience some construction noise, especially if any activities were conducted at night (refer *Figures* 9.2 and 9.3 of this Supplement). Some impacts from dust might also occur to this area, but would be likely to be effectively controlled by the use of dust control measures during construction (refer Figures 15.7 to 15.9 of the Draft EIS).

The Northern Road would be used for some construction traffic and that section of The Northern Road between Elizabeth Drive and Adams Road would be required to be upgraded to four lanes to maintain existing levels of service. Additional noise would be generated by the construction traffic, but, generally, this additional noise would not represent a discernible increase above existing levels of traffic noise (refer *Section* 9.3.2 of this Supplement).

Once the airport is operating, this local assessment area would experience a range of environmental impacts. Because the area is not directly in line with the parallel runways of any of the airport options, aircraft overflight noise impacts would be less severe than for most of the other local assessment areas examined. For example, the village of Wallacia would be likely to receive a maximum of 39 overflights exceeding 70 dBA on an average day under Options A and B and a maximum of three overflights exceeding 70 dBA on an average day under Option C. Areas further to the north would receive up to three overflights exceeding 70 dBA for Options A and B and up to 29 overflights exceeding 70 dBA on an average day under Option C.

Most of the local assessment area would experience some level of noise from ground operations of aircraft. The area east of Wallacia would receive levels of between 50 and 60 dBA with the area north of Wallacia receiving between 40 and 50 dBA (refer *Figure* 9.1 of this Supplement).

While the operation of the Second Sydney Airport would increase emissions of air pollutants in western Sydney, modelling carried out for the Draft EIS and this Supplement indicates that relevant air quality goals would not be exceeded in the Wallacia/Mulgoa/Sovereign Hill local assessment area.

The major impacts from the provision of off-site infrastructure would arise from the upgrading of The Northern Road to four lanes and the potential relocation of a 330 kilovolt electricity transmission line from within the airport site to a location potentially within this local assessment area. It is estimated that The Northern Road would experience an increase in traffic of approximately 45 percent because of the operation of the airport (comparison of with and without airport in 2016). The upgrading and increased traffic on this road would change the character of the surrounding environment. Access to and across the road might be restricted to maintain efficient traffic flows and traffic noise levels would increase. Noise mitigation measures would be available to reduce the extent of this impact (refer Section 13.4 of Draft EIS). These infrastructure improvements would be subject to further environmental assessment carried out under State legislation.

It is considered unlikely that this area would undergo significant land use modifications resulting from the operation of the airport. In the medium to long-term there will be increasing pressure to expand the southern suburbs of Penrith into the northern parts of this local assessment area. Such influences would be largely unrelated to the development of the airport.

Community Modifications

The most significant impacts arising from the development of the airport on this local assessment area would be likely to be related to aircraft overflight noise, the upgrading and increased traffic on The Northern Road and the potential for the relocation of a 330 kilovolt electricity transmission line from the airport site to within this local assessment area. These impacts would reduce the amenity of certain localities within the local assessment area to varying degrees.

It is not expected that the airport would significantly influence or result in major land use modifications, with the possible exception of creating additional pressure for development along an upgraded The Northern Road.

Benefits would arise from increased economic activity, improved access to jobs and improved services to the area.

Orchard Hills

General Character

The Orchard Hills assessment area is largely occupied by the Department of Defence and used as an armament depot and missile maintenance establishment. The Sydney Water supply pipeline also traverses this assessment area, to the south of which is land that is currently undeveloped, being relatively low-lying. Some specialised uses are located within this area including the Elizabeth Drive Landfill Waste Disposal and Recycling Centre, the University of Sydney's McGarvie Smith Farm and the Sydney Water Orchard Hills Water Treatment Works. Residential development is relatively low density; the majority of it is located to the north of the assessment area in Orchard Hills. Some limited facilities exist within this area: there is one church but no schools.

Description of Impacts

Parts of the Orchard Hills local assessment area would experience impacts during construction of the airport. Areas located south of the Sydney Water supply pipeline would experience construction noise impacts, especially if activities occur at night (refer *Figure* 9.3 of this Supplement). These same areas may experience impacts from dust generated during construction. These would, however, most likely be controlled by dust management measures (refer Figures 15.7 to 15.9 of the Draft EIS).

It is likely that Mamre Road, Luddenham Road and The Northern Road would be used for construction traffic. Additional noise would be created by this traffic, but generally this additional noise would represent less than a two dBA increase above existing levels of traffic noise (refer *Section* 9.3.2 of this Supplement).

Due to the orientation of the runways, Option C would result in the greatest impact on this area as a result of aircraft overflight noise. Depending on the location of individual properties in relation to the runways, areas south of the Sydney Water Supply Pipeline could received between 15 and 192 overflights exceeding 70 dBA on an average day under Option C. Areas to the north of the pipeline would have a reduced impact, but would still receive up to 89 overflights exceeding 70 dBA on an average day. The impacts of Options A and B would be significantly less with the area receiving a maximum of 21 overflights exceeding 70 dBA on an average day. The area south of the Sydney Water Supply Pipeline would also receive noise from ground operations of aircraft of between 50 and 60 dBA with the area north of the pipeline receiving noise levels of between 40 and 50 dBA (refer *Figure 9.1* of this Supplement).

While the operation of the Second Sydney Airport would increase emissions of air pollutants in western Sydney, modelling carried out for the Draft EIS and this Supplement indicates that relevant air quality goals would not be exceeded in the Orchard Hills local assessment area.

Water quality within South Creek would not be significantly affected by the construction and operation of the airport (refer *Chapter 13* of this Supplement). Should, however, further urban development be proposed in the South Creek Valley as a response to the development of the airport or for other reasons, cumulative impacts on water quality in South Creek Valley would be a significant environmental issue.

Traffic using Luddenham Road could increase by more than 10 times due to the operation of the airport. The road would be required to be upgraded to four lanes. Traffic noise impacts to adjoining properties would be likely to be significant and noise mitigation measures would need to be considered during the environmental assessment and design of the upgrading of the road.

The hazards and risks created by the operation of Option C could influence some activities within Defence Establishment Orchard Hills. These changes would be unlikely to significantly influence the general character of the local assessment area.

Community Modifications

The major influences of the airport on the character of the Orchard Hills local assessment area would be from the impacts of aircraft overflight noise, especially due to the operation of Option C, and the upgrading of local roads and the increased traffic that would use those roads. A range of impacts would occur to properties within the area, leading to a reduction in residential amenity and a change to the overall character of the area.

Camden Rural Lands

General Character

The Camden Rural Lands assessment area is located to the south of the sites of the airport options. It borders suburbs forming part of Camden, including Narellan, Smeaton Grange, Currans Hill and Elderslie. The western boundary of the assessment area is formed by the Nepean River. To the east, but not falling within the assessment area are the new suburbs of Eschol Park, Kearns, Raby and Eagle Vale.

While much of this area is rural in nature, there are some special uses, including the Oran Park Motor Racing Circuit, Camden Airport and recreational uses such as the Cobbitty Polo Club, the Camden Lakeside Golf Course, the Rugby League Country Club and El Caballo Blanco.

The area is traversed by several electricity transmission lines and includes a water supply channel which extends through part of the area to the east.

Residential density is generally low, with several communities scattered throughout the area, including Cobbitty, Catherine Fields and Leppington. These communities provide basic facilities, including a total of three primary schools, two child care centres and three tertiary establishments. The assessment area also accommodates two churches in Cobbitty and Leppington. Open space is restricted to local ovals and reserves in the aforementioned villages.

Description of Impacts

The Camden Rural Lands assessment area is unlikely to be affected by the construction of the airport, with the exception of local residents and businesses potentially taking advantage of the economic and employment opportunities created by the construction activities.

The direct environmental impacts of the operation of the airport would vary, depending on the airport option selected and the location of particular properties. For example, the southern parts of the local assessment area are estimated to receive less than one aircraft overflight exceeding 70 dBA on an average day. Under Options A and B some localities could receive up to 46 overflights exceeding 70 dBA on an average day. In contrast, under Option C areas to the north of Cobbitty adjoining the Bringelly/Rossmore/Austral local assessment area would receive up to 126 overflights exceeding 70 dBA on an average day. These areas would also be impacted by levels of noise from ground operation of aircraft of approximately 45 to 50 dBA (refer *Figure 9.1* of this Supplement).

While the operation of the Second Sydney Airport would increase emissions of air pollutants in western Sydney, modelling carried out for the Draft EIS and this Supplement indicates that relevant air quality goals would not be exceeded in the Camden Rural Lands local assessment area.

As a result of the relatively poor infrastructure provision within the majority of this assessment area, it is unlikely that the development of the airport would significantly increase pressure for major land use changes. Such pressure would, however, increase in the area north of Catherine Field should a rail line to the airport be developed through this area. Both the development of the rail line and any subsequent urban development would result in a range of adverse and beneficial environmental impacts.

Community Modifications

The two major influences of the airport on the Camden Rural Lands assessment area would arise from the impacts of aircraft noise, especially from the operation of Option C, and the potential development of a rail line to the airport through the northern part of the assessment area. The extent of the impacts caused by these factors and the resulting change in character of the local assessment area would vary significantly depending on the location of properties within the local assessment area.

Warragamba/Silverdale/Werombi

General Character

The Warragamba/Silverdale/Werombi local assessment area is located south-west of the sites of the airport options. Located within this area are the villages of Warragamba and Silverdale. Elsewhere, residential densities are low, with dwellings scattered throughout the remainder of the assessment area. Some basic facilities are located within each of the villages and include three churches, a primary school and a child care centre. Three other churches are also located within the assessment area and five tertiary educational establishments. The main road through the area is Silverdale Road which links Wallacia in the north to Wollondilly in the south. The reserves and picnic areas within Warragamba serve a regional function for open space. Some local reserves and open space exist within Silverdale and Warragamba, but apart from recreational facilities at Warragamba Dam there are no other major local or regional areas of open space located here.

Much of the assessment area is located within the Warragamba catchment area. To the west is the Burragorang State Recreation Area. Most development is concentrated within the communities of Warragamba and Silverdale. Other land uses include agricultural activities, quarries and industrial (waste disposal depot and sub-station).

Description of Impacts

The Warragamba/Silverdale/Werombi assessment area would be unlikely to be adversely affected by the construction of the airport with the exception of local residents and businesses potentially taking advantages of the economic and employment opportunities created by the construction activities.

The direct environmental impacts of the operation of the airport would vary depending on the airport option selected and the location of particular properties. For example, the southern parts of the local assessment area are estimated to receive less than one aircraft overflight exceeding 70 dBA on an average day. The impact of aircraft overflight noise would be most severe under Options A and B. Some localities might receive up to 121 overflights exceeding 70 dBA on an average day. In contrast, under Option C, this local assessment area would receive up to 18 overflights exceeding 70 dBA on an average day. These areas would also be impacted by levels of noise from ground operation of aircraft of approximately 45 to 50 dBA (refer *Figure 9.1* of this Supplement).

Modelling undertaken for this Supplement predicts that when operating at 30 million passengers per year, the airport would give rise to increased ozone concentrations in areas 10 to 50 kilometres to the west of the airport, in the late afternoons of days when retarded seabreezes bring photochemically old air into western Sydney. This effect would impact on the southern parts of the Warragamba/Silverdale/Werombi local assessment area (refer *Figure 11.4* of this Supplement). These ozone impacts due to the operation of the airport are predicted to occur about 25 times (on average) per year, typically for approximately one hour, with increases of one part per hundred million in ground level concentrations. The health impacts associated with this increase in levels of ozone are described in *Chapter 23* of this Supplement.

It is considered unlikely that the airport would have a major influence on land uses within this local assessment area. The area is generally poorly serviced and remote from urban centres. The local assessment area would not be adversely impacted by or would not significantly benefit from the provision of off-site infrastructure to service the airport.

Community Modifications

The character of the villages of Warragamba and Silverdale are likely to change significantly, especially under Options A and B, due to the impact of aircraft overflight noise. A large number of rural residential properties and some recreational areas would also suffer from a significant decline in amenity. This would represent a significant change to the currently peaceful rural setting of these villages and properties. The area would not be adversely impacted by the provision of off-site infrastructure, nor would it gain significant benefits from such investments.

24.4 Response to Social Issues

Issues raised in submissions on the Draft EIS, and not directly addressed as part of the preceding assessment within this Chapter, were:

- the influence of community consultation on the social impact assessment;

- the extent of the social impact assessment area;
- the adequacy and accuracy of land use and population assumptions used in the social impact assessment;
- impacts on recreational opportunities not adequately considered;
- impacts on potential native title claimants;
- impacts on radio and television reception; and
- assessment of the combined effects of Sydney Airport and a Second Sydney Airport at Badgerys Creek.

The adequacy and accuracy of land use and population assumptions used in the social impact assessment and for the assessment of other environmental issues is addressed in *Chapter 7* of this Supplement. Details of potential major title claimants are addressed in *Chapter 17* of this Supplement. A discussion of the combined noise effects of Sydney Airport and the Second Sydney Airport is contained in *Chapter 8*.

24.4.1 Influence of Community Consultation on Social Impact Assessment

As described in Chapter 12 of *Technical Paper No. 2* social impacts will differ, depending on the type of development proposed and the range of issues associated with it. Social impacts can be defined within the EIS process, whereby the affected communities assist in defining issues and priorities. Social impact should, therefore not be based on an academic approach to social research, but rather be based on the range of issues identified by community response and arising from investigations conducted as part of the environmental assessment process.

For the social impact assessment conducted for the Second Sydney Airport proposal, consultations with potentially affected communities took place while preparing the Draft EIS. *Technical Paper No. 1* provides details of the extent and nature of the consultation process adopted and the major issues arising from the consultation. The parameters of the social impact assessment were then defined from the issues raised during the process and used to inform the environmental impact assessment.

24.4.2 Social Impact Assessment Area

Comment was made in submissions that the area examined for the social impact assessment was not extensive enough and should have included areas such as Blacktown. The Draft EIS and this Supplement examine a range of impacts on the region surrounding the airport sites and on the broader Sydney region. This range of impacts would include both biophysical and socioeconomic impacts. It is not possible to provide a specific analysis of the potential land use and social changes that may occur in established urban areas in excess of 10 kilometres from the airport site. For the most part, it is considered that these areas are likely to be more influenced by the beneficial economic consequences of the airport rather than individual biophysical and noise related impacts.

24.4.3 Impacts on Recreational Opportunities

Section 24.3.3 contains a discussion on potential impacts of some recreational facilities within the local assessment areas, especially the Bents Basin State Recreation Area. Recreational resources in western Sydney were identified in the Draft EIS and *Technical Paper No. 2*. Major resources located in the region surrounding the airport sites include (refer *Figure 24.2*):

- Blue Mountains National Park - 2,200,000 visitors per year;
- Bents Basin State Recreation Area - 60,000 visitors per year;
- Burragorang State Recreation Area - 50,000 visitors per year; and
- Western Sydney Regional Park - visitation figures not available (National Parks and Wildlife Service, 1994a and b).

The most significant impact of the operation of the airport would be the impacts of aircraft overflight noise on the Bents Basin State Recreation Area which is discussed in *Section 24.3.3*. Impacts on the Blue Mountains National Park and Burragorang State Recreation Area would not be as significant, as discussed in Section 12.4.2 of the Draft EIS and *Section 8.4.4* of this Supplement.

24.4.4 Impacts on Radio and Television Reception

The extent to which radio and television reception might be disrupted cannot be accurately quantified. This would be dependent on the type of aircraft, the height at which aircraft are travelling, the relative position of radio and television masts, the airport option selected, the flight paths adopted for the airport and on a particular day, the utilisation of the runways in relation to meteorological effects. It is however, likely that there might be disruption to some radio and television reception for communities immediately adjoining the proposed airport, especially if they are immediately under the flight paths, aligned with the runways for the various options. The Noise Complaint Unit at Sydney Airport reports periodic complaints regarding this matter, especially if a lesser use runways (the east-west cross runway) is utilised (Sydney Airport Noise Complaint Unit, 1998, *pers. comm.*).

24.5 Overview of Social and Cumulative Impacts

The potential social impacts of the proposed Second Sydney Airport include effects on individuals, on communities, and on specific facilities. The major impacts would be:

- potential relocation of existing residents and reordering of future urban release areas – both these measures would result in changes to the population of areas affected;
- subsequent change in demand for and potential closure of community services and facilities;
- loss of residential amenity and impacts on quality of life;
- potential impacts arising from severance, due to the access corridors required to service the airport; and
- reduction in ability to use community facilities, in particular open space and recreation areas.

Significant social impacts would arise from all of the airport options. The effects on individuals would vary depending on the value they give to a range of different factors that influence their quality of life, and their reaction to changes in those factors.

The total impacts of the Second Sydney Airport proposal, including both direct impacts and cumulative impacts, would vary significantly from area to area. At a local level, communities immediately surrounding the airport site, such as Luddenham,

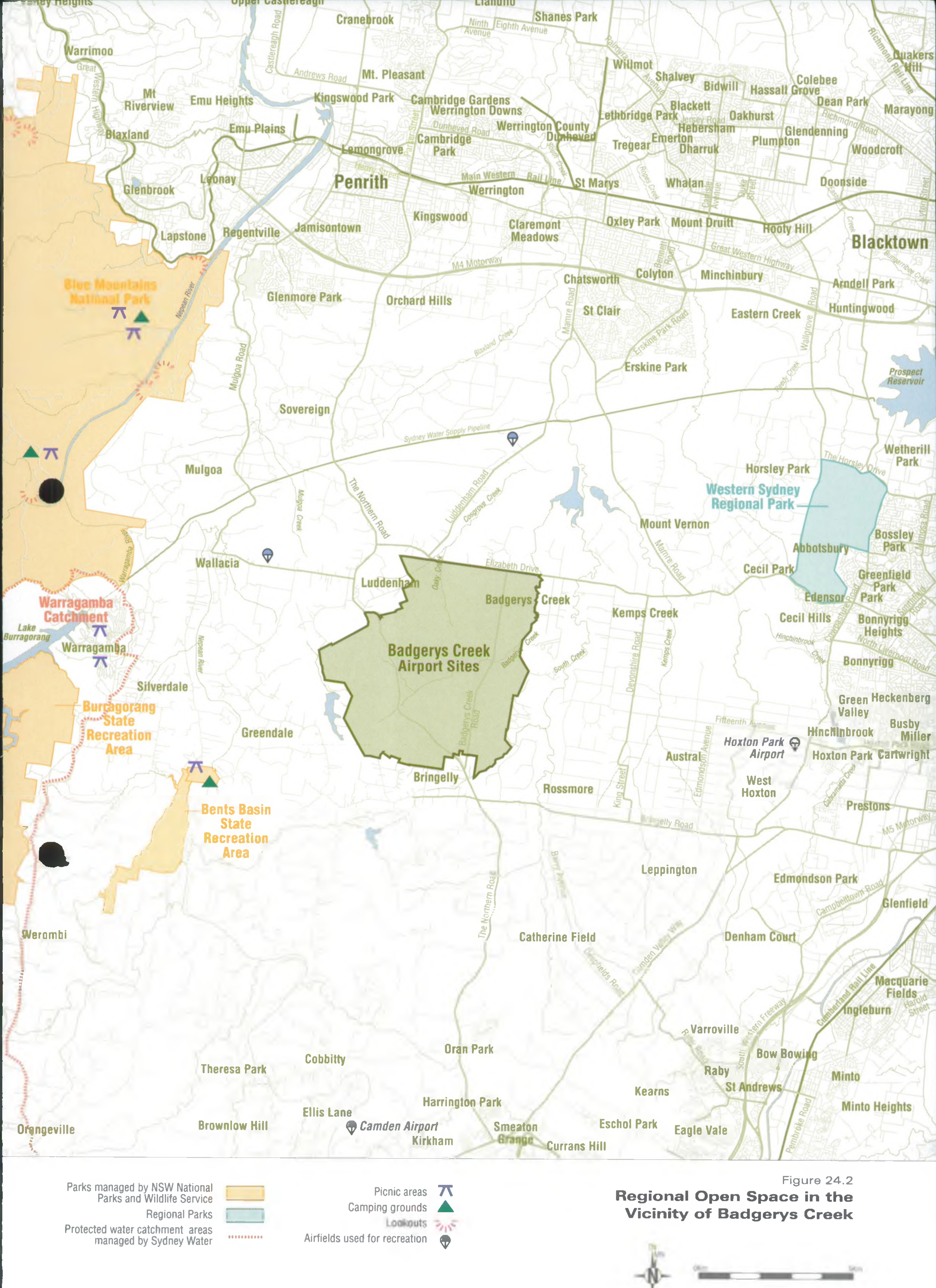


Figure 24.2
Regional Open Space in the Vicinity of Badgerys Creek

Badgerys Creek, Kemps Creek, Rossmore, Bringelly and Greendale would experience significant direct biophysical and social impacts from both the construction and operation of the airport. These would include:

- dust generated during construction;
- construction noise;
- significant aircraft overflight noise and ground operation noise; and
- degradation of air quality to a level which suggests that relevant air quality goals in some areas may not be met.

In addition, these local areas would experience impacts from a range of activities that would be consequential to the development of the airport, including the upgrading of roads, increased traffic on those roads, the potential provision of a rail link and the provision of other services to the airport. The development of the airport and the provision of these services would create pressure on authorities to allow various forms of urban development to occur in these areas. Should such development be allowed, a range of both beneficial and adverse impacts would result. These would include:

- biophysical impacts, especially in relation to water quality and air quality;
- significant changes in the character and amenity;
- changes to land values, probably both increases and decreases; and
- a range of social benefits from the improvement in the provision of transport links, other urban services and increased economic activity and improved access to jobs.

Most activities influence and change a variety of other human activities. A proposal of the scale of the Second Sydney Airport would influence many other activities in the Sydney region and potentially other activities throughout NSW and Australia. These changes to other activities would result in a variety of impacts, both adverse and beneficial. These regional cumulative impacts of the airport proposal have been identified and discussed on the basis of the pressure on a range of environmental resources (land and social structures, air, water and biodiversity) that might be exerted by:

- the development of the airport;
- consequential activities related to that development; and
- other activities that are planned for the western region of Sydney.

The construction of the Second Sydney Airport would contribute to short-term degradation of biodiversity and water quality in western Sydney through the clearing of vegetation and construction-related water impacts. Through the adoption of appropriate management measures, however, the proposal would contribute to the rehabilitation and long-term protection of important vegetation communities and would make a positive contribution to improving water quality in the South Creek Valley and in the wider Hawkesbury Nepean River system.

The operation of the Second Sydney Airport and the motor vehicle traffic generated by the airport would be significant contributors to emissions of air pollutants in Sydney. At its peak level of activity (30 million passengers per year) the airport and the motor vehicle traffic it generates would emit the following amount of Sydney's emissions (1992 estimate) of air pollutants: approximately six percent of oxides of nitrogen, three percent of carbon monoxide, two percent of sulphur dioxide, two percent of hydrocarbons and three percent total suspended particulates. Relevant goals for nitrogen dioxide and particulate matter in the immediate vicinity of the airport (within one to two kilometres) would be exceeded on occasions. Exceedences of the goal for ozone would also occur, in an area to the west of the airport site, generally located west of Camden and over the Blue Mountains. Annual greenhouse gas emissions from the airport are predicted to be equivalent to 0.3 percent of total NSW gas emissions on the basis of current NSW projections extrapolated to 2016.

The most significant biophysical and social regional cumulative impacts that would arise indirectly from the development of the airport would be modifications to metropolitan planning strategies. Such modifications could include further urban development of South Creek Valley.

The NSW Government's recently released *Planning Strategy for the Greater Metropolitan Region of Sydney, Newcastle, Wollongong and the Central Coast* (Department of Urban Affairs and Planning, 1998a) and the accompanying Planning *Strategy for Western Sydney* (Department of Urban Affairs and Planning (1998b) acknowledges the potential for the development of the Second Sydney Airport at Badgerys Creek, but does not provide planning policies or initiatives to take advantage of the benefits or manage the adverse effects of the airport proposal. If the airport is to proceed, such a planning response would be required and would need to involve inputs from local, State and Commonwealth governments as well as community stakeholders.

Western Sydney is and will continue to undergo significant change. Existing strategic planning suggests that over the five-year period to 2002, 53,000 new houses will be constructed in western Sydney (Department of Urban Affairs and Planning, 1998b). Should the Second Sydney Airport proceed, strategies would need to be developed to ensure that the Second Sydney Airport either enhances targeted outcomes for western Sydney, or appropriate environmental management measures are adopted to ensure that the achievement of outcomes are not compromised. The planning response to the Second Sydney Airport would need to examine how the airport and associated development could best achieve the strategic planning outcomes identified by the NSW Government for Western Sydney (Department of Urban Affairs and Planning, 1998b). Examples of stated planning outcomes for western Sydney that might be enhanced include:

- growth in employment opportunities across all sectors;
- improved access to employment; and
- the development of a central industrial/warehousing/employment zone as a major employment and freight centre.

Examples of outcomes which would require the adoption of appropriate environmental management measures for the Second Sydney Airport to ensure that the outcomes are not compromised include:

- improved air quality through better transport, industry and housing practice creating a more compact city that is less reliant on car use;
- improved water quality through improved stormwater management, urban design and sewage systems;
- protection and management of waterways and riverine corridors on a sustainable basis;

- protection of biodiversity outside of the reserve system; and
- protection of Aboriginal and non-Aboriginal heritage.

The consequences of the biophysical and socioeconomic changes that would result from the operation of the Second Sydney Airport would not only be dependent on the scale and nature of the direct and cumulative impacts, but also the overall timing and rate of change. The analysis documented in *Chapter 4* of this Supplement in relation to air traffic forecasts and the aircraft movement capacity of Sydney Airport suggests that it is unlikely that the Second Sydney Airport would reach its planned operating limit of approximately 30 million passengers per year until at least the 2020s or 2030s. Therefore, many, but not all, of the direct and cumulative impacts of the airport proposal would result in gradual changes to the human and biophysical environments, with such change potentially occurring over a period of 20 to 30 years. Such a rate of change would improve the capacity of governments and the community to manage adverse consequences and take advantage of potential benefits.

PART H

Environmental Management

Chapter 25

Overview of Environmental Management

Chapter 25
Overview of Environmental Management

25.1 Summary of the Draft Environmental Impact Statement

The Draft EIS outlined an approach to environmental management of the Second Sydney Airport and provided an overview of the principles and requirements to be integrated into a management system. The aims of environmental management of the Second Sydney Airport were to reduce the environmental impacts of the proposal and increase public amenity over time.

Environmental management in the Draft EIS was based on the adoption of an 'environmental management system' which would conform to the requirements of ISO 14000, a recognised international best practice standard. The environmental management system would be a 'living' system with mechanisms in place to regularly review and update the relevant components. The basic components of the system were identified in the Draft EIS, and would be further developed and refined during the design stages of the airport.

Parts D, E, F and G of the Draft EIS assess the impacts from a Second Sydney Airport at Badgerys Creek and provide for a range of management measures based on the principles of ecologically sustainable development. An indicative list of environmental management measures was included in Appendix G of the Draft EIS, drawing together the mitigation measures recommended in the Draft EIS.

The regulatory arrangements for leased Commonwealth airports are established under the *Airports Act 1996* and Regulations made pursuant to the Act. The Act sets various planning, environmental and building control requirements including requiring a company holding a lease for a Second Sydney Airport to submit an airport master plan and an airport environmental strategy for approval by the Minister for Transport and Regional Services.

The Draft EIS identified the need for the environmental management of the Second Sydney Airport to consider the existing economic and urban structure of western Sydney and the future planning of the region. Local, State and Commonwealth Government responses to environmental issues would be required to assist in achieving acceptable environmental management of the Second Sydney Airport and to help ensure the future development of western Sydney proceeds in accordance with the goals of Sydney's metropolitan planning strategy *Cities for the 21st Century* (Department of Planning, 1995).

25.2. Summary of Environmental Management Issues

25.2.1. Issues Raised in Submissions

Environmental Management Framework

Submissions from organisations such as Liverpool City Council and the Western Sydney Alliance suggested that the environmental management framework should include a definition of the organisations responsible for environmental management of site operations, the roles and responsibilities of Commonwealth, State and local governments and how the provisions of ISO 14001 would be implemented on the site.

Environmental Management Measures

Submissions on the Draft EIS expressed concern over the lack of detail in the mitigation measures contained in Appendix G of the Draft EIS.

The EIS Guidelines outlined a number of environmental management measures which should be addressed in the EIS. The submission from the Bankstown and Environs Airport Resistance, amongst others, considered that some of these management measures were not adequately addressed. Submissions stated that measures proposed to mitigate and monitor the proposal's adverse impacts were not considered adequately and, it was suggested, did not draw together a clear statement of specific mitigation proposals. The likely effectiveness and secondary effects of the proposed safeguards and monitoring programs, costs of mitigation measures and opportunities to improve the existing environmental qualities within the impacted environment were also considered by some submissions to be inadequately addressed in the Draft EIS. Some submissions expressed concern over the possibility that environmental management may be abandoned at a political whim.

Environmental Management in the Context of Ecologically Sustainable Development

Submissions from Communities Against an Airport in Western Sydney, the Total Environment Centre, the NSW Government and the Western Sydney Alliance, among others, expressed concern over the lack of attention to the principles of ecologically sustainable development when applied to assessment of impacts from environmental issues and development of mitigation measures.

In accordance with the principles of ecologically sustainable development, it was suggested in submissions that comprehensive mitigation measures should be incorporated into the environmental management plan, despite the lack of full scientific certainty in the analysis of impacts. A key objective of such a plan for the airport was considered to be the need to improve the environment, as opposed to maintaining existing conditions. Some submissions also considered that no attempt was made to place an economic value on environmental factors, except for noise.

25.2.2. Issues Raised by the Auditor

The Auditor assessed that the Draft EIS did not adequately address the EIS Guidelines for environmental safeguards, monitoring proposals and environmental management plans. Safeguards specifically identified as not being addressed included greenhouse gas emissions, changes to groundwater and flooding, disruption to surface traffic and mitigation of deleterious impacts on recreational and community activities. The Auditor also considered that many of the environmental safeguards contained in Appendix G of the Draft EIS were vague and non-specific.

The Auditor recommended organisations responsible for environmental management be identified, and that the environmental management system include reference to whether or not the environmental management plans would be regularly reviewed in light of operational experience.

The Auditor also criticised the presentation of the information, as it was considered that the measures proposed to mitigate and monitor the proposal's adverse impacts were not drawn together in a clear statement of specific mitigation proposals.

Finally, the Auditor sought clarification regarding who would be responsible for meteorological monitoring and what would be done with the results afterwards, as well as the cost of the monitoring programs.

25.3 Approach to Environmental Management

25.3.1 Overview of Legislation and Regulation

Commonwealth Legislation

The *Airports Act 1996* establishes a Commonwealth environmental management regime at leased Commonwealth airports. The main elements include regulations providing standards and duties in relation to environmental pollution, the requirement for environment strategies for each airport and the appointment of an Airport Environment Officer with responsibility for ensuring the monitoring and remediation of pollution. An "airport site" is defined by the Act as one that is declared by the regulations, and is a Commonwealth place used, or intended to be developed, for use as an airport. Under *Section* 6 of the Act specific provisions are made for a "Sydney West Airport" which is to be taken as an airport at a particular time even if, at that time, it is merely intended to be developed for use as an airport or is being developed for use as an airport.

Section 98 of the *Airports Act 1996* covers all major airport works, such as building works, earthworks and engineering and electrical work that take place on an airport site. This Act would apply to the construction and operation of the Second Sydney Airport.

Furthermore, *Section 112* of the *Airports Act 1996* excludes State and Territory laws on land use, planning and regulation of building activities to which the Act applies. *Section 136* of the *Airport Act 1996* allows for State and Territory environment law to apply to a leased Commonwealth airport, except in those cases where the Commonwealth has regulated for a specific area. The Commonwealth has regulated for environmental management and pollution control on leased airports and hence State and Territory environmental law in these areas does not apply, with the exception of activities detailed in the following section.

The *Airports (Building Control) Regulations* set out the process for the approval of building and works applications and enable conditions to be placed on the granting of building or works approvals, including environmental conditions.

The *Airports (Environment Protection) Regulations* provide a framework for environmental management and control of pollution for leased Commonwealth airports. These regulations:

- set standards and impose duties in relation to environmental pollution (dealing with air, water and soil quality and on-ground noise emissions);
- authorise the monitoring and remediation of breaches of the environmental standards; and
- support better environmental outcomes at leased Commonwealth airports.

In conjunction with the *Airports (Building Control) Regulations*, the *Airports (Environment Protection) Regulations* would comprehensively cover the impacts associated with the construction and operation of a Second Sydney Airport. This will ensure that a uniform approach to management and required environmental performance is achieved across all Commonwealth leased airports.

Relationship to State Environmental Legislation

As described above, the *Airports Act 1996* excludes State or Territory legislation on land use, planning and regulation of building activities to which the Act applies. Under *Regulation 1.04* of the *Airports (Environment Protection) Regulations*, State legislation which makes provision for matters covered under the Act has no effect on an airport site declared under the Regulations. The following areas of environmental management are not addressed by the Regulations:

- emissions from engines or noise generated by aircraft in-flight, taking off, landing and taxiing at an airport. These issues are dealt with under *Air Navigation (Aircraft Engine Emissions) Regulations* and *Air Navigation (Aircraft Noise) Regulations* which are administered by the Department of Transport and Regional Services; and
- motor vehicle pollution, waste disposal, disposal of hazardous materials, ozone depleting substances, the use and sale of pesticides and occupational health and safety issues. These are covered by respective State legislation and regulated by the relevant State authority where the airport is situated.

Responsibility for Environmental Management of Airports

Under the *Airports Act 1996* all staff (and companies) operating at the airport would be required to comply with a general duty to ensure that habitat, flora and fauna, ecosystems, endangered species and sites of indigenous and heritage significance are properly protected. The *Airports Act 1996* applies penalties for environmental harm.

The *Airport (Environment Protection) Regulations* aim to establish a co-operative approach to environmental management on airports. The intent is to promote awareness of environmental issues, improve environmental management practices and ensure that management systems are in place to deal with the pollution, including noise, soil, water and air quality, produced by, and on, airports, with a view to reducing those environmental impacts and increasing public amenity over time. This approach places the responsibility for positive environmental outcomes on the airport lessee company, its tenants and airport users. In accordance with current "best practice" environment regulation, the regime is less a matter of prescriptive rules and penalties for non-compliance, and more a matter of broad duties and obligations to maintain and improve the environmental health of the airport.

The airport lessee company would have responsibility for protecting the environment through development and implementation of an airport environment strategy. The strategy would be consistent with the general approach to environmental management based on ISO 14000, as shown in *Figure 25.1*. The strategy must set out comprehensively how the airport would be operated so that its environmental performance can be maintained or improved. In particular, the strategy would specify:

- environmental management objectives;
- identified sites of environmental and indigenous significance;
- environmental management training considered necessary for persons employed on the airport site by the airport operator;
- sources of environmental impact;
- studies, reviews and monitoring to be carried out including timeframes; and
- the specific measures (and associated timeframes) that the airport operator proposes to adopt to prevent, control or reduce environmental impacts.

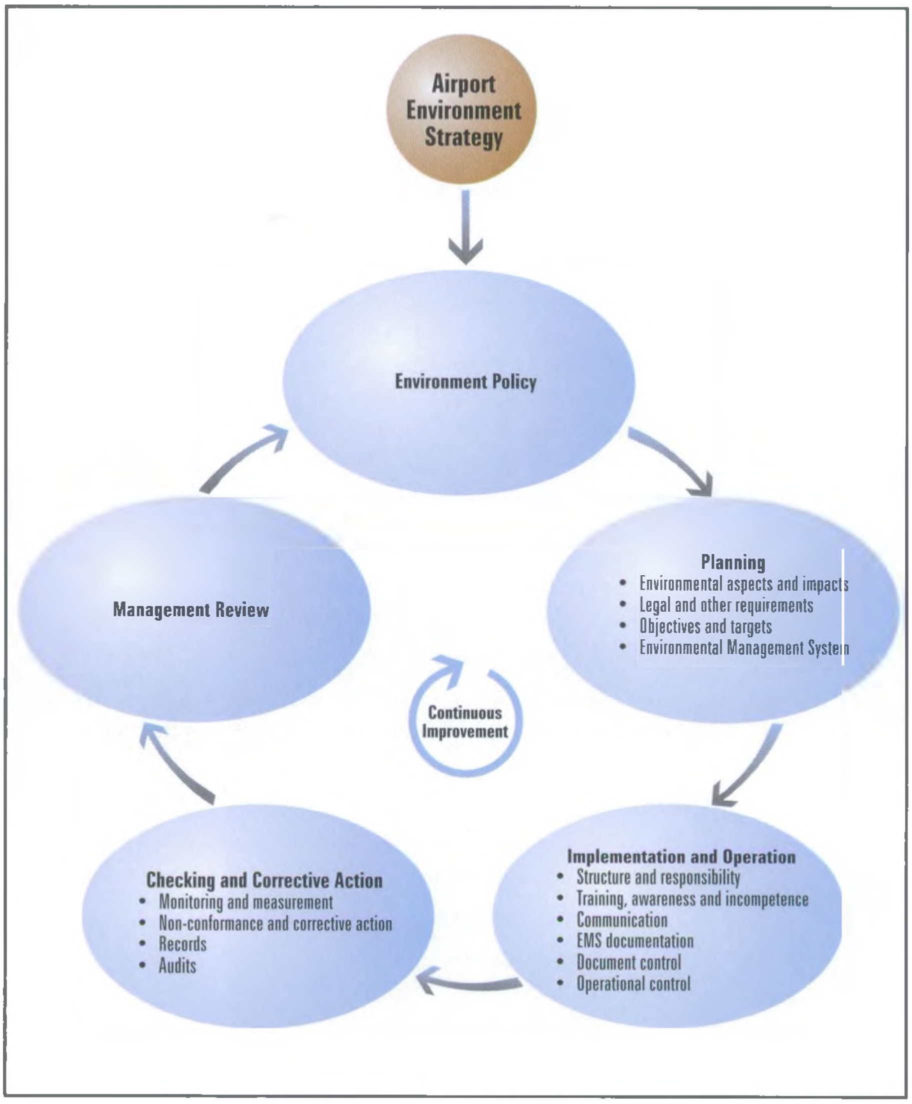


Figure 25.1
Airport Environment Strategy (Based on ISO 14001)

This strategy would be subject to the approval of the Minister for Transport and Regional Services and must be submitted for public comment through a statutory public consultation process. The airport lessee company must have due regard to comments received prior to submitting the airport environment strategy to the Minister for approval. Following approval, the airport lessee company and other users of the airport must take all reasonable steps to comply with the airport environment strategy.

The airport lessee company would also be required to investigate and monitor the environmental performance of their airport using environmental standards, to record information in an environmental site register and to report the results of this monitoring to the Department of Transport and Regional Services.

This includes details of any pollution that exceeds the safe limits, and details of any remedial action that has been taken to prevent or minimise the pollution or its recurrence.

While the primary obligation to monitor the levels of pollution and noise fall on the airport lessee company, occupiers of land at airport sites would also have obligations to monitor the environmental effects of their own activities and report results to the airport lessee company.

The Department of Transport and Regional Services would regulate the day to day environmental management process at the Second Sydney Airport. The Secretary of the Department would appoint an Airport Environment Officer, with suitable qualifications and experience, to administer the environmental requirements of the airport lessee company, tenants and airport users. The Airport Environment Officer would be responsible for the day-to-day administration of environmental controls. To perform their job, the Airport Environment Officer would be authorised to exercise powers under *Part 18* of the *Airports Act 1996* in relation to monitoring and searches, and would be able to make decisions, under the *Airports (Environment Protection) Regulations* in relation to such matters as the grant of authorisations, land contamination investigation, directions to remediate, issue of environmental protection orders and directions to comply with authorisations. The Department of Transport and Regional Services has responsibility for oversight of the Airport Environment Officer and for enforcement of any breaches of the Regulations.

25.3.2. Environmental Management Framework

Key Components of the Environmental Framework

It is proposed that the environmental management framework for the airport would primarily consist of three components as depicted in *Figure 25.2:*

- the preparation of an environmental management plan for construction consistent with the requirements of the *Airports (Environment Protection) Regulations* and *Airports (Building Control) Regulations* for the construction of the airport. This would include the appointment of an Airport Environment Officer and Airport Building Controller (who are statutory officers under the *Airports Act 1996*) who would be responsible for regulating the management of the on-airport environmental impacts of construction;
- the preparation of an airport environment strategy as required by the *Airports Act 1996* dealing with operational environmental issues within the airport boundary, that is on-ground environmental issues; and
- the development of a 'Noise Management Plan' prior to the commencement of airport operations to minimise aircraft noise impacts having regard to the safety and efficiency of airport operations. In developing the Plan the desirability and practicability of a range of noise management measures would be examined. These include:
  - the determination of flight paths;
  - the determination of runway use;
  - the provision of periods of respite from aircraft noise;
  - the management of the numbers of aircraft overflights;
  - the control of the loudness of noise events;

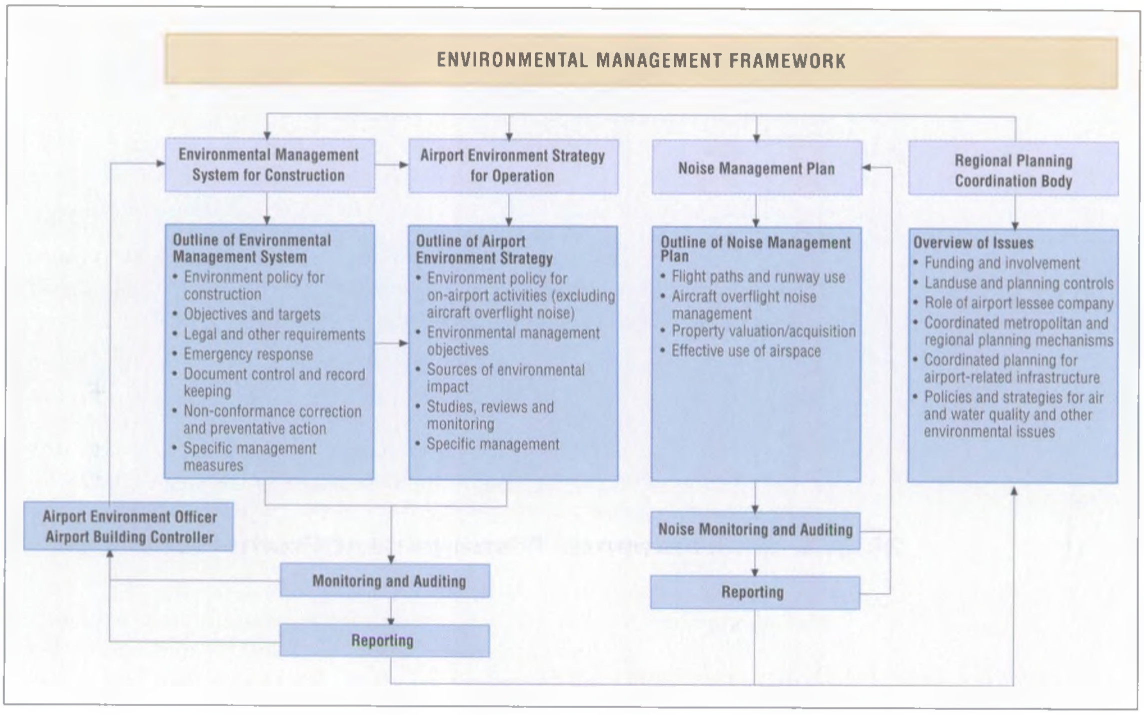


Figure 25.2
Environmental Management Framework

- the management of noise at night;
- the insulation and/or acquisition of buildings exposed to the highest noise levels;
- the imposition of a noise levy to fund noise amelioration works;
- the establishment of a permanently staffed Noise Enquiry Unit at the Airport;
- the installation of a satisfactory noise and flight path monitoring system; and
- the effective use of airspace associated with the operation of civil and military aircraft from other airports.

The Noise Management Plan would be prepared by the airport lessee company in conjunction with Airservices Australia and in accordance with a Consultation and Communications Strategy which would seek to:

- help the airport lessee company and Airservices Australia reach better decisions regarding the issue of aircraft overflight noise and the selection of methods, mechanisms and operating plans to mitigate aircraft overflight noise impacts;

- inform the community of airport operation plans and discussions;
- provide opportunities for community involvement at a national, state and local level to broaden the information base on which decisions are made; and
- establish a community liaison forum to discuss and work towards resolving issues related to the Plan.

In addition, a regional planning co-ordination body would be established to help ensure that any associated off-site development within the airport sub-region and any other planning or development initiatives undertaken by State, local government or other agencies is undertaken in an environmentally sensitive and co-ordinated manner. This body would form the fourth component of the environmental management framework. The following matters would need to be considered by a regional planning co-ordination body established to address planning and land use issues in the region surrounding the Second Sydney Airport:

- the appropriate level of funding and involvement to be provided in support of the regional planning co-ordination body;
- the appropriate application of land use and planning controls to development proposed in areas affected by aircraft noise in accordance with *Australian Standard 2021 - 1994*;
- the possibility of incorporating a concurrence role in local, regional or State environmental planning instruments for the airport lessee company for certain types of development within areas affected by aircraft overflight noise greater than 25 ANEC;
- the appropriate mechanisms for ensuring coordinated metropolitan and regional planning, having regard to the potential interaction of the metropolitan urban development program and any urban development proposed to be located along a rail link to the airport;
- the appropriate mechanisms for ensuring airport-related infrastructure is planned and coordinated in accordance with the requirements of the various provider agencies; and
- further consideration of policies and strategies to address air and water quality issues associated with future urban development in the region surrounding the Second Sydney Airport.

Overview of Environmental Management System for Airport Construction

An environmental management plan would be developed and implemented for the construction of a Second Sydney Airport. The plan would be consistent with the requirements of the *Airports (Environment Protection) Regulations* in respect to the protection and management of the environment as described in *Section 25.3.1* of this Chapter. The plan would contain the following elements:

- environmental policy;
- organisational commitment;
- objectives and targets;
- legal and other requirements;
- environmental management plans for specific issues;

- responsibilities and reporting structure, including all contractors and sub-contractors;
- training and awareness;
- document control and record keeping;
- emergency response;
- non-conformance, correction and preventative action;
- environmental monitoring, compliance and review audits; and
- communications, including community consultation.

Construction of the airport would not commence until the Minister for Transport and Regional Services was satisfied that the environmental management plan had identified all relevant legislative requirements; was consistent with the undertakings and conditions of approval following the determination of the Second Sydney Airport proposal; and had been subject to a process of public comment and review.

The environmental management plan would clearly assign responsibilities for specific management plans and actions to the lead authority/airport lessee company responsible for the construction of the Second Sydney Airport. The Airport Environment Officer and the Airport Building Controller would be responsible for regulating the management of airport environmental impacts associated with construction.

Overview of Environmental Management System for Airport Operation

Airport Environment Strategy

Development of an Airport Environment Strategy is required under *Part* 6 of the *Airports Act 1996*. The airport environment strategy would be the key mechanism for controlling all operational impacts. Responsibility for preparing and implementing the airport environment strategy would rest with the airport lessee company. It would be implemented prior to the airport commencing operation.

The airport environment strategy would include policies and targets for:

- continuous improvement in the environmental consequences of activities at the airport;
- progressive reduction in existing pollution at the airport;
- development and adoption of a comprehensive environmental management system for the airport that maintains consistency with relevant Australian and international standards (that is, ISO 14 000 series);
- identification and conservation, by the airport operator and tenants, of areas of natural, indigenous or heritage value;
- involvement of the local community and airport users in the development of the strategy; and
- dissemination of the strategy to tenants, airport users and the local community.

The development of the Airport Environment Strategy must identify environmentally significant areas within the airport site, including:

- any relevant recommendation of the Australian Heritage Commission;

- any relevant recommendation of the Commonwealth environment portfolio regarding biota, habitat, heritage or kindred matters; and
- any relevant recommendation of a body established in the State in which the airport is located, having responsibilities in relation to conservation of biota, habitat, heritage or kindred matters.

The Strategy must also identify the sources of environmental impact associated with the operation of the airport and, as the case requires, must address:

- the quality of air at the airport site, and in so much of the regional airshed as is likely to be affected by airport activities;
- water quality, including potentially affected groundwater, estuarine waters and marine waters;
- soil quality, including that of land already known to be contaminated;
- release into the air of substances that deplete stratospheric ozone;
- generation and handling of hazardous waste and any other kind of waste;
- usage of natural resources (whether renewable or non-renewable);
- usage of energy, the production of which generates greenhouse gases; and
- generation of noise.

In order to manage environmentally significant areas and the sources of environmental impact, the Airport Environment Strategy must include details of proposed studies, reviews or monitoring programs and proposed measures for preventing, controlling or reducing the environmental impact of the airport operations. The Strategy must also identify the systems which would be used for the testing, measuring and sampling to be undertaken for possible, or suspected, pollution or excessive noise.

Once a draft of the Airport Environment Strategy has been prepared it must be put on display for public comment for a period of 90 days. Once the public comment period is over, and the airport lessee company has given due regard to the comments received, the draft Airport Environment Strategy and a summary of public comments are sent to the Minister for Transport and Regional Services for approval. Once approved the airport lessee company must also ensure that every person who is a sub-lessee or licensee at the airport is aware of the Strategy.

Implementation of the Strategy

Once approved by the Minister, the airport lessee company would embark on the implementation of the elements outlined in the Airport Environment Strategy. Effective implementation of the Strategy would assist the airport lessee company in achieving improvements in environmental management by tenants at the airport. It is a requirement of the Act that the airport lessee company and any person who carries out an activity on the airport must take all reasonable steps to ensure compliance with the Strategy. The Airport Environment Officer would be responsible for ensuring that the airport lessee company and other operators on the airport implemented and complied with the Strategy.

As part of the development of an Airport Environment Strategy for the Second Sydney Airport, the airport lessee company would be required to develop an environmental management system. The most widely accepted standard for an environmental management system is the ISO 14001 standard. The company awarded the lease for the Second Sydney Airport would be required to develop an environmental management system based on the requirements of ISO 14001.

Once approved an airport environment strategy would remain in force for five years. It would then be replaced with a fresh draft that is required to address the same issues and undergo the same public consultation process as the previous version.

Community Involvement

Both the preparation of the Environmental Management Plan for construction and the Airport Environment Strategy would be prepared in accordance with a Consultation and Communications Strategy. These strategies would be developed specific to the requirements and processes set out under the *Airports Act 1996* and any additional processes established by the airport lessee company for airport operation. These would include the processes to be followed in developing the Noise Management Plan and the roles and responsibilities of the airport lessee company in terms of its involvement in the regional planning co-ordination body.

The construction phase has the potential to affect the community through both direct and indirect impacts. Direct impacts would include issues such as the impact from noise and dust, while indirect impacts would include issues such as inconvenience associated with changed traffic arrangements. While construction impacts would be temporary, localised and where possible mitigated through the implementation of environmental management measures, effective communication with the local community would form an important component of the consultation process.

During operation of the airport the main impact on the community is likely to be aircraft overflight noise. There also may be impact arising from other operational activities such as aircraft maintenance, access and traffic management and ongoing site construction and repair works.

25.3.3 Environmental Management in the Context of Ecologically Sustainable Development

The guiding principles for environmental management at leased Commonwealth airports are consistent with the *Inter-Governmental Agreement on the Environment* (Council of Australian Governments, 1992) to which all Australian States, Territories and the Commonwealth Government are signatories. The *National Strategy for Ecologically Sustainable Development* (Commonwealth of Australia, 1992a) has established what the goal, core objectives and guiding principles of such development should be. Ecologically sustainable development may be defined as using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained and total quality of life, now and in the future, can be increased.

In this context, environmental management would involve:

- protection of beneficial uses of the air, land and water environments and the control of unwanted noise;
- integration of environmental considerations into government decision making to ensure that there is proper examination of both short and long term environmental considerations, and that measures taken are cost effective;
- commitment to the precautionary principle, that is, where there are threats of serious or irreversible environmental damage, lack of full scientific certainty

should not be used as a reason for postponing measures to prevent environmental degradation;

- commitment to inter-generational equity to preserve and enhance the health, diversity and productivity of the environment of future generations;
- conservation of biological diversity;
- internalisation of environmental costs within an economic structure that encourages environment protection by reflecting accurate market costs of resources; and
- decisions and actions should provide for broad community involvement on issues which affect them.

The environmental management measures described in *Appendix* M of this Supplement take these matters into consideration. Therefore, it would follow that adherence to these measures should contribute to meeting the goals and objectives of ecologically sustainable development.

25.4 Potential Management Measures

Potential environmental management and mitigation measures for the proposal are identified in *Appendix* M. The following matters would be taken into consideration in determining whether a particular measure is reasonable and practicable:

- the sensitivity of the receiving environment;
- the nature of the harm that the undertaking would cause, or has the potential to cause;
- the current state of technical knowledge about preventing, or minimising, the environmental impacts of a particular undertaking; and
- the probable benefits and detriments (if any) that should be expected from the implementation of each measure.

The strategies outlined in *Appendix* M would aim to comply with the relevant Commonwealth regulations, namely the *Airports (Environment Protection) Regulations*.

Responsibility for ensuring that the environmental management measures are carried out, including monitoring, reporting and demonstration of compliance with relevant legislation would be determined by the airport lessee company as part of its airport environment strategy in accordance with the *Airports Act 1996* and the *Airports (Environment Protection) Regulations*. During construction and operation of the airport the Airport Environment Officer would be appointed to the Department of Transport and Regional Services to ensure compliance with the *Airports Act 1996* and the *Airports (Environment Protection) Regulations*.

25.5 Overview of Environmental Management

Environmental management of the Second Sydney Airport would be conducted within a framework established by the *Airports Act 1996* and the *Airports (Environment Protection) Regulations*. For construction this would involve preparing an Environmental Management Plan, while during operation this would involve preparing an Airport Environment Strategy. Both the Environmental Management Plan and Airport Environment Strategy would be prepared in accordance with the regulations to manage environmental impacts during construction and operation of the Second Sydney Airport.

An Environmental Management System consistent with the ISO 14001 standard would be developed and implemented by the airport lessee company, or in the absence of an airport lessee company, the Department of Transport and Regional Services. The Environmental Management System would be designed to ensure effective on-going management commitment and action, and would include the development of issue-specific environmental management plans. These plans would set out the measures which would be implemented to prevent environmental harm, or where prevention is not reasonable or practicable, control or reduce potential environmental impacts of the Second Sydney Airport.

A number of environmental management measures are available to control or reduce potential impacts during construction and operation of the airport. During construction, steps would be taken to control dust, noise, ground vibration, visual impacts and the effects on water quality, as well as impacts on other areas of the environment at risk. These would be enforced by the Airport Environment Officer and Airport Building Controller. When the airport becomes operational, the airport environment strategy would address similar issues, but focus on environmental matters relevant to the operation of a Second Sydney Airport. Opportunities would be provided for input from the community in the development of the environment strategy.

In relation to the issue of aircraft overflight noise, a Noise Management Plan would be prepared prior to airport operation for the purpose of examining the appropriate mode of airport operation and the effective use of airspace in order to reduce potential impacts. Measures to be implemented might include controls on the way the airport operates, management of flight paths, the acquisition of properties, or the acoustical treatment of houses.

In addition, it is proposed that the airport lessee company and the Department of Transport and Regional Services would participate in a Regional Planning Co-ordination Body to help ensure that any associated development within the airport sub-region and any other planning or development initiatives taken by State, local government or other agencies is undertaken in an environmentally sensitive manner.

PART I

Comparison and Conclusions

Chapter 26

Comparison and Conclusions

Chapter 26
Comparison and Conclusions

26.1 Summary of the Draft Environmental Impact Statement

26.1.1 Comparison of Airport Options

The Draft EIS compared the three airport options by identifying significant issues, reviewing environmental studies to select appropriate assessment criteria, and comparing the performance of each airport option against the selected criteria. The results of the comparison were summarised and presented in table form in both the Draft EIS (Table 26.1) and the Summary (Table 9). The table indicated which option or options performed best against each criterion.

In brief, comparison of the airport options revealed a similar range of potential impacts across a large number of the environmental issues examined; there were, however, a small number of significant differences. Those environmental issues that did not allow a clear distinction to be made between the options included the requirements for off-airport site infrastructure; the overall impacts of high and mid-range aircraft overflight noise; air quality impacts; effect on land transport systems and employment benefits. Those environmental issues that demonstrated a significant difference between the options included the following:

- Options B and C would allow greater flexibility and efficiency in design and operation than Option A, and are more capable of future expansion;
- Options A and B would be more consistent with the metropolitan and regional planning carried out to date; however, further strategic planning investigation may show that Option C would have similar metropolitan and regional planning benefits;
- the three options would produce different aircraft overflight noise levels in the various communities surrounding the airport. The relative impacts of these differences would depend on individual reaction;
- because of the smaller site area, the impacts of Option A on stream and terrestrial habitats and items of Aboriginal heritage would be less than those of Options B and C;
- Option C would potentially create a higher risk of fatality from aircraft crashes than Options A or B;
- Option C would be more compatible with the operation of Sydney Airport than Options A or B, although the extent of this constraint in the case of A and B has not been fully quantified; and
- Option A could be between $400 million and $700 million cheaper to build than Options B or C because of the smaller scale of infrastructure proposed.

26.1.2 Conclusions of the Draft Environmental Impact Statement

The Draft EIS concluded that each of the airport options would result in a range of both adverse and beneficial environmental and economic impacts. Any assessment of these should be considered in the context of the implications of not proceeding with the Second Sydney Airport proposal, commonly referred to as the 'do nothing' option. Adopting the do-nothing option would likewise result in a range of environmental and economic impacts.

Key matters identified by the Draft EIS for consideration included the consistency of the options with metropolitan planning strategies, noise impacts, regional air and water quality issues, land transport, and airspace interactions of the proposed airport with the operation of Sydney Airport. Key differences between the options included the level of aircraft overflight noise impacts on individual communities, the extent of biological and physical impacts and airspace management issues.

26.2 Summary of Issues Related to the Conclusions of the Draft Environmental Impact Statement

26.2.1 Summary of Issues Raised in Submissions

Conclusions of the Draft Environmental Impact Statement

Submissions on the Draft EIS, including those from the NSW Government and the Total Environment Centre, among others, expressed concern that no final recommendations or conclusions are presented that identify a preferred airport option. The NSW Government's submission stated that this concern is related to the variety of options presented, which makes the assessment of the potential impact of the airport very difficult, with conclusions in regard to operating roles, flight path configurations and other airport operational issues not drawn.

In addition to unspecified references to flaws in the overall environmental impact assessment noted in submissions, inner city councils such as Ashfield and Botany stated that the lack of consideration of a 'do nothing' option failed to highlight the consequences of continued unrestrained growth at Sydney Airport.

Implications of Ultimate Airport Development

Concerns about the implications of ultimate airport development were varied. Fairfield City Council, for example, referred to the implications of increasing the runway capacity of Options B and C by expanding the master plan to incorporate a double wide spaced parallel runway system. Others, such as the Australian Business Chamber, stated that the Draft EIS inadequately considered the implications of ultimate airport development because greater attention should be given to the importance of airports to Sydney's global competitiveness and the potential economic benefits available for western Sydney.

Other Issues

Submissions on the Draft EIS also suggested that the overall impacts of the proposed airport have been downplayed in the Draft EIS. Evidence raised as supporting this conclusion included the failure to undertake flooding studies and other water quality assessments.

26.2.2 Summary of Issues Raised by the Auditor

The Auditor drew conclusions regarding the overall compliance of the Draft EIS. The Auditor found that the Draft EIS suffered from a lack of precision in the project description which, together with time and cost constraints imposed by the proponent, had resulted in a Draft EIS which did not go into the degree of detail which would reasonably be expected for a major proposal affecting a large number of people in Australia's largest city.

Further, the Auditor found the Draft EIS avoided any comparative evaluation of airport options and suggested that techniques, such as multi-criteria analysis could be used to assist the Commonwealth Government and the public in the consideration of the project.

The overall conclusion of the Auditor was that the Draft EIS lacked sufficient detail for a project of this size.

26.3 Response to Issues Related to the Conclusions of the Draft Environmental Impact Statement

26.3.1 Conclusions of the Draft Environmental Impact Statement

Several different evaluation techniques are available that might be used to assess and compare the relative performance of a project. The extent to which a particular technique is appropriate depends on the nature of the project being evaluated.

As stated in the Draft EIS, it is not appropriate for the number of 'best performances' to be added together to make-up a single 'best performance overall' as some issues and criteria may be more or less important than others. For example, some people may value potential hazards and risks as being more important than aircraft overflight noise impacts. Others will have a different opinion. In addition, the relative importance a person will give to a particular issue may not be constant but vary with circumstances. Further, it could be argued that the impacts on the local community should be given greater weight than those on the regional community or the nation at large.

The primary reason multi-criteria analysis, as suggested by the Auditor, and other quantifiable techniques are considered inappropriate is because they rely on value judgements to weigh the relative performance of each airport option and the relative performance of a 'do nothing' option. While there are techniques available to gain community input into appropriate evaluations, such as contingent valuation, such techniques are considered unfeasible in the context of the Second Sydney Airport because of the current level of public debate and the size of the community that would potentially be affected, be it beneficially or adversely, by the proposal. Furthermore, while this Supplement contains further discussion of the 'do nothing' option, it still is not possible to provide sufficient definition of such an option to allow a comprehensive comparison with the three airport options proposed for Badgerys Creek.

The environmental consequences of the 'do nothing' option on the community surrounding Sydney Airport have not been assessed in detail. Calculating the future capacity of Sydney Airport, and therefore providing a basis for assessment, requires judgements to be made concerning: the capacity of the physical infrastructure (such as runways, terminals and transport access); the capacity of airspace management systems; pricing and access arrangements; and the strategic and business decisions of the major users of the airport. Further, the effect of measures to mitigate environmental impacts, such as government policies on noise sharing, the curfew and hourly movement caps, cannot be predicted with certainty. The complex interaction of each of these elements and their potential to change over time underlines the difficulty in clearly defining a 'do nothing' option. A detailed study of the environmental consequences of a 'do nothing' option would in this context be unrealistic, add significantly to the complexity of the EIS and add little to the community's understanding of the impacts of a Second Sydney Airport at Badgerys Creek.

The analysis contained in the Draft EIS and the additional investigations undertaken for this Supplement provide an extensive range of data on the physical, biological, social and economic impacts of a decision to either proceed or not to proceed with the Second Sydney Airport proposal at Badgerys Creek. While many of these impacts can be compared to relevant guidelines, such as air quality and water quality impacts, there are no such definitive guidelines to indicate whether, for example, the economic benefits of the proposal are sufficient to offset the adverse consequences of aircraft overflight noise. Such issues have received significant community comment during the exhibition of the Draft EIS and are ultimately matters to be judged by the Commonwealth Government.

26.3.2 Implications of Ultimate Airport Development

The EIS's analysis focuses on a major airport handling 30 million passengers and 245,000 aircraft movements each year. The Draft EIS considered that this capacity could possibly be reached by 2016. Revision of the forecasts presented in *Chapter 4* of this Supplement indicates that, based on the forecast of total passenger movements for the Sydney basin, a level of 30 million passengers per year at the Second Sydney Airport might not be reached until much later, possibly about 2030.

Under the *Airports Act 1996* further environmental approvals may be required in order to develop the Second Sydney Airport to achieve the level of development described under the master plans for each option. Accordingly, it would be expected that further environmental approvals would be required to expand the operational capacity of the airport to an ultimate airport level of development as described in Chapter 9 of the Draft EIS.

26.3.3 Other Issues

A range of additional environmental investigations has been carried out for this Supplement. This included additional analysis of air and water quality issues in accordance with the recommendations of the Draft EIS and additional assessments in response to issues raised in submissions and by the Auditor. Generally, these additional environmental investigations support and reinforce the conclusions made in the Draft EIS.

26.4 Conclusions of the Final Environmental Impact Statement

26.4.1 Overview of Issues

A total of 15,650 submissions on the Draft EIS were received.

As outlined in *Chapter 2* of this Supplement, many issues were raised in submissions on the Draft EIS. Issues most frequently mentioned by the community, summarised as common themes, were:

- the need to give greater consideration to, and support for, alternatives situated outside the Sydney basin for a second Sydney airport;
- the effects of aircraft overflight noise on the health and wellbeing of the community, and, in particular, the impacts on sleep and disruption to education and learning;

- the impact of the airport on the air quality of western Sydney and specifically the related health implications for asthma, respiratory illness, the rate of cancer and heart disease and other community health issues;
- the impact of air emissions from the airport and related motor vehicle traffic on the quality of water in Sydney's drinking water reservoirs;
- the potential for the airport to contribute to increased concentrations of waterborne pollutants and thereby result in an adverse impact on the water quality of the Hawkesbury Nepean River system and the South Creek Valley;
- the impacts due to increased congestion arising from additional road traffic generated by the airport, specifically the air quality and health implications;
- the economic benefits to western Sydney in terms of employment being overstated and insufficient to offset the negative environmental impacts of the airport; and
- the hazards and risk to people and major infrastructure associated with aircraft overflight, in particular the environmental impacts of potential fuel dumping and fuel venting episodes.

A number of submissions (7,839) also generally indicated that no airport should be built at Badgerys Creek and that the airport would generally impact on the quality of life of residents surrounding the airport (2,698 submissions). A smaller number of submissions indicated support for an airport at Badgerys Creek (61 submissions) and expressed concern about delays in decisions on the second airport (87 submissions).

As mentioned in *Chapter 3*, issues were raised suggesting that the EIS process and the Draft EIS itself was flawed or inadequate. For the majority of submissions which suggested the Draft EIS was flawed, this conclusion was generally based on claims that the Draft EIS understated the potential impacts. Submissions made by the NSW Government, local government and some community groups raised more detailed issues regarding the scope of the Draft EIS and the methodology used to assess many of the impacts. These included methodological issues specific to:

- lack of definition of the precise role of the airport and how it would operate in the future;
- the use of a maximum of 245,000 annual aircraft movements to assess many of the impacts instead of 360,000 annual aircraft movements as stated in the original proposal for the Second Sydney Airport put forward by the Commonwealth Government;
- lack of detailed assessment of alternatives, especially alternative sites outside the Sydney basin and the environmental implications of 'doing nothing';
- aircraft overflight noise, especially methods used to assess impacts on schools, sleep and property values; and the descriptors used to describe levels of noise;
- failure to use the model developed for the Metropolitan Air Quality Study for the air quality assessment; the lack of some data, especially for the vertical profile of air currents; and the method used to assess the impacts of emissions from airport-related motor vehicle traffic;
- lack of hydrology, water quality and groundwater modelling and the methods used to assess impacts on drinking water quality;
- lack of a benefit cost analysis;

- assessment of health impacts, including the claim that levels of background air quality were understated no use of quantifiable relationships between health and noise levels found in research literature; and the methods used to assess impacts of air pollution and aircraft fuel venting on drinking water supplies; and
- cumulative impacts, especially the extent of assessment of the environmental impacts of off-site infrastructure required to service the airport.

26.4.2 Overview of Response to Methodological Issues

Definition of the Proposal

Precisely defining the role of the Second Sydney Airport at this stage is not possible. The airport's role would evolve over time in response to a wide range of economic, environmental, policy and operational considerations, through a complex process involving the community, the Commonwealth and State Governments, local government and the airlines.

In the absence of a defined role for the Second Sydney Airport, a range of air traffic forecast scenarios have been used for environmental assessment purposes. This approach provides a comparison between different development options and gives the community an opportunity to have their say.

An issue related to the definition of the proposal is whether or not the EIS process represents the only occasion on which the environmental impacts of the proposed airport would be assessed. The construction and operation of the Second Sydney Airport would be undertaken in accordance with the *Airports Act 1996* and the *Airports (Environmental Protection) Regulations*. The Act specifies that a major development plan is required for each major development at an airport, as defined in the Act. In deciding whether to approve a major development plan, the Minister for Transport and Regional Services must take account of a number of considerations, including the impact that implementing the plan would have on the environment. If the Minister considers that the proposed development is environmentally significant, then the assessment procedures under the *Environment Protection (Impact of Proposals) Act 1974* would apply and a formal assessment process may be required by the Minister for the Environment.

Alternatives

The Guidelines for the EIS specifically state that alternative site locations for Sydney's second major airport will not be addressed in detail by this environmental assessment process, having been the subject of a separate 'site selection' EIS in 1985 and subsequent Government decisions.

Alternative strategies such as the 'do nothing' option, use of other capital city airports or development of a very high speed train system have been examined but do not provide a viable alternative to a second major airport for Sydney.

In view of the demand forecasts and the future constraints on Sydney Airport's capacity, there are no prudent and feasible alternatives to building a second major airport for Sydney if demand is to be satisfied.

Aircraft Overflight Noise

Technical Paper No. 3 contains a detailed survey of existing research on the impacts of noise on education and learning. However, in response to submissions questioning the number and level of noise events at which a significant disturbance to learning activities may occur, a further literature search was conducted for this Supplement. Conclusions of relevant research are consistent with the assumption made in the Draft EIS that only relatively minor effects occur outside the zone of 10 aircraft overflights per school day exceeding 65 dBA.

Several submissions suggested alternative methodologies for the assessment of sleep disturbance due to aircraft overflight noise. The Auditor, for example, suggested use of a methodology based on Griefahn (1992) and use of a methodology derived from material published by the NSW Environment Protection Authority. Although those methodologies were examined, the Sleep Disturbance Index used in the Draft EIS is considered to provide the most useful indication of potential impacts of aircraft overflight noise on sleep. As indicated by the Auditor the Sleep Disturbance Index used in the Draft EIS is not an index widely accepted by the professional acoustic community, equally however, no other measure would fulfil that requirement.

Submissions claimed that the assessment of aircraft overflight noise was flawed because of the reliance on the 'ANEF system'. While the equivalent ANEC levels are described, the assessments contained in the Draft EIS and this Supplement are not based on that descriptor but on a large range of descriptors including:

- noise events per 24-hours over 60 dBA, 70 dBA, 80 dBA and 90 dBA;
- noise events per night over 60 dBA, 70 dBA, 80 dBA and 90 dBA;
- noise events between 9 am and 3 pm (school hours) over 65 dBA;
- L_{Aeq}, 24 hour;
- L_{Aeq}, 10.00 pm to 6.00 am; and
- Sleep Disturbance Index.

Although criticised in many submissions, presentation of noise levels in terms of the ANEC descriptor in the Draft EIS was required by the EIS Guidelines. In addition, as described in the Draft EIS, ANEC levels are directly relevant to at least one form of noise impact, the impact on potential future land use, which is generally controlled using recommendations of *Australian Standard 2021* and guidelines released by the NSW Department of Urban Affairs and Planning.

Although the Draft EIS and *Technical Paper No. 3* contained discussion of potential daily and seasonal variations in noise, a number of submissions suggested more quantifiable data should have been provided. Such data is contained in *Chapter 8* of this Supplement.

The methodological issues raised in submissions have not warranted any significant alterations to the approach used to assess aircraft overflight noise impacts of the Second Sydney Airport.

Air Quality

The preferred approach to assessing air quality impacts involved the use of the Regional Airshed Model developed for the *Metropolitan Air Quality Study* (MAQS) by the NSW Environment Protection Authority. Access to this model was requested but was not granted by the Environment Protection Authority. Regional dispersion modelling was carried out using LADM, a sophisticated modelling tool used for the *Metropolitan Air Quality Study*, coupled with an air chemistry model also used in the *Metropolitan Air Quality Study*. These models were used to predict ozone levels and two further models were used to predict the frequency and location of ozone impacts. These tools are considered to provide a reasonable basis for assessment of ozone impacts due to airport operation.

The Draft EIS concluded that further analysis of air quality and ozone impacts in the vicinity of Badgerys Creek should be undertaken in accordance with a precautionary approach to environmental impact assessment using more recently available meteorological and air quality data to improve the accuracy of the analysis. Further, it was concluded that it would be prudent to undertake sensitivity analysis using different vertical profile assumptions.

Re-assessment of air quality impacts undertaken for this Supplement utilised three years of meteorological data from the Bureau of Meteorology monitoring station at Badgerys Creek and one year of air quality and meteorological data from the NSW Environment Protection Authority monitoring stations situated at Bringelly, St Mary, Blacktown, Liverpool, Camden and Campbelltown. In addition, vertical profile sensitivity analysis has also been undertaken as described in *Chapter 11*.

The Draft EIS contained a quantified analysis and discussion of the potential impacts of air emissions from airport-related motor vehicle traffic. A number of submissions raised concern that those emissions were not fully integrated into the air quality modelling. The further analysis and modelling of air quality impacts contained in this Supplement, and the resultant air quality-related health impacts, incorporates the predicted emissions from airport-related motor vehicle traffic.

Water

The potential for downstream flooding was identified in the Draft EIS as an issue requiring further modelling work to confirm the conclusion that peak flow rates from the site would be reduced to less than pre-development flow rates, and that water quality management measures could potentially improve the quality of stormwater run-off from the airport sites. Additional studies and investigations of water issues have been conducted for this Supplement, including:

- additional water quality surveys;
- groundwater field investigations and modelling of local and regional groundwater systems;
- investigation of sewage treatment reuse and disposal options;
- re-examination of construction water management and operation of water cycle management;
- assessments of the effectiveness of stormwater management measures and potential downstream flooding and local and regional water quality impacts; and
- further analysis of the impacts of airborne pollutants emitted by aircraft on water quality.

The methodological issues raised in submissions have not warranted any significant alterations to the conclusions reached in the Draft EIS.

Benefit Cost Analysis

A benefit cost analysis was not undertaken for the Draft EIS due to the difficulty in defining the future capacity of Sydney Airport (the 'do nothing' option) and the complexity of valuing many of the environmental impacts associated with the development.

Since the preparation of the Draft EIS, and in response to public comment, additional work has been undertaken on both the financial and economic viability of the Second Sydney Airport proposal.

Health

Further research was undertaken for this Supplement into the relationship of changes in air quality and noise levels to human health. The research indicated that the methods used to assess the air quality-related health impacts in the Draft EIS were appropriate. Further data on the relationship between noise levels and health has become available since the publication of the Draft EIS. This has allowed some further conclusions to be drawn regarding that issue in this Supplement.

Further analysis carried out for this Supplement, including investigations undertaken by the CSIRO, confirm the predictions in the Draft EIS of the absence of threats to human health from the deposition of emissions from aircraft engines in water supply reserves.

Cumulative Impacts

A number of submissions raised the issue of inadequate assessment of the environmental impacts of the support infrastructure required to service the airport. The Draft EIS identified the type of infrastructure that would be required to be put in place to enable an airport accommodating 30 million passengers a year to efficiently operate from the Badgerys Creek site. Analysis of air quality, land transportation and noise impacts of this infrastructure was included in the Draft EIS. A broader discussion of other environmental issues was also provided.

This Supplement contains additional analysis of regional biodiversity and water quality impacts, and has integrated the air emissions of both the operation of the airport and airport-related motor vehicle traffic into revised air quality modelling. A consolidated discussion of cumulative environmental issues is provided in *Chapter 24* of this Supplement.

26.4.3 Overview of Further Analysis Undertaken for this Supplement

The need to address recommendations of the Draft EIS and other issues raised in submissions and/or by the Auditor required further analysis to be carried out for this Supplement. The most significant conclusions of that analysis are summarised below.

The Need for a Second Major Airport for Sydney

A review of Sydney basin air traffic movement forecasts was undertaken for this Supplement in response to a number of issues. While the latest Sydney basin forecasts are significantly lower than the predictions in the Draft EIS, the overall forecast growth in air traffic is still substantial. The revised forecasts do not obviate the need for additional major airport facilities for the Sydney basin in the first decade of the new millennium.

The future capacity of Sydney Airport is addressed in this Supplement through an analysis of the 'do nothing' option, that is, allowing the capacity of Sydney Airport to expand under current operational and broad policy settings. On the basis of this work, the 'do nothing' option is not feasible and Sydney will require additional major airport facilities in the latter part of the next decade, if demand is to be satisfied.

The idea that linking major urban centres on the east coast of the country with a very high speed rail system would delay, or even negate, the need for additional airport facilities in Sydney has been examined. Preliminary work indicates that, even with assumptions that are, in terms of those normally provided for rail, optimistic about the diversion of passengers from aviation to high speed rail, there would only be a modest extension to the life of Sydney Airport.

Alternative Sites

A review of alternative sites for the second Sydney airport within the Sydney basin, which were suggested in submissions, found that each had serious deficiencies that were unlikely to be remedied within the timeframe required for a decision on the second airport. It is considered that there are no realistic alternative sites to Badgerys Creek for a second major airport in the Sydney basin.

The viability of all sites that lie outside the Sydney basin is almost entirely dependent on the feasibility of servicing these sites with a very high speed train. A preliminary examination found that there was significant doubt that a very high speed train would be capable of meeting the travel requirements of air passengers.

Land Use and Planning

The Draft EIS and work carried out for this Supplement recognise that the development of western Sydney would be significantly influenced by the airport and its associated infrastructure, providing a catalyst to employment and economic growth, potential residential development and associated human and physical services. Urban planning decisions and the resultant characteristics of land uses in the region surrounding the airport would be substantially influenced by its development. These influences would have major implications for urban planning, both positive and negative.

At this stage of the development of the Second Sydney Airport proposal, it is not possible to precisely identify the urban planning response to the airport. Two potential future land use scenarios were developed for the Draft EIS which identified the possibility of urban villages being established within the South Creek Valley adjacent to a rail link to the airport. A third future land use scenario is examined in this Supplement that excludes further major urban development from the South Creek Valley. This scenario is more consistent with policy positions in submissions from the NSW Government and Liverpool City Council. As was identified in the Draft EIS, the Supplement further acknowledges that any future urban development within the South Creek Valley would raise significant regional environmental issues, especially in relation to air and water quality. The Supplement also identifies a new rail link to the airport as gaining only marginal operational benefits, at least in the short to medium terms, from the establishment of new urban villages around rail stations.

Aircraft Overflight Noise

Due to the number and complexity of issues raised in submissions regarding aircraft overflight noise, significant additional analysis was carried out for this Supplement. This analysis included further assessment of impacts on noise sensitive land uses, impacts on sleep, daily and seasonal variations in noise levels, and the potential for management measures to reduce the overall levels of noise. The conclusions drawn from this further analysis do not differ qualitatively from those in the Draft EIS. They are summarised as follows:

- the assumption in the Draft EIS that only relatively minor effects on learning occur outside the zone of 10 events per school day exceeding 65 dBA is supported by other research. It is estimated that 20 existing educational facilities would be affected by this level of noise under Options A and B when the airport operates at 30 million passengers a year, and 75 schools would experience this level of noise under Option C;
- for many of the noise indicators examined, there would be only small differences between the potential noise impacts of the airport options. For

example, the impacts would be similar for the higher and mid-range noise levels modelled. At the lower noise levels modelled (10 noise events a day greater than 70 dBA), it is possible to conclude that Option C is likely to affect more people than Options A and B;

- for areas affected largely by operations on the main parallel runways, 'worst day' noise impacts would not vary greatly from 'average day' impacts. In these areas, 'worst day' impacts would occur on between 20 and 50 percent of all days. The areas affected largely by cross-wind runway operations, 'worst day' impacts would be significantly higher than 'average day' impacts. However, in these areas, 'worst day' impacts could occur as unfrequently as one day in two years;
- seasonal variation in noise impacts would be most pronounced for Options A and B. For these options, operations in a south-westerly direction would be more prevalent in winter. This would lead to higher exposure in areas under departure flight paths to the south, and under arrival flight paths from the north. The converse is true in summer. For Option C, there is very little predicted seasonal variation in noise exposure; and
- it would be possible to reduce noise impacts by modifying both flight paths and operations of the airport through the development of a noise management strategy. An example of some measures that could be used in the development of such a strategy has been analysed in this Supplement. The analysis shows that reductions in the numbers of people affected by aircraft overflight noise could be achieved for all airport options. For operations over a full 24-hours, the most substantial reductions in noise impacts would be achieved at the lower noise levels examined, especially for Option C. For night-time operations, more substantial reductions in noise impacts would be possible for all airport options.

Air Quality

More recent data on background air quality obtained for this Supplement from the NSW Environment Protection Authority and meteorological obtained from the Bureau of Meteorology has enabled refinement of air quality modelling.

Based on the revised air quality modelling, exceedances of goals for nitrogen dioxide, ozone and particulate matter less than 10 microns are predicted to occur when the Second Sydney Airport is operating at its proposed limit of 30 million passengers per year.

Exceedances of air quality goals for nitrogen dioxide and particulate matter are predicted to occur within an area extending approximately two and 1.5 kilometres respectively from the airport boundary. Up to 500 people are estimated to live in the area of potential exceedance of nitrogen dioxide in 2016 and up to 300 people are estimated to live in the area of exceedance of fine particulates in 2016.

Increases in ozone of up to one part per 100 million in ground level concentrations are predicted about 25 times per year when the airport is operating at 30 million passengers per year. These exceedances would occur in an area located approximately 10 to 50 kilometres west of the sites of the airport options. It is estimated that approximately 6,000 people would live in these areas in 2016.

No exceedances beyond the airport boundary are predicted to occur for sulphur dioxide and carbon monoxide.

Hydrocarbon odours would be detectable for greater than 44 hours per year up to 3.5 kilometres from the Second Sydney Airport in a north-westerly direction. It is estimated that approximately 1,300 people would live in this area in 2016.

These impacts are greater than those described for similar air quality parameters in the Draft EIS. The reasons for these differences are:

- the inclusion of the contribution of motor vehicles, which is defined through the increased vehicle kilometres travelled from traffic generated by the airport within the air quality model;
- the tightening of the air quality goals as a result of the adoption of the National Environment Protection Measures by the NSW Environment Protection Authority in 1998;
- the use of meteorological and air quality data more reflective of the conditions likely to be experienced at the sites of the airport options, accompanied by an increased frequency of period of low wind speed and therefore poor dispersion conditions for ground level pollutants; and
- in the case of nitrogen dioxide, the revised conversion rate for oxides of nitrogen to nitrogen dioxide.

Water

Groundwater systems at the sites of the airport options would not be used due to the high natural salinity of local water. Deep excavations during construction might intersect the local alluvial aquifer, but any perched water would be small in volume and easily drained to temporary evaporation basins rather than to the local creek system. During operation the airport development would increase the surface water run-off and decrease groundwater recharge. This would lead to a slight increase in groundwater salinity.

On-site tertiary sewage treatment would be provided to cater for up to at least the first stage (up to 10 million passengers per year) of the airport's development. High quality treated effluent would enable re-use as non-potable water supply and irrigation on noise affected land. On occasions when discharge to Badgerys Creek is required, effluent would not be discharged unless it met the licence requirements of Sydney Water. A number of options would be available to provide sewerage services for the airport during the later stages of development. The most appropriate option would depend on the timing and rate of airport and off-site development.

Streams traversing the sites of the airport options reflect the effects of predominant agricultural land use and are characterised by elevated levels of nutrients, with occasional pollutants from horticultural activities. Stormwater discharged from the airport site would be of better quality than existing run-off, contributing to an improvement in the ecology of receiving waters. This improved quality would be achieved by preventing contaminants entering the drainage system and treating all surface water in water quality control ponds prior to discharge.

Development of an airport at Badgerys Creek would increase the volume and rate of stormwater run-off. Peak flows would be controlled by stormwater detention basins, ensuring that the proposal would not exacerbate flooding. A potential impact of the increased stormwater run-off would be the increased potential for stream scouring and resultant impacts on aquatic flora and fauna.

Emissions from aircraft would result in low concentrations of benzene and other volatile compounds and particulates in water supply storages. The estimated concentration of polycyclic aromatic hydrocarbons in aircraft exhaust measured as fall-out in the water of Lake Burragorang is estimated to be less than 0.01 micrograms per litre. This is less than the health-related drinking water guideline set by the Australian and New Zealand Environment Conservation Council of 0.01 micrograms per litre.

Flora and Fauna

Since the preparation of the Draft EIS, the National Parks and Wildlife Service has undertaken an extensive review of the flora and fauna of the western Sydney region. In addition, a population of the Cumberland Plain Large Land Snail, listed as endangered on Schedule 1 of the *Threatened Species Conservation Act 1995* has been identified at the sites of the airport options.

The sites of the airport options are considered to be of State significance for flora and fauna based on the following attributes:

- remnants of the endangered ecological communities Cumberland Plain Woodland, and River-flat Forest, considered to be of regional conservation significance;
- a population of the endangered plant *Pultenaea parviflora* that is considered to have regional conservation significance;
- a population of the threatened Cumberland Plain Large Land Snail considered to be of State conservation significance; and
- a wildlife corridor along Badgerys Creek of regional significance.

Potential measures to mitigate impacts on endangered ecological communities would involve retention of vegetation remnants within the airport sites wherever possible and the regeneration of these remnants. Long-term management would involve revegetation in areas considered inappropriate for regeneration due to their highly degraded condition, or in areas between vegetation remnants suitable for linking with regenerated ecological communities. Environmental management of the potential impacts to the Cumberland Plain Large Land Snail would involve retention of remnant Cumberland Plain Woodland known to contain the snail and the potential relocation to suitable on-site conservation areas proximate and of a similar nature.

In the short to medium term the impacts of construction of the Second Sydney Airport would be high as a result of clearance of regionally significant endangered ecological communities and a regionally significant population of the endangered *Pultenaea parviflora*. In the long-term however, the conservation significance of the remaining remnants would be enhanced through regeneration and rehabilitation works. The area of remnant vegetation to be retained and the area of regeneration would contribute to the long-term viability of the endangered ecological communities at the airport sites. Similarly, the proposed management of *Pultenaea parviflora* involving the re-introduction of seed and stock into on-site conservation areas would ensure its long-term conservation within the sites of the airport options.

Aviation

The EIS Supplement provides further information regarding the complex airspace arrangements necessary for the efficient operation of Sydney Airport and a Second Sydney Airport at Badgerys Creek. It provides a more detailed description of the interaction between the airports and highlights the airspace management advantages of Option C.

Further material has been provided explaining the differences in airspace arrangements between various countries. It is confirmed that the second airport would have a significant impact on the general aviation industry in the Sydney basin.

Work for the EIS Supplement shows that there would be no need for fuel dumping to take place in the Badgerys Creek area. New regulations, which will be in effect prior to the opening of the Second Sydney Airport, should minimise the already low incidence of inadvertent fuel venting.

Economics Issues

Since the preparation of the Draft EIS, and in response to public comment, significant additional work has been undertaken on both the financial and economic viability of the Second Sydney Airport proposal.

The results of both the financial and economic assessments must be qualified because of uncertainties about the accuracy of some of the key inputs, including future pricing policies for the airport, the cost estimates and future demand for the airport. In the case of the economic assessment, it has also not been possible to quantify some of the environmental costs because of methodological difficulties and the lack of some key data.

Despite the above qualifications, it is concluded that both the Stage 1 and master plan airport proposals would be economically viable, and that there would be major economic benefits to Australia, NSW, Sydney and the Badgerys Creek region from the proposed airport.

In contrast, if aeronautical charges placed on aircraft and passengers were to be based on those that currently apply at Sydney Airport, the Stage 1 and master plan proposals appear not to be financially viable. However, relatively small increases in airport revenue (or substantial decreases in construction costs) could make the Stage 1 development financially viable. By way of illustration, a passenger charge of around $1 to $2 on passengers departing through either Sydney Airport or the Second Sydney Airport would cover the costs of constructing and operating the Stage 1 development of Option A.

Health

Investigations carried out for this Supplement included further literature reviews of the health impacts of changes in air quality, noise levels and perceptions of hazards and risks; a review of air quality related health impacts using the results of revised air quality modelling; and further analysis of the impacts of air emissions on drinking water quality. The investigations of both the Draft EIS and Supplement have enabled some health impacts of the Second Sydney Airport to be quantified and broad conclusions to be drawn in other areas where existing data does not allow the relationship between a particular impact and a health response to be specifically identified.

Revised air quality modelling was carried out using new data obtained from the NSW Environment Protection Authority and the Bureau of Meteorology. Quantifiable health impacts based on the revised air quality modelling, which includes the impacts of vehicle traffic to and from the airport, have been recalculated for this Supplement and are documented in *Table 26.1*. Interpretation of the data on adverse health effects must be guided by the limitations of the methods of analysis such as the imprecision of the methods of modelling both air quality projections and health risk assessments and conflicting published information on adverse health effects of pollutant exposures. Also, some of the predicted hospital admissions and all deaths are impacts that would have occurred regardless of the airport. There is no known method of quantifying how much earlier the admission or death would occur. It was also not possible to model the effects of long-term exposure to pollutants. However, there is some doubt as to whether there are clinically relevant long-term effects in the range of exposures under consideration.

In studies carried out for the Draft EIS, benzene was chosen as an indicator of the impact of volatile emissions from aircraft exhaust on drinking water quality. This selection was confirmed as being appropriate after a review by CSIRO. It is estimated that in both dry and wet weather the concentrations of benzene and other volatile compounds in Lake Burragorang would be lower than relevant guideline values. The CSIRO also confirmed the predicted absence of threats to human health as a consequence of deposition of emissions from aircraft engines in rainwater tanks.

Existing knowledge of the extent of noise-related health risks does not make it possible to quantify the levels of noise-related health impacts that may arise from the operation of the Second Sydney Airport. Nevertheless, examples of specific impacts may include the potential for increased stress amongst children, the potential for increased prevalence of heart disease and the potential for hearing damage. Generally, these impacts might occur within the most severely noise-affected areas located directly under flight paths within approximately two kilometres of the boundary of the airport site. These areas would be the subject of specific noise management measures such as the availability of voluntary acquisition and noise insulation programs. Consideration would also need to be given to the relocation of Bringelly Primary School.

26.4.4 Corrections to the Draft Environmental Impact Statement

Submissions on the Draft EIS and subsequent investigations by the Department of Transport and Regional Services and PPK have identified several errata. None of the identified errors alter conclusions drawn in the Draft EIS. The errata are as follows:

- *Figure 19 Aerial Photograph of Sites of Badgerys Creek Airport Options* of the Summary incorrectly depicts the boundaries of Options B and C in the north-west corner of the sites. These boundaries should be reversed;
- *Figure 10.14 Required Off-Airport Site Infrastructure* incorrectly depicts the location of electricity transmission lines required to support the airport. The correct locations are depicted in *Figure 7.2* of this Supplement;
- *Table 3 Cumulative Aircraft Overflight Noise Impacts on Estimated Populations in the Years 2006 and 2016* and *Table 9 Comparative Assessment of Airport Options* of the Summary; and *Table 12.5 Cumulative Aircraft Overflight Noise Impacts on Estimated Populations in the Years 2006 and 2016* and *Table 28.1 Comparative Assessment of Airport Options* of the Draft EIS contained an error relating to individual noise level estimates for Option C in 2006. This error is explained and corrected in *Section 8.6.1* of *Chapter 8* of this Supplement;
- *Table 17.3 Impacts of Construction on Flora and Fauna* incorrectly indicates a loss of 120 and 210 hectares of terrestrial habitat of high local significance for Options A and B, respectively. The correct areas are 121 and 212 hectares;
- *Table 18.2 Present Agricultural Land Use at Badgerys Creek* contained a formatting error which is corrected in *Table 15.2* of this Supplement; and

- *Table 22.8 Future Traffic Volumes on Key Approach Roads to Second Sydney Airport* contained a formatting error which is corrected in a revised table provided in *Appendix N1*.

26.4.5 Comparison of Options

Table 26.1 presents a comparison of the airport options. The option considered to perform best against each criterion is coloured blue. Where two options are coloured blue, this indicates that there was no significant difference in their assessment. Where there is no significant difference between all three options, no ranking is shown.

It is not appropriate for the number of 'best performances' to be added together to make up a single 'best performance overall' as some issues and criteria may be more or less important than others. For example, some people may value potential hazards and risks as being more important than noise impacts. Others might have a different opinion.

The assessment of many environmental issues did not allow a clear distinction to be made between the options. These issues included the requirements for off-airport site infrastructure; the overall impacts of high and mid-range levels of aircraft overflight noise; water quality impacts; effects on land transport systems; and economic benefits.

The environmental issues that demonstrated a significant difference between the airport options included:

- *Airport Sites* – the sites and subsequent designs and operations of Options B and C would be more flexible and efficient than Option A, and more capable of future expansion;
- *Aircraft Noise* – the three options would produce different aircraft overflight noise levels in the various communities surrounding the airport. Option C has the potential to create the greatest level of disturbance to sleep, however, it is likely that the implementation of noise management measures would reduce this impact to a level similar to Options A and B. At the lower range of noise impacts examined (10 noise events a day greater than 70 dBA) Option C is likely to impact more people than Options A and B. The potential implementation of noise management measures could again significantly reduce the level of this impact, however, it would still be likely to be greater than for Options A and B;
- Air Quality – due to the smaller site area of Option A, more people are likely to be impacted by levels of nitrogen dioxide and fine particulates (less than 10 microns) that exceed air quality goals than for Options B and C. An area immediately to the west of the boundary of Option A could also be potentially exposed to air toxic compounds above desirable levels;
- Flora and Fauna – Option A would have the least impact on flora and fauna. This is primarily due to the retention and proposed enhancement of the regionally significantly Badgerys Creek wildlife corridor. Option C is preferred to Option B, as the remnant vegetation that would be retained are of higher conservation value and provide higher quality habitat for the Cumberland Plain Large Land Snail;
- Hazards and Risks – Option C would potentially create a higher risk of fatality from aircraft crashes than Options A or B;

- Airport Operations – Option C would be more compatible with the operation of Sydney Airport than Options A or B, although the extent of this constraint in the case of Options A and B cannot be quantified at this stage; and
- Costs – Option A would be between $400 million and $700 million cheaper to build than Options B or C because of the smaller scale of airport infrastructure proposed.

26.4.6 Conclusions

Environmental Assessment Process

This EIS, that is, the Draft EIS together with this Supplement which reports the additional investigations carried out following the public review period, provides extensive information to the Commonwealth Government, and through the public release of these documents, to the community and other stakeholders, on both the need for the Second Sydney Airport and its potential adverse and beneficial impacts. Consequently, the EIS is an important resource for the decision-makers, but a number of other important steps remain to be taken as described in *Chapter 1* before a decision can be made.

Clearly a proposal of the scale and nature of the Second Sydney Airport would result in a range of adverse and beneficial impacts. These impacts have been comprehensively examined in the EIS through detailed responses to guidelines released by Environment Australia and issues raised by the community.

The Draft EIS was released in December 1997. Over fifteen thousand submissions on the Draft EIS were lodged in the 14 week public exhibition period. Partly in response to the comments on the Draft EIS, and partly on the proponent's initiative, an extensive series of additional studies was undertaken for the Supplement. These were designed to increase the understanding of the environmental and economic issues, their impacts and their management.

The modelling undertaken to estimate the level of these impacts generally made worst case assumptions and was based on an operating level of 30 million passengers a year. This level would not be reached for 20 or 30 years.

The following section contains conclusions drawn on key environmental issues. For clarity, the outcomes of the assessment of some environmental issues are not referred to. For a more complete understanding of the potential impacts of the Second Sydney Airport proposal, reference should be made to the Draft EIS, associated Technical Papers and the Supplement.

Need for a Second Sydney Airport

Sydney Airport will reach capacity in the latter part of the next decade unless there are significant changes to noise management and other policy settings and to airline operating practices. While some initiatives, such as the use of Bankstown Airport for regional services, would reduce the demand for Sydney Airport, they offer only short-term solutions. In the medium-term, new airport facilities for domestic and international services will be required if the expected demand for air travel to and from Sydney is to be met. Failure to meet demand for air travel to and from Sydney would have a major economic impact on Australia in general and NSW in particular.

A review of potential alternative sites confirmed that Badgerys Creek remains the most feasible site for a second major airport.

Table 26.1 Conclusions and Comparative Assessment of Airport Options Operating at 30 Million Passengers a Year

Assessment Criterion Performance Measure/Indicator	Option A
Airport Planning and Development (Chapters 8 and 9 of Draft EIS/Chapter 6 of Supplement)	
Airfield Efficiency and Layout	
Efficiency and flexibility in design and operation	Inflexible for alternative terminal configurations; location of airport support facilities split; limited land for commercial development
Construction	
Ease of construction	27 million cubic metres of earthworks; 6 year construction program; transmission line to be relocated; flexibility for staging
Air Traffic Demands	
Capacity to satisfy long term demand for air travel	Planned to satisfy operational objective of 30 million passengers a year; potential limitations because of airspace conflicts with Sydney Airport
Expandability	
Ease of future expansion	No capability for expansion within existing airport boundary
Planning and Land Use (Chapter 10 of Draft EIS/Chapter 7 of Supplement)	
Metropolitan and Regional Planning	
Compliance with current metropolitan and regional planning	Supports a range of metropolitan planning objectives and creates opportunity for self contained new urban communities, close to employment opportunities and serviced by public transport; site accessible to existing employment centres; no significant changes to Urban Development Program
Support of employment centres	Airport site would be accessible to existing employment centres, and land surrounding site could be available for employment uses
Off Airport Site Infrastructure	
Benefit of off airport site infrastructure to regional planning	Road, rail and other services required for airport would also benefit existing and planned communities
Acquisition of Properties	
Numbers of properties to be acquired to allow airport development	1 (part of public road)
Defence Activities	
Impact on armaments logistic support	Low[2]
Relocation costs	No costs

Aircraft Overflight Noise (Chapters 11 and 12 of Draft EIS/Chapter 8 of Supplement)		
Land Use Planning[3, 4, 5, & 6]	**Potential Impact Without Noise Management**	**Potential Impact With Noise Management**
People (2016 estimate) who may experience the following ANEC levels:		
- greater than 30 ANEC	200	No reduction
- greater than 25 ANEC	700-1,000	No reduction
- greater than 20 ANEC	4,500-6,000	2,500
- greater than 15 ANEC	11,000-14,000	8,000
Communication Disturbance[3, 4, 5, & 6]		
People (2016 estimate) who may experience, on average, the following number of noise events over 70 dBA a day:		
- greater than 100 events	400-900	No reduction
- greater than 50 events	2,500-5,000	1,500
- greater than 20 events	8,500-9,500	5,000
- greater than 10 events	15,000	10,000
Sleep Disturbance[3,4, 5, & 6]		
People (2016 estimate) who may, on average, be awoken at night the following number of times:		
- once a night	<100	Not calculated Refer Section 8.7.6
- once every 2 nights	500-1,000	
- once every 5 nights	6,000-8,000	
Disturbance to Learning[3, 5 & 6]		
Existing educational facilities (including child care centres) which may experience, on average, the following number of noise events over 65 dBA between 9am and 3pm:		
- more than 20 events	15	5
- more than 10 events	20	14

Comparative Assessment[1]

Option B	Option C
Flexibility for alternative terminal configurations; efficient layout of airport support facilities; sufficient land for commercial development	Flexibility for alternative terminal configurations; efficient layout of airport support facilities; sufficient land for commercial development
36 million cubic metres of earthworks; 6.5 year construction program; transmission line to be relocated; flexibility for staging	29 million cubic metres of earthworks; 6 year construction program; transmission line to be relocated; flexibility for staging
Planned to satisfy operational objective of 30 million passengers a year; potential limitations because of airspace conflicts with Sydney Airport	Satisfies operational objective of 30 million passengers a year
Good capability for expansion	Good capability for expansion
Supports a range of metropolitan planning objectives and creates opportunity for self contained new urban communities, close to employment opportunities and serviced by public transport; site accessible to existing employment centres; no significant changes to Urban Development Program	Supports a range of metropolitan planning objectives and may create the potential for self contained new urban communities, close to employment opportunities and serviced by public transport: (this potential may be more limited than for Options A or B); site accessible to existing employment centres; no significant changes to Urban Development Program
Airport site would be accessible to existing employment centres, and land surrounding site could be available for employment uses	Airport site would be accessible to existing employment centres, and land surrounding site could be available for employment uses
Road, rail and other services required for airport would also benefit existing and planned communities	Road, rail and other services required for airport would also benefit existing and planned communities
194	206
Low[2]	Moderate to High
No costs	Not available[2]

Option B: Potential Impact Without Noise Management	Option B: Potential Impact With Noise Management	Option C: Potential Impact Without Noise Management	Option C: Potential Impact With Noise Management
<100-200	No reduction	<100-300	No reduction
500-800	400	300-700	No reduction
3,500-5,000	2,000	900-1,500	No reduction
11,000-14,000	7,500	15,000-19,000	10,000
300-700	No reduction	300-500	No reduction
2,000-4,000	No reduction	700-1,000	No reduction
7,000-9,500	No reduction	6,000-17,000	No reduction
16,000-17,000	No reduction	60,000-72,000	32,000
<100	Not calculated Refer Section 8.7.6	<100-100	Not calculated Refer Section 8.7.6
300-800		400-600	
3,500-6,000		1,500-17,000	
13	2	25	3
20	11	75	26

Table 26.1 Conclusions and Comparative Assessment of Airport Options Operating at 30 Million Passengers a Year

Assessment Criterion Performance Measure/Indicator	Option A
Noise-Induced Vibration	
People (2016 estimate) who may experience one noise event per 30 days capable of causing vibration to buildings (that is over 90 dBA)	700–1,000
Direct Property Devaluation	
Cost of direct property devaluation from noise impacts (1996$)	$49–67 million
Noise Management	
Cost of voluntary acquisition for dwellings affected by more than 35 ANEC (1997$)	$6–11 million
Cost of acoustical treatment for dwellings affected between 25 and 35 ANEC (1997$)	$12–19 million
Cost of acoustical treatment for dwellings affected between 30 and 35 ANEC (1997$)	$3 million
Other Noise Impacts (Chapter 13 of Draft EIS/Chapter 9 of Supplement)	
Construction Noise[6]	
People (2016 estimate) affected by noise levels over 45 dBA during the day without noise management measures	1,000
People (2016 estimate) affected by noise levels over 40 dBA during the night without noise management measures	2,500
Ground Operation Noise - During Neutral Conditions[6 & 7]	
People (2016 estimate) affected by noise levels over 50 dBA	2,500
Ground Operation Noise - During Temperature Inversion (Night-time) Conditions[6 & 8]	
People (2016 estimate) affected by noise levels over 50 dBA with and without orientation control	21,000 (14,000 with noise management)
Meteorology (Chapter 14 of Draft EIS/Chapter 10 of Supplement)	
Runway Use	
Usability of runways due to wind conditions	94.15% for aircraft with 10 knot cross wind capability; 97.25% for 13 knot cross wind capability; 99.84% for 20 knot cross wind capability
Air Quality (Chapter 15 of Draft EIS/Chapter 11 of Supplement)	
Ozone	
People (2016 estimate)[6] exposed to 1 part per 100 million increase in peak hourly ozone concentrations during high background ozone events	6,000
Nitrogen Dioxide	
People (2016 estimate)[6] exposed to peak hourly nitrogen dioxide concentrations of more than 12 parts per 100 million	500
Particulates	
People (2016 estimate)[6] exposed to peak 24-hour particulate matter concentrations of more than 50 micrograms per cubic metre	300
Odours	
People (2016 estimate)[6] who would be able to detect kerosene odours for more than 44 hours per year	1,500

Comparative Assessment[1] Option B	Option C
500–2,500	6,000–8,000
$52–60 million	$25–31 million
$0	$12–27 million
$7–9 million	$6–12 million
$1–3 million	$2–5 million
1,000	1,000
2,500	2,500
1,500	1,500
21,000 (14,000 with noise management)	16,000 (13,000 with noise management)
97.75% for aircraft with 10 knot cross wind capability; 99.30% for 13 knot cross wind capability; 99.96% for 20 knot cross wind capability	99.23% for aircraft with 10 knot cross wind capability; 99.91% for 13 knot cross wind capability; 99.99% for 20 knot cross wind capability
6,000	6,000
100	Less than 100
100	Less than 100
1,000	1,000

Table 26.1 Conclusions and Comparative Assessment of Airport Options Operating at 30 Million Passengers a Year

Assessment Criterion Performance Measure/Indicator	Option A
Mineral Resources (Chapter 16 of Draft EIS/Chapter 12 of Supplement)	
Mineral Resources	
Sterilisation of mineral resources	57-63 million tonnes of medium ash thermal coking coal
Water (Chapter 16 of Draft EIS/Chapter 13 of Supplement)	
Stream Habitat and Biota	
Length of stream habitat to be removed	2.2 kilometres
Increase in total average run-off post airport development	4 percent
Aquatic Ecosystem Water Quality	
Percentage of time total phosphorus concentrations in South Creek comply with water quality guideline value at 0.05 milligrams per litre	Existing 26 percent ; post airport development 34 percent
Percentage of time total nitrogen concentrations in South Creek comply with water quality guideline value of 0.5 milligrams per litre	Existing 76 percent; post airport development 78 percent
Percentage of time suspended solids concentrations in South Creek comply with water quality guideline value of 20 milligrams per litre	Existing 69 percent; post airport development 64 percent
Flooding	
Capability of managing flooding impacts	High
Flora and Fauna (Chapter 17 of Draft EIS/Chapter 14 of Supplement)	
Fauna	
Area of habitat for Cumberland Plain Large Land Snail removed	89 hectares of low to high quality habitat
Extent of fragmentation and barriers to fauna corridors	Corridor of regional significance retained
Disturbance to adjacent terrestrial habitat	None
Significant terrestrial fauna species potentially affected by airport site construction	2 species national significance, 16 species State significance; 67 species regional significance; 5 species listed under international agreements; 2 aquatic species
Flora	
Area of endangered ecological communities cleared	124 hectares
Area to be managed in long-term by regeneration and revegetation of endangered ecological communities	222 hectares
Significant flora species directly affected by airport construction	33 species of regional significance; one species (*Pultenaea parviflora)* listed under the Commonwealth *Endangered Protection Act, 1992*
Potential impacts of weeds and fire	Low
Environmental Management	
Ability to manage adverse impacts on significant flora species	Area of endangered ecological communities to be regenerated and revegetated in the long-term would exceed area to be cleared; area of *Pultenaea parviflora* increased
Ability to manage adverse impacts on significant fauna species	Area of potential snail habitat to be managed in the long-term greater than Options B and C. Relocation program for Cumberland Plain Large Land Snail proposed; potential for success of relocation program to be determined

Comparative Assessment[1]

Option B	Option C
64-84 million tonnes of medium ash thermal coking coal	63-84 million tonnes of medium ash thermal coking coal
6.5 kilometres	7.9 kilometres
4 percent	7 percent
Existing 26 percent ; post airport development 34 percent	Existing 26 percent ; post airport development 36 percent
Existing 76 percent; post airport development 78 percent	Existing 76 percent ; post airport development 77 percent
Existing 69 percent; post airport development 64 percent	Existing 69 percent ; post airport development 63 percent
High	High
93 hectares of low to high quality habitat	94 hectares of low to moderate quality habitat (remnant of highest quality retained)
Barrier across corridor of regional significance created	Barrier across corridor of regional significance created
None	None
2 species national significance, 16 species State significance; 67 species regional significance; 5 species listed under international agreements; 2 aquatic species	2 species national significance, 16 species State significance; 67 species regional significance; 5 species listed under international agreement; 2 aquatic species
143 hectares	150 hectares
303 hectares	273 hectares
34 species of regional significance; one species (*Pultenaea parviflora)* listed under the Commonwealth *Endangered Protection Act, 1992*	37 species of regional significance; one species (*Pultenaea parviflora)* listed under the Commonwealth *Endangered Protection Act, 1992*
Low	Low
Area of endangered ecological communities to be regenerated and revegetated in the long-term would exceed area to be cleared; area of *Pultenaea parviflora* increased	Area of endangered ecological communities to be regenerated and revegetated in the long-term would exceed area to be cleared; area of *Pultenaea parviflora* increased
Relocation program for Cumberland Plain Large Land Snail proposed; potential for success of relocation program to be determined	Area of potential snail habitat to be managed in the long-term greater than Option B. Relocation program for Cumberland Plain Large Land Snail proposed; potential for success of relocation program to be determined

Table 26.1 Conclusions and Comparative Assessment of Airport Options Operating at 30 Million Passengers a Year

Assessment Criterion Performance Measure/Indicator	Option A
Agriculture, Energy and Waste (Chapter 18 of Draft EIS/Chapter 15 of Supplement)	
Agriculture	
Direct loss of agricultural productivity due to land acquisition	$0.6 million per year
Energy	
Fuel consumption during construction	90 million litres
Waste	
Waste production during operation	15,000 tonnes
Hazards and Risks (Chapter 19 of Draft EIS/Chapter 16 of Supplement)	
Aircraft Crashing	
Maximum predicted fatality risk (persons per 100 years)	2.5
People (2016 estimate) on the ground exposed to a risk of fatality from aircraft crashes greater than one chance in 1 million	2,500
Number of schools and hospitals exposed to a risk of fatality from aircraft crashes greater than 0.5 chance in 1 million	One childcare facility; four schools; no hospitals
Exposure of Major Infrastructure	
Major Infrastructure exposed to predicted maximum risk of aircraft crashes per square kilometre of: - 1 crash per 1,000 years	None
- 1 crash per 10,000 years	Prospect Reservoir; Warragamba Dam; Sydney Water Supply Pipeline; two electricity sub-stations
- 1 crash per 100,000 years	As above; Defence Establishment Orchard Hills; Moomba to Sydney gas pipeline (part)
Bushfire	
Risk of bushfire to airport operations	Low
Bird and Bat Strike	
Risk of bird strike to aircraft operations	Manageable risk
Risk of bat strike to aircraft operations	Manageable risk
Land Contamination	
Environmental and health risks of existing land contamination	Low
Cultural Heritage (Chapters 20 and 21 of Draft EIS/Chapters 17 and 18 of Supplement)	
Aboriginal Cultural Heritage	
Number of known sites and isolated finds of local and regional significance affected	60
Number of predicted sites and isolated finds of local and regional significance affected	119
Collective value of resource	Low
Expressed Aboriginal values	Site is subject to Native Title claim; Aboriginal sites, locations and natural environment are culturally important to Aboriginal people; Local Aboriginal Land Council opposes development of second airport in Sydney basin
Area of potentially significant archaeological resource disturbed	2.0 square kilometres; less than one percent of surviving regional resource
Proportion of known archaeological resource within Cumberland Plain region lost	7.8 percent
Ability to manage adverse impacts on Aboriginal cultural heritage	Limited scope for in situ conservation; salvage may be possible

Comparative Assessment[1] Option B	Option C
$2.3 million per year	$1.7 million per year
90 million litres	90 million litres
15,000 tonnes	15,000 tonnes
2.2	5
2,500	9,000
Two childcare facilities; two schools; no hospitals	Four childcare facilities; seven schools; no hospitals
None	Sydney Water Supply Pipeline; Defence Establishment Orchard Hills
Prospect Reservoir; Warragamba Dam; Sydney Water Supply Pipeline; two electricity sub-stations	As above
As above; Defence Establishment Orchard Hills; Moomba to Sydney gas pipeline (part)	As above
Low	Low
Manageable risk	Manageable risk
Manageable risk	Manageable risk
Low	Low
85	94
196	205
Low	Low
Site is subject to Native Title claim; Aboriginal sites, locations and natural environment are culturally important to Aboriginal people; Local Aboriginal Land Council opposes development of second airport in Sydney basin	Site is subject to Native Title claim; Aboriginal sites, locations and natural environment are culturally important to Aboriginal people; Local Aboriginal Land Council opposes development of second airport in Sydney basin
3.4 square kilometres; less than one percent of surviving regional resource	3.1 square kilometres; less than one percent of surviving regional resource
10.9 percent	12.3 percent
Limited scope for in situ conservation; salvage may be possible	Limited scope for in situ conservation; salvage may be possible

Table 26.1 Conclusions and Comparative Assessment of Airport Options Operating at 30 Million Passengers a Year

Assessment Criterion Performance Measure/Indicator	Option A
Non-Aboriginal Cultural Heritage	
Number of identified sites of local, regional or State significance affected	8 local; 5 regional; 1 partial loss (regional); 7 of these items listed by Liverpool Council
Number of identified sites having sufficient cultural significance to warrant entry on National Estate Register	9
Ability to manage adverse impacts on non-Aboriginal cultural heritage	Potential to retain site of Lawsons Inn; able to relocate headstones/ burial remains, etc, removed from two churches
Transport (Chapter 22 of Draft EIS/Chapter 19 of Supplement)	
Construction Traffic	
Impact of construction traffic on road network	Upgrading of The Northern Road between Elizabeth Drive and Adams Road to four lanes; intersection improvements at Elizabeth Drive-Devonshire Road, Bringelly Road-Cowpasture Road and Camden Valley Way, Northern Road-Adams Road
Rail Transport During Operation	
Estimated morning peak travel times between key centres and Second Sydney Airport:	
- Sydney CBD	48 minutes
- Parramatta CBD	33 minutes
- Sydney Airport	41 minutes
- Blacktown	43 minutes
- Campbelltown	30 minutes
- Liverpool	22 minutes
Compatibility with existing and future network	Opportunity for new transit oriented residential development; provides opportunity for creation of loop line to Main Western rail line; links to high frequency services at Glenfield station and East Hills rail line (allowing direct line to Sydney Airport)
Road Traffic During Operation	
Estimated morning peak travel times between key centres and Second Sydney Airport:	
- Sydney CBD	74 minutes from airport; 60 minutes to airport
- Parramatta CBD	42 minutes from airport; 38 minutes to airport
- Sydney Airport	59 minutes from airport; 50 minutes to airport
- Blacktown	35 minutes from airport; 35 minutes to airport
- Campbelltown	28 minutes from airport; 25 minutes to airport
- Liverpool	21 minutes from airport; 23 minutes to airport
Compatibility with existing and future network	Accessible to Western Sydney Orbital which, if constructed, would provide a high level of service to many parts of Sydney; upgrading of Elizabeth Drive already approved; further improvements required on Luddenham Road, The Northern Road, Bringelly Road and Devonshire Road north of Fifteenth Avenue; compatible with the Action for Transport Strategy; environmental constraints to the upgrade of Bringelly Road and The Northern Road; a key road network constraint would be the capacity of the M4 Motorway
Aviation (Chapter 22 of Draft EIS/Chapter 20 of Supplement)	
Aviation	
Compatibility with Sydney Airport in terms of airspace management and airport capacity	Significant impact, potentially reducing capacity of both airports
Impacts on secondary airports	Hoxton Park would close, moderate impacts on Camden and Bankstown
Impacts of restricted airspace	Defence Establishment Orchard Hills would have minor impacts on airport operations
Impacts on other aviation activities	High impacts on parachuting at Menangle and Wilton

Comparative Assessment[1]

Option B	Option C
10 local; 5 regional; 1 partial loss (regional); 8 of these items listed by Liverpool Council	11 local; 6 regional; 1 partial loss (regional); visual impact of security fence on Kelvin Park Homestead (State); 10 of these items are listed by Liverpool Council
9	9
Potential to retain site of Lawsons Inn, 'Evergreen' House, former Badgerys Creek Butchery and original Badgerys Creek school buildings; able to relocate headstones/ burial remains, etc, removed from two churches	Potential to retain site of Lawsons Inn and 'Evergreen' House; able to relocate headstones/burial remains, etc, removed from two churches; can reduce visual impact of security fence on Kelvin Park Homestead (State significance)
Upgrading of The Northern Road between Elizabeth Drive and Adams Road to four lanes; intersection improvements at Elizabeth Drive-Devonshire Road, Bringelly Road-Cowpasture Road and Camden Valley Way, Northern Road-Adams Road	Upgrading of The Northern Road between Elizabeth Drive and Adams Road to four lanes; intersection improvements at Elizabeth Drive-Devonshire Road, Bringelly Road-Cowpasture Road and Camden Valley Way, Northern Road-Adams Road
48 minutes 33 minutes 41 minutes 43 minutes 30 minutes 22 minutes	45 minutes 30 minutes 38 minutes 40 minutes 27 minutes 19 minutes
Opportunity for new transit oriented residential development; provides opportunity for creation of loop line to Main Western rail line; links to high frequency services at Glenfield station and East Hills rail line (allowing direct line to Sydney Airport)	Opportunity for new transit oriented residential development; provides opportunity for creation of loop line to Main Western rail line; links to high frequency services at Glenfield station and East Hills rail line (allowing direct line to Sydney Airport)
74 minutes from airport; 60 minutes to airport 42 minutes from airport; 38 minutes to airport 59 minutes from airport; 50 minutes to airport 35 minutes from airport; 35 minutes to airport 28 minutes from airport; 25 minutes to airport 21 minutes from airport; 23 minutes to airport	74 minutes from airport; 60 minutes to airport 42 minutes from airport; 38 minutes to airport 59 minutes from airport; 50 minutes to airport 35 minutes from airport; 35 minutes to airport 28 minutes from airport; 25 minutes to airport 21 minutes from airport; 23 minutes to airport
Accessible to Western Sydney Orbital which, if constructed, would provide a high level of service to many parts of Sydney; upgrading of Elizabeth Drive already approved; further improvements required on Luddenham Road, The Northern Road, Bringelly Road and Devonshire Road north of Fifteenth Avenue; compatible with the Action for Transport Strategy; environmental constraints to the upgrade of Bringelly Road and The Northern Road; a key road network constraint would be the capacity of the M4 Motorway	Accessible to Western Sydney Orbital which, if constructed, would provide a high level of service to many parts of Sydney; upgrading of Elizabeth Drive already approved; further improvements required on Luddenham Road, The Northern Road, Bringelly Road and Devonshire Road north of Fifteenth Avenue; compatible with the Action for Transport Strategy; environmental constraints to the upgrade of Bringelly Road and The Northern Road; a key road network constraint would be the capacity of the M4 Motorway
Significant impact, potentially reducing capacity of both airports	Operation of airports would be compatible
Hoxton Park would close, moderate impacts on Camden and Bankstown	Hoxton Park would close; moderate impacts on Bankstown; low impacts on RAAF Base Richmond; high impacts on Camden
Defence Establishment Orchard Hills would have minor impacts on airport operations	Conflicts with restricted airspace over Defence Establishment Orchard Hills
High impacts on parachuting at Menangle and Wilton	High impacts on parachuting at Menangle and Wilton

Table 26.1 Conclusions and Comparative Assessment of Airport Options Operating at 30 Million Passengers a Year

Assessment Criterion Performance Measure/Indicator	Option A
Visual and Landscape (Chapter 23 of Draft EIS Chapter 21 of Supplement)	
Terrain Modification	
Area of airport site impacted by construction (short to medium term)	1,623 hectares
Scale of earthworks	Up to 16 metres cut and 13 metres fill
Visibility	
Viewing opportunities	Views from The Northern Road, otherwise limited beyond 10 kilometres
Operational lighting impacts (night-time)	Moderate to high within 5 kilometres; moderate between 3 and 10 kilometres due to skyglow
Economic Impacts (Chapter 24 of Draft EIS Chapter 22 of Supplement)	
Costs	
Construction costs (1997$)[9]	$3–4.1 billion
Costs of infrastructure (1997$)[10]	$1,041-1,096 million
Economic Viability	
Internal rate of return	12 percent
Benefit cost ratio	2.2
Net present value	$4.3 billion
Health (Chapters 11, 12 and 15 of Draft EIS Chapter 23 of Supplement)	
Short-Term Health Effects of Ozone	
Hospitalisations for respiratory disease per 100 years (additional or one or more days earlier than expected)	9
Deaths per 100 years (one or more days earlier than expected)	3
Short-Term Health Effects of Particulates Below 10 Microns in Size	
Hospitalisations for respiratory disease per 100 years (one or more days earlier than expected)	16
Deaths per 100 years (one or more days earlier than expected)	3
Coughing (additional person-days per year)	585
Clinically important decline in lung function (additional person-days per year)	78
Health Effects of Air Toxics	
Increase in number of cancer cases per 100 years	9
Health Impacts of Aircraft Overflight Noise	
Hearing loss	No impacts on residents
Psychological health	Not possible to quantify impacts
Heath impacts of sleep disturbance	Not possible to quantify impacts
Potential to increase incidence of heart disease	Research suggests potential for relatively high noise levels to cause impacts. These levels would generally occur in areas close to the airport boundary where homes would either be insulated or voluntary Government acquisition would be available
Potential to cause stress in school children	Research suggests potential for relatively high noise levels to cause impacts. Luddenham Public School would potentially be exposed to such high levels

Comparative Assessment[1] Option B	Option C
2,736 hectares	2,727 hectares
Up to 13 metres cut and 10 metres fill	Up to 9 metres cut and 13 metres fill
Views from The Northern Road, otherwise limited beyond 10 kilometres	Views from The Northern Road, otherwise limited beyond 10 kilometres
Moderate to high within 5 kilometres; moderate between 3 and 10 kilometres due to skyglow	Moderate to high within 5 kilometres; moderate between 3 and 10 kilometres due to skyglow
$3.5–4.8 billion	$3.4–4.7 billion
$1,041-1,096 million	$1,041-1,096 million
12 percent	12 percent
2.2	2.2
$4.3 billion	$4.3 billion
9	9
3	3
13	15
2	3
479	552
64	73
9	8
No impacts on residents	No impacts on residents
Not possible to quantify impacts	Not possible to quantify impacts
Not possible to quantify impacts	Not possible to quantify impacts
Research suggests potential for relatively high noise levels to cause impacts. These levels would generally occur in areas close to the airport boundary where homes would either be insulated or voluntary Government acquisition would be available	Research suggests potential for relatively high noise levels to cause impacts. These levels would generally occur in areas close to the airport boundary where homes would either be insulated or voluntary Government acquisition would be available
Research suggests potential for relatively high noise levels to cause impacts. Kemps Creek Public School would potentially be exposed to such high levels	Research suggests potential for relatively high noise levels to cause impacts. Bringelly Public School would potentially be exposed to such high levels

Table 26.1 **Conclusions and Comparative Assessment of Airport Options Operating at 30 Million Passengers a Year**

Assessment Criterion Performance Measure/Indicator	Option A
Water-Related Health Impacts	
Potential to exceed ANZECC guidelines for benzene levels in drinking water	Low
Health impacts due to stormwater/treated wastewater discharges	Low
Social and Cumulative Impacts (Chapters 25 and 27 of Draft EIS/Chapter 24 of Supplement)	
Employment and Economic Activity	
Generation of construction jobs	Up to 8,400 person years of labour on-site and 17,000 person years off-site
Generation of jobs during airport operation in region	19,000 jobs in the Badgerys Creek region
Potential to support regional economic benefits	Region has relatively mature industry structure to take advantage of increased economic activity
Community Character and Lifestyles	
Potential to cause severance or alienation of communities	Community alienation would be experienced due to displacement of residents and facilities from within existing airport sites; and due also to the corridors accessing the airport (Kemps Creek, Badgerys Creek, Bringelly and Luddenham)
Potential to significantly change community character and individual lifestyles	Community character likely to change dramatically from rural to urban; overall amenity of nearby communities likely to decline, especially Badgerys Creek, Luddenham, Greendale, Bringelly, Rossmore, Kemps Creek, Mount Vernon, Warragamba, Wallacia, Silverdale and Horsley Park
Community Facilities and Services	
Change to provision of community facilities and support structures	Loss of community facilities (school, store, post office) at Badgerys Creek; breakdown of family and business support structures probable, given the historical development and agricultural industry; long term replacement with new commercial and social structures
Displacement of individuals or communities	Displacement of community at Badgerys Creek (approximately 500 people); displacement of residents due to acquisition of properties in 35 ANEC, individual reaction to noise and other potential environmental impacts

Notes:
1. The airport option considered to perform best against each criterion is shaded blue. Where two options are shaded blue, this indicates that there is no significant difference in performance. Where there is no significant difference between any of the options, no shading is shown.
2. Based on the conclusion that Options A and B could co-exist with defence activities at Orchard Hills. It is uncertain whether Defence facilities at Orchard Hills would have to be relocated if Option C were developed.
3. Estimates of people impacted by noise vary because of the different assumptions made about how the airport may operate.
4. Impacts of noise levels assume all residential properties within the 35 ANEC contour would be acquired.
5. There are limitations in the accuracy of predicting future aircraft noise levels and future population.
6. Population are 2016 estimates. Estimates of population greater than 10,000 have been rounded to the nearest 1000; estimates of population between 1,000 and 10,000 have been rounded to the nearest 500; and estimates of population less than 1,000 have been rounded to the nearest 100. Estimates of population less than 100 are shown as <100.

Comparative Assessment[1] Option B	Option C
Low	Low
Low	Low
Up to 8,400 person years of labour on-site and 17,000 person years off-site	Up to 8,400 person years of labour on-site and 17,000 person years off-site
19,000 jobs in the Badgerys Creek region	19,000 jobs in the Badgerys Creek region
Region has relatively mature industry structure to take advantage of increased economic activity	Region has relatively mature industry structure to take advantage of increased economic activity
Community severance and alienation would be experienced due to acquisition of the airport site and displacement of residents and facilities within existing site; and due also to the corridors accessing the airport (Kemps Creek, Badgerys Creek, Bringelly and Luddenham)	Community severance and alienation would be experienced due to acquisition of the airport site and displacement of residents and facilities within existing site; and due also to the corridors accessing the airport (Kemps Creek, Badgerys Creek, Bringelly, Luddenham and Rossmore)
Community character likely to change dramatically from rural to urban; overall amenity of nearby communities likely to decline, especially Badgerys Creek, Luddenham, Greendale, Bringelly, Rossmore, Kemps Creek, Mount Vernon, Warragamba, Wallacia, Silverdale and Horsley Park	Community character likely to change dramatically from rural to urban; overall amenity of nearby communities likely to decline, especially Badgerys Creek, Luddenham, Greendale, Bringelly, Rossmore, Kemps Creek, Erskine Park, Orchard Hills, Sovereign and Catherine Field
Loss of community facilities (school, store, post office) at Badgerys Creek; breakdown of family and business support structures probable, given the historical development and agricultural industry; long term replacement with new commercial and social structures	Loss of community facilities (school, store, post office) at Badgerys Creek; breakdown of family and business support structures probable, given the historical development and agricultural industry; long term replacement with new commercial and social structures
Displacement of community at Badgerys Creek (approximately 1,000 people); displacement of residents due to acquisition of properties in 35 ANEC, individual reaction to noise and other potential environmental impacts	Displacement of community at Badgerys Creek (approximately 1,200 people); displacement of residents due to acquisition of properties in 35 ANEC, individual reaction to noise and other potential environmental impacts

Notes:

7. Isothermal (neutral) atmospheric conditions occur when temperature is constant above ground level notwithstanding height.
8. Temperature inversions occur when temperature increases uniformly with height above ground level, up to 100 metres.
9. Range of costs provided because of assumed level of accuracy.
10. Estimated costs of infrastructure required to service the airport including roads, a rail line, water supply, fuel pipeline, gas supply, electricity supply, telecommunications and sewage disposal services. Estimates do not include costs of consequential upgradings of other parts of the rail network. A range of costs is shown because of rail alternatives available.

Environmental Impacts

Noise

The EIS documents anticipated levels of aircraft overflight noise for communities located in a large area surrounding the airport site. The three airport options considered would result in different aircraft noise levels for individual communities. Investigations carried out for the Supplement indicated that the impacts of aircraft overflight noise could be reduced by modifying flight paths and airport operations. A curfew is another option.

Accordingly, the extent of aircraft overflight noise impacts would vary depending on the airport option selected, how it would operate and the noise management measures adopted. For example, the number of people who would be affected by the higher range of noise impacts examined of more than 50 aircraft movements a day over 70 dBA (the level at which conversations within homes would be disturbed) could vary from 700 people for Option C to 4,000 people for Option B. For the lower range of noise impacts examined of more than 10 aircraft movements a day over 70 dBA, the number of people affected could vary from 10,000 for Option A to 72,000 people for Option C.

A comparison of Sydney Airport and a potential second airport at Badgerys Creek showed that for the same level and type of aircraft traffic, significantly fewer people would be exposed to aircraft noise from an airport at Badgerys Creek than from Sydney Airport. This is due to the much lower population density near the proposed second airport site.

Noise impacts would also occur because of construction activities and ground operation of aircraft. Relevant criteria for daytime and night-time construction noise would be likely to be exceeded in an area extending up to approximately 1.5 and 3 kilometres respectively from the airport boundary. Relevant criteria for the generation of noise for the operation of aircraft located on the ground would probably be exceeded within an area extending up to approximately seven kilometres from the airport boundary.

Air Quality

Comprehensive modelling of potential air quality impacts was undertaken. This included construction-related impacts and the air quality impacts of the operation of the airport and airport-related motor vehicle traffic.

It was estimated that relevant goals for the generation of dust and fine particulates (less than 10 microns) during construction of the airport might be exceeded during worst case conditions within an area extending up to approximately 1.5 and five kilometres respectively from the airport boundary. This could be significantly reduced through the implementation of environmental management measures.

During the operation of the airport it was estimated that relevant goals for nitrogen dioxide and fine particulates would be exceeded within an area of approximately two and 1.5 kilometres respectively from the airport boundary. The operation of the airport and airport-related motor vehicle traffic would increase ozone concentrations in areas eight to 43 kilometres to the west of the airport. This would occur when synoptic conditions cause high ozone events in western Sydney, on average about 25 times per year.

Hydrocarbon odours would be generated by the operation of the airport and were predicted to exceed the relevant goal in an area of up to approximately 3.5 kilometres from the airport boundary.

Water Quality

Through the use of water management measures the quality of stormwater discharged from the site is predicted to generally improve when compared to the existing situation (for all water quality indicators examined with the exception of suspended solids – refer *Table 26.1*). No significant impacts on groundwater or drinking water supplies were predicted.

The Second Sydney Airport would create pressure for changes to metropolitan planning strategies. Such changes might result in further urban development of the South Creek Valley. Regional water quality impacts would be a likely consequence of such development

Health

While there is some uncertainty about the exact relationship between changes in air quality and health impacts, studies undertaken for the EIS indicated a low probability of any serious adverse health impacts such as premature hospitalisations and deaths attributable to air quality changes arising from the Second Sydney Airport. Events such as episodes of coughing or decline in lung function in people with asthma were projected to occur rarely within the affected population.

Existing knowledge of the extent of noise-related health risks did not make it possible to quantify the levels of noise-related health impacts that may arise from the operation of the Second Sydney Airport. Nevertheless, examples of specific impacts may include the potential for increased stress amongst children, the potential for increased prevalence of heart disease and the potential for hearing damage. Generally, these impacts might occur within the most severely noise affected areas located directly under flight paths within approximately two kilometres of the boundary of the airport site. These areas would be the subject of specific noise management measures.

Flora and Fauna

The short to medium-term impacts of the construction of the Second Sydney Airport on flora and fauna would be high as a result of clearance of regionally significant endangered ecological communities and endangered plant and animal species. In the longer term, however, the conservation significance of the remaining remnants would be enhanced through regeneration and rehabilitation works. The area of remnant vegetation to be retained, combined with the areas proposed to be regenerated, would contribute to the long-term viability of the endangered ecological communities at the airport sites.

Cultural Heritage

Aboriginal sites and features located on the airport sites are of low scientific value and considered to have local significance. Adverse impacts would be mitigated through the adoption of processes and procedures in accordance with the Airports (Environment Protection) Regulations.

Nine of the non-Aboriginal heritage items and sites identified on the airport site have National Estate values. Their management would be undertaken in accordance with the procedures set out in the Australian Heritage Commission Act 1975 and any proposal to destroy one or more of these items would require further site specific evaluation and assessment.

Land Transport

As the operations of the airport increase, significant improvements would be progressively required to both roads and public transport systems to cater for land transport demands. While the EIS did not assess in detail the environmental impacts of off-site infrastructure required to support the airport, the land transport improvements identified would be of a similar scale to other major transport infrastructure improvements currently proposed or likely to be required to service western Sydney over the next 20 or 30 years.

Substantial benefits would arise from the provision of such infrastructure in western Sydney and proven methods to mitigate the environmental impacts of the infrastructure would be available.

Hazards and Risks

Levels of risk associated with operation of the Second Sydney Airport would be consistent with levels of risk commonly experienced around other airports. The overall societal risk from operation of the Second Sydney Airport would be lower than the societal risk for Sydney Airport, but a greater risk of aircraft crashing would be introduced to an area of western Sydney where the current level of risk from hazardous developments is considerably lower.

Economic Impacts

An economic benefit cost analysis of a major airport at Badgerys Creek was undertaken. The benefits were compared with the environmental and other costs which could be measured in dollar terms, including the noise and health costs.

The results should be treated with caution due to data limitations, but it was concluded that a major airport would have net economic benefits for Australia, NSW and Sydney. These economic benefits would be about double the quantifiable costs.

From the perspective of a potential airport owner, airport charges would have to be greater than those currently levied at Sydney Airport for the Second Sydney Airport to be financially viable.

The proposed airport would be a significant generator of jobs in western Sydney.

Cumulative Impacts

A decision to proceed with the Second Sydney Airport would, over time, significantly alter the character of western Sydney. Gradual changes to the noise environment, air quality and the rural character of the region would occur. On the other hand, benefits would come from economic activity (including employment) and the provision of transport and other urban services. These benefits would, however, bring with them pressure to alter land use patterns and allow additional urban development which could potentially result in further biophysical and social impacts.

Development of an airport at Badgerys Creek would reduce some of potential environmental impacts of satisfying expected demand for air travel to and from Sydney, compared to the potential further development of Sydney Airport. This is because the population densities surrounding each airport site are very different; for example, over 40 times more people live within ten kilometres of Sydney Airport than within the same distance of Badgerys Creek. It follows that, if the volume and type of aircraft traffic were the same at Sydney Airport and the Second Sydney Airport, then the number of people exposed to risk and aircraft noise from the second airport would be much smaller than the number of people affected by the operation of Sydney Airport.

Environmental Management

An environmental management system would be developed and implemented for the Second Sydney Airport project to ensure effective ongoing implementation of measures to control and reduce the potential environmental impacts of the Second Sydney Airport. The management system would include issue-specific environmental management plans. In addition to the project-specific environmental management measures, Commonwealth, State and local government-initiated regional environmental management measures would be beneficial. Such measures should respond to issues such as the appropriate land use planning response to the airport and related cumulative air quality, water quality and biodiversity issues.

It is likely that the Second Sydney Airport would be developed in a series of stages and would not reach its planned operating limit of 30 million passenger per year until at least the 2020s or 2030s. Therefore, many but not all of the impacts of the airport would result in gradual changes to the human and biophysical environments. This gradual onset of the environmental impacts would improve the capacity of governments and the community to manage adverse consequences and take advantage of potential benefits.

Glossary

Glossary

Term	Definition
Aboriginal Land Council	Administrative authority responsible for the protection of Aboriginal sites in its local area.
Aboriginal site	Site where any deposit, object or material evidence relating to indigenous and non-European habitation exists, for example artefact scatters, grinding groove sites or scarred trees.
Airshed	Lower atmosphere within a geographic region.
Air toxics	Airborne organic pollutants, such as benzene, formaldehyde, 1-3 butadiene and diesel soot, some of which have been linked with incidence of cancer or other long term health effects.
Air Traffic Forecast 1	A scenario used in the EIS in which the Second Sydney Airport would handle overflow traffic from Sydney Airport, with the proportion of international and domestic air traffic assumed to be similar at both airports.
Air Traffic Forecast 2	A scenario used in the EIS in which the capacity of Sydney Airport would be restricted to 25 million passengers per year and all subsequent growth in the Sydney basin would be directed to the second airport.
Air Traffic Forecast 3	A scenario used in the EIS in which a greater proportion of international flights (using larger and consequently noisier aircraft) would be directed to the Second Sydney Airport. The capacity of Sydney Airport would be capped at 20 million passengers per year.
Aircraft movement	One landing or one take off by an aircraft.
Airport Environment Strategy	A document prepared in accordance with the *Airports Act 1996* setting out a comprehensive strategy for how an airport will be operated so that its environmental health is maintained or improved.
Auditor	SMEC Australia Pty Ltd, appointed by the Minister for the Environment and Heritage to report on the appropriateness and adequacy of the data and methodologies used in the EIS.
Australian Noise Exposure Concept (ANEC)	Similar to the ANEF measure except the word concept refers to the levels of noise exposure which would occur if particular future scenarios eventuated.
Australian Noise Exposure Forecast (ANEF)	A measure of aircraft noise impact which combines both noise level and frequency of aircraft operations relating to forecast future airport operations, and generally presented as a set of contours on a map.
A-weighted decibel (dBA)	Measure of noise based on the frequency sensitivity of the human ear and expressed using a logarithmic scale.

Term	Definition
Benefit cost analysis	A technique for systematically estimating the economic impact of alternative actions by measuring benefits and costs, and determining whether the former outweigh the latter.
Biodiversity	The variety of life forms: the different plants, animals and micro-organisms, the genes they contain, and the eco-systems they form.
Birdstrike	Collision between a bird and an aircraft.
Brown haze	A brownish layer in the lower atmosphere visible on some winter mornings and caused by the presence of particulate matter in the air.
Bubble licence	A licence, issued by the Environment Protection Authority to Sydney Water Corporation, which sets upper limits for combined contaminants from several sewage treatment plants.
Burra Charter	Short title for Australia ICOMOS Charter for the Conservation of Places of Cultural Significance (Australia ICOMOS, 1987).
Carcinogen	A substance which tends to produce a cancer in a body.
Community Assessment Areas (CAA)	Individual areas of western Sydney identified in the EIS for the purpose of describing aircraft noise impacts on individual communities and noise sensitive land uses, such as educational facilities.
Cross wind	That component of wind blowing at right angles to the line of progress of an aircraft.
Curfew	A set of controls imposing restrictions on aircraft movements at an airport during the night.
Decibels (dB)	A measure of noise relating to pressure fluctuations in the air, measured on a logarithmic scale.
Discount rate	The rate applied to a stream of payments, due over future periods, to present the amounts in 'today's money'. The rate reflects the risk associated with an action (for example, an investment), and the cost of money committed to that action, over time.
Ecologically Sustainable Development (ESD)	Development which uses, conserves and enhances the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased.
Economic viability study	A study which seeks to take account of all the costs and benefits of a proposal in order to assess whether the benefits outweigh the costs (see benefit cost analysis).
Environmental Auditor	See Auditor.
Environmental management plan	A plan designed to minimise environmental impacts of a particular activity or enterprise.
Environmental Management System	A management system implemented within an organisation to monitor and control the environmental impacts of its activities.
Financial viability study	A study which focuses exclusively on accounting costs and revenues to provide a picture of the financial value of an asset. It attempts to measure the financial returns from investment in an

Term	**Definition**
	asset.
Flight path	A defined corridor in airspace along which aircraft are required to fly.
Flight zone	Describes in general terms the airspace that may be used by aircraft operating to and from an airport.
Footprint analysis	Analysis of chemical interaction of airport emissions with existing pollutants in air to produce photochemical pollutants such as ozone.
Fuel dumping	Controlled release of fuel from aircraft at designated locations at high altitudes during emergency conditions – any fuel dumping for the Second Sydney Airport would occur over the Tasman Sea.
Fuel venting	Accidental release of a small amount of fuel from an aircraft due to malfunction in the fuel valve system.
Greater Sydney Metropolitan Region	The combined Sydney, Newcastle and Wollongong region.
Greenhouse gas	Gases such as carbon dioxide which are believed to increase global warming by trapping heat near the earth's surface.
Local Environmental Plan	An environmental planning instrument prepared and administered by local government.
Local Government Area	Local administrative area; City, Municipality or Shire.
Master Plan	A document which sets out the broad framework for the possible long term development of an airport and includes an indication of the size, extent and timing of required support facilities for the airport.
Metropolitan Planning Strategy	A NSW government policy concerning urban planning policies to be applied to the Greater Sydney Metropolitan Region.
Mitigation measure	Methods employed to reduce the impact of activities which have been identified as being potentially detrimental to the environment.
N70	The number of times on an average day that an area may experience noise levels of 70 dBA or more from overflying aircraft, and generally expressed as a set of contours on a map.
New Large Aircraft	A general name for a range of future aircraft types still in the concept design stage having a wingspan of up to 84 metres and a length of up to 85 metres.
Obstacle Limitation Surfaces (OLS)	A series of surfaces associated with the runways of an airport that define the desirable limits to which objects may project into the airspace around an airport.
Option A	An airport development proposal with two parallel runways 4,000 metres and 3,000 metres in length, constructed on an approximate north-east to south-west alignment and separated by 1,670 metres.
Option B	An airport development proposal adopting an identical parallel runway alignment to Option A. Both parallel runways are 4,000 metres in length and separated by 2,300 metres. A 2,500 metre cross wind runway is also included.

Term	Definition
Option C	An airport development proposal with two parallel runways on an approximate north to south alignment. Both parallel runways are 4,000 metres in length and separated by 2,300 metres. A 2,500 metre cross wind runway is also included.
Ozone	A form of oxygen (O_3) produced by photochemical reactions, which can cause eye irritation at concentrations above 10 parts per hundred million.
Particulate matter	Dispersed airborne solid and liquid particles larger than single molecules but smaller than 500 microns, which contribute to air pollution. The EIS assessment focuses on particulate matter less than 10 microns as this is the size for which air quality criteria have been established.
Passenger movement	An arrival or departure of a fare paying aircraft passenger from an airport.
Photochemical smog	Air pollution which arises from the interaction of sunlight with various airborne chemicals such as nitrogen oxides, sulphur dioxide and hydrocarbons.
Piezometer	A pipe screened opposite an aquifer in which the elevation of the groundwater level or pressure surface can be determined.
Sleep Disturbance Index	A numerical equivalent to the estimated average number of aircraft noise induced awakenings during one night.
Smog	See photochemical smog.
Societal risk	The risks from an installation or activity to society as a whole, taking into account the actual number of people outside the facility who are exposed to various levels of risk.
Stage 1	A possible first stage of the development of Options A, B or C which would be capable of handling up to 10 million passengers per year.
Sydney basin	The area bounded by the Blue Mountains in the west, the Pacific Ocean in the east, high ground generally to the south of Picton, and high ground in the north associated with the catchment area for the Hawkesbury River.
Sydney Statistical Region	The area comprising 45 local government areas within Sydney used by the Australian Bureau of Statistics.
Temperature inversion	An atmospheric condition where the temperature of a layer of air increases with height above the ground surface.
Terminal Area Radar (TAR)	An electronic navigation aid that provides for the surveillance and control of aircraft operating to or from an airport and during take-off and landing operations.
Trajectory modelling	Modelling of air pollutants using data on wind fields to predict dispersion of air pollutants over a wide area.
Urban Development Program	A NSW government land release system administered by the Department of Urban Affairs and Planning for the purpose of managing and monitoring residential development.

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